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Proposed SARPs Text for Support of VDL Handoffs by the ATN Internet

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AERONAUTICAL TELECOMMUNICATIONS NETWORK PANEL

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SUMMARY

Action 16/7 arising from the 16th meeting of ICAO/ATNP/WG2, required "... to prepare a PDR proposing modifications to the VDL SNDCF. The PDR was required to indicate any needed changes to the VDL Mode 2 SARPs. This paper is a response to that action.



EUROCONTROL

ATN PROJECT

**Proposed SARPs Text for Support of VDL Handoffs
by the ATN Internet**

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Introduction

Action 16/7 arising from the 16th meeting of ICAO/ATNP/WG2, required “Mr. Whyman to prepare a PDR proposing modifications to the VDL SNDCF. The PDR should also indicate any needed changes to the VDL Mode 2 SARPs. This was after consideration of WP/470 on the probable need for ATN SARPs changes to accommodate VDL Mode 2 handoffs.

After consideration of the issue, it is believed that the appropriate SARPs changes are to section 5.3.5 “Air/Ground Interconnection”. Changes are necessary here to record the need to save a returned called address when a subnetwork connection is opened over a VDL Subnetwork Handling of the Handoff appears also to fit naturally alongside the handling of Join and Leave Events in this section.

The proposed changes to section 5.3.5 are attached. They comprise three main changes:

1. Changes to Air, Ground and Air/Ground procedures to handled and record a different Called Address returned on a CALL ACCEPT to that issued on the CALL REQUEST. Whilst only the Air Initiated procedures are affected by VDL Mode 2, it is believed that a generic change should be made so that future networks that have a similar requirement and which are not air initiated can be accommodated without further SARPS changes.
2. A new section 5.3.5.2.14 to describe the “Handoff Event” and how it is handled by the IS-SME. Note that the specification has been generalised to include support of multiple priorities, which will be necessary to accommodate VDL Mode 3.
3. Amendments to the APRLs to add the Handoff Event.

It is not believed that any further changes are required to the Mobile SNDCF as the necessary changes to accommodate VDL were made prior to SARPs validation.

5.3.5 Air/Ground Interconnection

5.3.5.1 Interconnection Scenarios

Note 1.— Air/Ground interconnection applies to the interconnection between an ATN Airborne Router and an ATN Air/Ground Router over one or more Mobile Subnetworks.

Note 2.— The significant difference between Air/Ground and Ground/Ground Interconnection is that in the former case interconnection is automatic and consequential on the availability of communications and local policy, while, in the latter case, interconnection is a deliberate and planned action with the direct involvement of network administrators.

Note 3.— While IDRPs are also intended to be used over Air/Ground Interconnections, as an interim measure, the optional non-use of IDRPs over Air/Ground Interconnections is permitted by this specification and according to 5.3.5.2.12.

Note 4.— For the purposes of this specification, the functional model of an ATN Router illustrated in Figure 5.3-1 is assumed. This model illustrates the basic functional entities in an ATN Air/Ground (Class 5 Router) and ATN Airborne Router with IDRPs (Class 6 Router), the data flow between them as solid lines, and the flow of certain events and control information, by dashed lines.

Note 5.— Figure 5.3-1 introduces a new architectural entity, the Intermediate System - Systems Management Entity (IS-SME). As specified below, this plays an important role in the realisation of Route Initiation in Air/Ground Operations, by responding to changes in subnetwork connectivity and thereby controlling the route initiation and termination procedures.

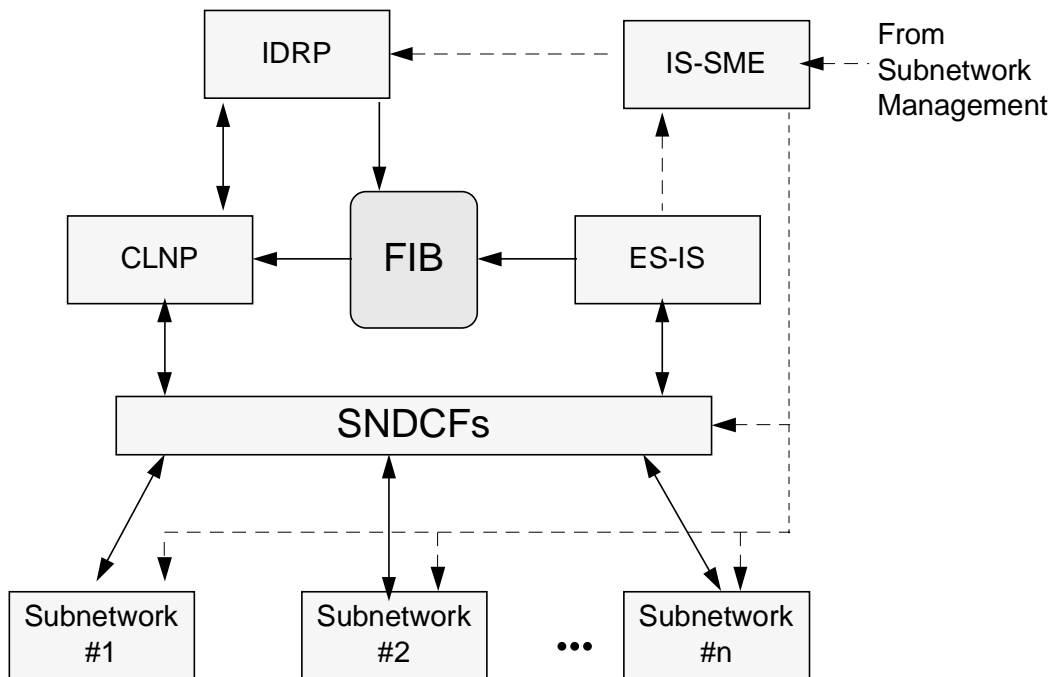


Figure 5.3-1 Assumed ATN Router Architecture for Air/Ground Route Initiation

5.3.5.2 Air/Ground Route Initiation

5.3.5.2.1 General

5.3.5.2.1.1 *BIS-BIS communications over a Mobile Subnetwork shall be either air-initiated or ground-initiated, with one of these two modes of operation selected for all instances of a given subnetwork type.*

Note 1.— Three classes of procedures are distinguished by this specification. These are: (a) Air-Initiated i.e. when the Airborne Router initiates the procedure, (b) Ground-Initiated i.e. when the Air/Ground Router initiates the procedure, and (c) Air or Ground-Initiated i.e. when either the Airborne or the Air/Ground Router may initiate the procedure.

Note 2.— Two types of Mobile Subnetworks are also recognised by this specification. These are: (a) those which provide information on the availability of specific Mobile Systems on the subnetwork through the Join Event defined in this section, and (b) those which do not. The latter type are only appropriate to Route Initiation Procedures which are Air-Initiated.

Note 3.— For a given Mobile Subnetwork type, the use of air-initiated or ground-initiated procedures, and the implementation of Join Events is outside of the scope of this specification, and is a matter for the SARPs specified by the relevant ICAO panel.

Note 4.— The interfaces to all Mobile Subnetworks are assumed to be compatible with ISO/IEC 8208. The ISO/IEC 8208 term Data Terminal Equipment (DTE) is also used in this specification to refer to a system attached to a Mobile Subnetwork.

5.3.5.2.1.2 For Air-Initiated Subnetworks that do not provide information on the availability of specific Mobile Systems, Airborne Routers shall comply with the procedures specified in 5.3.5.2.3.1, and Air/Ground Routers shall comply with the procedures specified in 5.3.5.2.2.

5.3.5.2.1.3 For Air-Initiated Subnetworks that do provide information on the availability of specific Mobile Systems, Airborne Routers shall comply with the procedures specified in 5.3.5.2.3.2, and Air/Ground Routers shall comply with the procedures specified in 5.3.5.2.2.

5.3.5.2.1.4 For Ground-Initiated Subnetworks, Air/Ground Routers shall comply with the procedures specified in 5.3.5.2.4, and Airborne Routers shall comply with the procedures specified in 5.3.5.2.2.

5.3.5.2.1.5 For Air or Ground-Initiated Subnetworks, Air/Ground and Airborne Routers shall comply with the procedures specified in 5.3.5.2.2 and 5.3.5.2.5.

5.3.5.2.2 Route Initiation Procedures for a Responding ATN Router

5.3.5.2.2.1 General

Note 1.— Route Initiation is always asymmetric with a clearly defined initiator and responder. In all cases, the ATN Router in the responder role, follows the same procedures, as specified below.

Note 2.— For Air-Initiated Route Initiation, the Air/Ground Router is the responding ATN Router. For Ground-Initiated Route Initiation, the Airborne Router is the responding ATN Router.

5.3.5.2.2.1.1 Each ATN Router that is specified to take the responder role for a given Mobile Subnetwork type, and when attached to a subnetwork of that subnetwork type, shall be configured into a state whereby it “listens” for Call Indications on that subnetwork.

5.3.5.2.2.1.2 For each Call Indication received, a responding ATN Router shall, based on local policy, either:

- a) Accept the incoming call immediately using a Call Accept Packet, or*
- b) Validate the calling DTE address and either accept the call using a Call Accept Packet, or if the call is unacceptable then it shall be rejected using a Clear Request Packet.*

Note 1.— The procedures used to validate the calling DTE address and to determine the acceptability of the call, are outside the scope of this specification.

Note 2.— The number of simultaneous virtual circuits that the ATN Router needs to support will be subject to an implementation limit, that needs to be sufficient for the role in which the ATN Router is deployed.

5.3.5.2.2.1.3 When a subnetwork connection is successfully established, then the procedures of 5.3.5.2.6 shall be applied to that subnetwork connection.

5.3.5.2.2.2 Emergency Use of a Mobile Subnetwork

5.3.5.2.2.2.1 In the case of Air-Initiated Mobile Subnetworks, an Air/Ground Router shall not refuse a Call Indication or refuse to establish a BIS-BIS connection with an ATN Airborne Router, when a Call Indication from the ATN Airborne Router is received less than 5 minutes after a Call Indication was rejected, or a call was terminated by Systems Management.

5.3.5.2.2.2.2 The Air/Ground Router shall permit, through the implementation of an appropriate routing policy, the use of a so established connection for emergency and distress data.

Note.— This situation arises when the Airborne Router has no other Air/Ground connectivity, and refusal to accept a connection may cause a safety hazard. An Air/Ground Router may limit the use of such connections through routing policy, or permit full access, as a local matter.

5.3.5.2.3 Air-Initiated Route Initiation

Note.— This section specifies the procedures to be used by an Airborne Router for Air-Initiated route initiation.

5.3.5.2.3.1 Airborne Router Procedures for use of an ISO/IEC 8208 Mobile Subnetwork that does not Provide Information on Subnetwork Connectivity

5.3.5.2.3.1.1 General

5.3.5.2.3.1.1.1 An Airborne Router's IS-SME shall be configured with a list of subnetwork addresses for each supported Mobile Subnetwork that does not provide information on subnetwork connectivity.

5.3.5.2.3.1.1.2 This list shall include the addresses which are necessary to meet the communication needs of the aircraft.

Note.— In the case of the AMSS, the Airborne Router's IS-SME will be configured with a list for each GES that the aircraft may use to communicate. Each such list will include the subnetwork addresses (e.g. DTE addresses) of the Air/Ground routers attached to the GES in question through which communications services may be required.

5.3.5.2.3.1.1.3 An Airborne Router's IS-SME shall continually issue a Call Request to each subnetwork address on each appropriate list with which it does not currently have a subnetwork connection and which is not subject to a back-off period (see 5.3.5.2.3.1.2), in turn.

5.3.5.2.3.1.1.4 The period between each successive Call Request shall be configurable to ensure that the Mobile Subnetwork is not rendered unavailable.

5.3.5.2.3.1.1.5 On receipt of a Call Accepted packet, if the Called Line Address Modified Notification optional user facility is present in the packet and indicates that the returned Called Address is different from that used in the Call Request, and the subnetwork also generates "Handoff" events (see 5.3.5.2.14), then the IS-SME shall store the relationship between the originally called DTE Address and the returned Called Address in the some local database. The knowledge of this relationship shall be retained as long as a subnetwork connection exists with the DTE.

5.3.5.2.3.1.1.6 When a subnetwork connection is successfully established, then the procedures of 5.3.5.2.6 shall be applied to that subnetwork connection. The polling procedure shall continue for the remaining subnetwork addresses on the list, if any.

5.3.5.2.3.1.2 Call Request Failure

5.3.5.2.3.1.2.1 Whenever a Clear Indication is received in response to a Call Request that indicates rejection by the called DTE and includes a call clearing diagnostic code of 0, 133, 160..163, or 240, 241, 242, 244, 246, 248, then the Airborne Router shall implement a "back off" procedure.

5.3.5.2.3.1.2.2 The back off procedure shall comprise the effective quarantining of the called subnetwork address for a period configurable on a per subnetwork basis from 5 minutes to 20 minutes. During this period, a Call Request shall not be issued to the subnetwork address.

Note.— The purpose of the back off procedure is to avoid unnecessarily overloading of the Air/Ground subnetwork with Call Requests.

5.3.5.2.3.1.2.3 The "back off" procedure shall not be started on receipt of a Clear Indication which includes any other call clearing diagnostic code.

5.3.5.2.3.1.2.4 If a Clear Indication is received with a diagnostic code reporting an error that the SNDCF is unable to correct, then the called DTE shall be removed from the polled DTEs list.

5.3.5.2.3.1.2.5 Otherwise, if required, the SNDCF shall retry the call after having resolved the cause of the call rejection.

Note.— Certain call clearing diagnostic codes in the range 128..143 are used by the Mobile SNDCF specified in 5.7. The semantics of these codes are described in Table 5.7-3.

5.3.5.2.3.1.2.6 However, during any period when an Airborne Router does not have any subnetwork connections over Mobile Subnetworks, then all back off procedures shall be suspended until connectivity is established with at least one Air/Ground Router.

5.3.5.2.3.2 Airborne Router Procedures for use of an ISO/IEC 8208 Mobile Subnetwork that does Provide Connectivity Information

Note 1.— The connectivity information is provided as a "Join Event". This is an event generated by a Mobile Subnetwork when it is recognised that a system has attached to the subnetwork and is available for communication using the subnetwork. The Join Event provides the DTE Address of the newly available system. It may also include other subnetwork specific information needed to route a call to that DTE Address. For example, in the case of the VDL subnetwork, the call may need to be directed

via a specific Ground Station and hence the Ground Station Address must be provided in addition to the DTE Address.

Note 2.— An actual implementation of a Join Event may concatenate several distinct Join Events as defined above into a single message.

Note 3.— For air-initiated subnetworks, the Join Event is received by the IS-SME in the Airborne Router. The mechanism by which it is received is both subnetwork and implementation dependent and is outside of the scope of this specification.

5.3.5.2.3.2.1 On receipt of a Join Event, the Airborne Router shall either:

- a) Issue an ISO/IEC 8208 Call Request with the DTE Address reported by the Join Event as the Called Address, or
- b) Validate the DTE Address reported by the Join Event as to whether or not a subnetwork connection with it is acceptable according to local Routing Policy. If such a connection is acceptable then an ISO/IEC 8208 Call Request shall be issued with the DTE Address reported by the Join Event as the Called Address. Otherwise, the Join Event shall be ignored.

Note.— The Airborne Router validates the DTE Address that is the subject of the Join Event and determines the acceptability of a subnetwork connection with the so identified ATN Router, using procedures outside of the scope of this specification.

5.3.5.2.3.2.2 On receipt of a Call Accepted packet, if the Called Line Address Modified Notification optional user facility is present in the packet and indicates that the returned Called Address is different from that used in the Call Request, and the subnetwork also generates "Handoff" events (see 5.3.5.2.14), then the IS-SME shall store the relationship between the originally called DTE Address and the returned Called Address in the some local database. The knowledge of this relationship shall be retained as long as a subnetwork connection exists with the DTE.

5.3.5.2.3.2.3 When a subnetwork connection is successfully established, then the procedures of 5.3.5.2.6 shall be applied to that subnetwork connection.

5.3.5.2.4 Ground-Initiated Route Initiation

Note 1.— Ground-Initiated Route Initiation is only appropriate for Mobile subnetworks that originate a Join Event from their ground component.

Note 2.— For ground-initiated subnetworks, the Join Event is received by the IS-SME in the Air/Ground Router. The mechanism by which it is received is both subnetwork and implementation dependent and is outside of the scope of this specification.

5.3.5.2.4.1 On receipt of a Join Event, the Air/Ground Router shall either:

- a) Issue an ISO/IEC 8208 Call Request with the DTE Address reported by the Join Event as the Called Address, or
- b) Validate the DTE Address reported by the Join Event as to whether or not a subnetwork connection with it is acceptable according to local Routing Policy. If such a connection is acceptable then an ISO/IEC 8208 Call Request shall be

issued with the DTE Address reported by the Join Event as the Called Address. Otherwise, the Join Event shall be ignored.

Note.— Option (b) above permits an administration or organisation operating a ground-initiated Mobile Subnetwork to implement procedures, according to its local policy, whereby an Air/Ground Router may validate the DTE that is the subject of the Join Event and hence determine the acceptability of a subnetwork connection with the so identified Airborne Router. The purpose of this facility is to enable efficient management of the available subnetwork resources in areas of overlapping coverage. This facility is not appropriate when its use may result in an aircraft being denied Air/Ground data communications.

5.3.5.2.4.2 On receipt of a Call Accepted packet, if the Called Line Address Modified Notification optional user facility is present in the packet and indicates that the returned Called Address is different from that used in the Call Request, and the subnetwork also generates "Handoff" events (see 5.3.5.2.14), then the IS-SME shall store the relationship between the originally called DTE Address and the returned Called Address in the some local database. The knowledge of this relationship shall be retained as long as a subnetwork connection exists with the DTE.

5.3.5.2.4.3 When a subnetwork connection is successfully established, then the procedures of 5.3.5.2.6 shall be applied to that subnetwork connection.

5.3.5.2.5 Air or Ground-Initiated Route Initiation

Note 1.— Air or Ground-Initiated Route Initiation is only appropriate for mobile subnetworks that do provide connectivity information through a Join Event to the Airborne or Air/Ground Router, or both.

Note 2.— For Air or Ground-Initiated subnetworks, the Join Event is received by the IS-SME in the Airborne or Air/Ground Router, respectively. The mechanism by which it is received is both subnetwork and implementation dependent.

5.3.5.2.5.1 On receipt of a Join Event, the ATN Router shall either:

- a) Issue an ISO/IEC 8208 Call Request with the DTE Address reported by the Join Event as the Called Address, or
- b) Validate the DTE reported by the Join Event as to whether or not a subnetwork connection with it is acceptable according to local Routing Policy. If such a connection is acceptable then an ISO/IEC 8208 Call Request shall be issued with the DTE Address reported by the Join Event as the Called Address. Otherwise, the Join Event shall be ignored.

Note.— The ATN Router validates the DTE Address that is the subject of the Join Event and determines the acceptability of a subnetwork connection with the so identified ATN Router, using procedures outside of the scope of this specification.

5.3.5.2.5.2 If the Called Line Address Modified Notification optional user facility is supported by the subnetwork and indicates that the returned Called Address is different from that used in the Call Request, and the subnetwork also generates "Handoff" events (see 5.3.5.2.14), then the IS-SME shall store the relationship between the originally called DTE Address and the returned Called Address in the some local database. The knowledge of this relationship shall be retained as long as a subnetwork connection exists with the DTE.

5.3.5.2.5.3 When a subnetwork connection is successfully established, then the procedures of 5.3.5.2.6 shall be applied to that subnetwork connection.

Note.— When a call collision occurs, then the call collision resolution procedures are applied by the SNDCEF in order to ensure that only a single virtual circuit is established and that connection initiator and responder are unambiguously identified.

5.3.5.2.6 Exchange of Configuration Information using the ISO/IEC 9542 ISH PDU

5.3.5.2.6.1 ATN Airborne and Air/Ground Routers shall implement the ISO/IEC 9542 "Configuration Information" Function for use over each Mobile Subnetwork that they support.

5.3.5.2.6.2 Whenever a subnetwork connection is established over a Mobile Subnetwork, the ISO/IEC 9542 "Report Configuration" Function shall be invoked in order to send an ISH PDU containing the NET of the Airborne or Air/Ground Router network entity over the subnetwork connection.

5.3.5.2.6.3 In the case of an Airborne Router, if it supports the use of IDRP for the exchange of routing information over this subnetwork, then the SEL field of the NET inserted into the ISH PDU shall always be set to 00h (i.e. a binary pattern of all zeroes).

5.3.5.2.6.4 Alternatively, if the Airborne Router implements the procedures for the optional non-use of IDRP over this subnetwork, then the SEL field of the NET inserted into the ISH PDU shall always be set to FEh (i.e. a binary pattern of 1111 1110).

5.3.5.2.6.5 **Recommendation.**— When in the initiator role, an ATN Router should use the ISO/IEC 8208 "Fast Select" facility, if supported by the subnetwork, and encode the first ISH PDU in the Call Request user data, according to the procedures for the Mobile SNDCEF specified in Chapter 5.7.

5.3.5.2.6.6 **Recommendation.**— When in the responder role and the initiator has proposed use of the Fast Select Facility, the ATN Router should encode the first ISH PDU in the Call Accept user data, according to the procedures for the Mobile SNDCEF specified in Chapter 5.7.

Note.— The purpose of encoding an ISH PDU in call request or call accept user data is to minimise the number of messages sent over limited bandwidth Mobile Subnetworks and the time taken to complete the route initiation procedures.

5.3.5.2.6.7 Whenever an ISO/IEC 9542 ISH PDU is received, either as Call Request or Call Accept user data, or as data sent over the connection, the ISO/IEC 9542 Record Configuration function shall be invoked and the routing information necessary for NPDUs to be sent over the subnetwork connection to the indicated NET shall be written into the Forwarding Information Base for use by ISO/IEC 8473.

5.3.5.2.6.8 A Systems Management notification shall be generated to report the arrival of the ISH PDU to the ATN Router's IS-SME.

5.3.5.2.7 Validation of the Received NET

5.3.5.2.7.1 The IS-SME shall, using the received NET to identify the remote ATN Router, validate the acceptability of a BIS-BIS connection with that remote ATN Router.

5.3.5.2.7.2 If a BIS-BIS connection is unacceptable, then a Clear Request shall be generated to terminate the subnetwork connection. Forwarding Information associated with the subnetwork connection shall be removed from the Forwarding Information Base.

Note.— Except for the case of the situation described in 5.3.5.2.2.2, the acceptability of a BIS-BIS connection with the ATN Router identified by the received NET is determined using procedures outside of the scope of this specification.

5.3.5.2.7.3 If a BIS-BIS Connection is acceptable then an Air/Ground Router shall apply the procedures of 5.3.5.2.8, and an Airborne Router shall apply the procedures of 5.3.5.2.9.

5.3.5.2.8 Determination of the Routing Information Exchange Procedure by an Air/Ground Router

5.3.5.2.8.1 When the arrival of the ISH PDU is reported to the IS-SME of an Air/Ground Router, then the SEL field of the NET contained in this ISH PDU shall be inspected:

- a) If the SEL field takes the value of 00h (i.e. a binary pattern of all zeroes), then this shall be taken to imply that the Airborne Router that sent this ISH PDU supports the use of IDRP for the exchange of routing information. The procedures of 5.3.5.2.10. shall be applied.
- b) If the SEL field takes the value of FEh (i.e. a binary pattern of 1111 1110), then this shall be taken to imply that the Airborne Router that sent this ISH PDU supports the procedures for the optional non-use of IDRP for the exchange of routing information. The procedures of 5.3.5.2.12 shall be applied.

5.3.5.2.9 Determination of the Routing Information Exchange Procedure by an Airborne Router

5.3.5.2.9.1 When the arrival of the ISH PDU is reported to the IS-SME of an Airborne Router, then if the Airborne Router supports the use of IDRP for the exchange of routing information, then the procedures of 5.3.5.2.10 shall be applied. If the Airborne Router supports the procedures for the optional non-use of IDRP for the exchange of routing information, then the procedures of 5.3.5.2.12 shall be applied.

5.3.5.2.10 Establishment of a BIS-BIS Connection

5.3.5.2.10.1 The IS-SME shall append the NET received on the ISH PDU to the externalBISNeighbor attribute of the BIS's idrpConfig Managed Object, if not already present, and create an adjacentBIS Managed Object for the remote ATN Router identified by this NET, if one does not already exist.

5.3.5.2.10.2 If the ISH PDU was received from a subnetwork connection which was established with the local ATN Router in the responder role, then an IDRP activate action shall be invoked to start the BIS-BIS connection according to ISO/IEC 10747, if such a BIS-BIS connection does not already exist.

5.3.5.2.10.3 If the ISH PDU was received from a subnetwork connection which was established with the local ATN Router in the initiator role, then no IDRP activate action shall be invoked, but the ListenForOpen MO attribute shall be set to true if a BIS-BIS connection does not already exist.

Note.— This procedure minimises the route initiation exchanges over a bandwidth limited Mobile Subnetwork. The reversal of initiator and responder roles for the BIS-BIS connection compared with the subnetwork connection ensures the fastest route initiation procedure.

5.3.5.2.10.4 If a BIS-BIS connection was already established with the remote ATN Airborne Router, then the IS-SME of the Air/Ground Router shall cause

- a) the update of the Security path attribute's security information of all routes contained in the Adj-RIB-In associated with the remote ATN Airborne Router, and
- b) the IDRP Routing Decision function to be invoked in order to rebuild the FIB, the Loc_RIB and relevant Adj-RIB-Out(s) taking into account the additional subnetwork connectivity.

5.3.5.2.10.5 Furthermore, the Air/Ground Router shall re-advertise all routes affected by the change in subnetwork connectivity that are contained in the Adj-RIB-Out associated with the remote ATN Airborne Router subsequent to the update of the security path attribute's security information of these routes as specified in 5.8.

5.3.5.2.10.6 The IS-SME shall also ensure that the procedures for the optional non-use of IDRP are not concurrently being applied to routing information exchange with an ATN Router with the same NET over a different subnetwork connection.

5.3.5.2.10.7 This is an error and shall be reported to Systems Management; a BIS-BIS connection shall not be established in this case.

5.3.5.2.10.8 **Recommendation.**— When IDRP is used to exchange routing information over an Air/Ground subnetwork, the value of the Holding Time field in the ISH PDU should be set to 65534, except when a watchdog timer is applied to the subnetwork connection (see 5.3.5.2.13).

5.3.5.2.10.9 **Recommendation.**— When IDRP is used to exchange routing information over an Air/Ground subnetwork, the Configuration Timer should be set such that no further ISH PDUs are exchanged following the Route Initiation procedure.

Note 1.— The purpose of the above is to effectively suppress the further generation of ISH PDUs.

Note 2.— Normally, the IDRP KeepAlive mechanism is sufficient to maintain a check on the “liveness” of the remote ATN Router. However, when watchdog timers are necessary it is also necessary to ensure a “liveness” check on a per subnetwork connection basis. The ISH PDU fulfils this role.

5.3.5.2.11 Exchange of Routing Information using IDRP

5.3.5.2.11.1 Once a BIS-BIS connection has been established with a remote ATN Router, then:

- a) An Airborne Router shall advertise routes to the Air/Ground Router in accordance with the Routing Policy specified in 5.3.7.2.
- b) An Air/Ground Router shall advertise routes to the Airborne Router in accordance with the Routing Policy specified in 5.3.7.1.4 or 5.3.7.3.4 as appropriate for the role of the Air/Ground Router's RD.

5.3.5.2.12 Procedures for the Optional Non-Use of IDRP over an Air/Ground Data Link

5.3.5.2.12.1 General

Note.— In this case, there is no recommendation to suppress the periodic re-transmission of ISH PDUs according to the ISO/IEC 9542 Report Configuration Function. In the absence of IDRP, this re-transmission is necessary to maintain the “liveness” of the connection.

5.3.5.2.12.1.1 When the procedures for the optional non-use of IDRP are employed by an Airborne Router, then all ATN airborne systems on the same aircraft shall be located in the same Routing Domain.

Note.— This is because the procedures specified below make assumptions on the value and length of the NSAP Address Prefix that is common to all systems on board an aircraft, and these assumptions are invalidated if a single aircraft hosts multiple RDs.

5.3.5.2.12.2 Air/Ground Router

5.3.5.2.12.2.1 Through the actions of the IS-SME as specified below, an Air/Ground Router shall simulate the existence of a BIS-BIS connection with an Airborne Router that implements the procedures for the optional non-use of IDRP by implementing the following procedure:

- a) The NET of the remote ATN Router shall be appended to the **externalBISNeighbor** attribute of the BIS's **idrpConfig** Managed Object, if not already present, and an adjacentBIS Managed Object shall be created for the remote ATN Router identified by this NET, if one does not already exist. An Adj-RIB-In shall hence be created for this remote ATN Router and for the Security RIB-Att.

Note.— No activate action will be applied to this MO and the implementation will hence need to be able to process information in the Adj-RIB-In even though the MO is in the "idle" state. Implementations may choose to optimise the operation of these procedures with a special interface to IDRP.

- b) Truncating the NET received on the ISH PDU to the first eleven octets and using the resulting NSAP Address Prefix as the NLRI of a route which shall then be inserted into the Adj-RIB-In for the remote ATN Router and which shall be identified by the Security RIB-Att, as if it had been received over a BIS-BIS connection. This route shall include an RD_Path attribute with the received NET as the Routing Domain Identifier of the originating RD, and an empty security path attribute.

Note.— According to the rules for the update of path information specified in 5.8, the security path attribute will be updated by the Routing Decision process to include an Air/Ground Subnetwork type security tag and an ATSC Class security tag, if this is appropriate. This procedure is identical to the normal use of IDRP over a Mobile Subnetwork.

- c) The well-known mandatory path attribute RD_HOP_COUNT shall be set to 1 in the routes to be inserted into the Adj-RIB-In for the remote Router implementing the procedures for the optional non-use of IDRP. In addition, for routes to be inserted into the Adj-RIB-In for an adjacent Airborne Router implementing the procedures for the optional non-use of IDRP, the well-known mandatory path attribute CAPACITY shall be set according to the capacity of the Mobile Subnetwork(s) over which the Airborne Router is reachable.

5.3.5.2.12.2.2 If a subnetwork connection is concurrently established with the remote ATN Router over which the procedures for the optional non-use of IDRP have been applied, then the IS-SME shall not repeat the above procedures for the new subnetwork connection.

5.3.5.2.12.2.3 Instead, the IS-SME shall cause the IDRP Routing Decision function to be invoked in order to rebuild the FIB taking into account the additional subnetwork connectivity.

5.3.5.2.12.2.4 This shall include re-update of the security information contained in routes received from the remote ATN Router, according to 5.8.

5.3.5.2.12.2.5 The IS-SME shall also ensure that a normal BIS-BIS connection does not concurrently exist with an ATN Router with the same NET.

5.3.5.2.12.2.6 This is an error and shall be reported to Systems Management; the procedures for the optional non-use of IDRP shall not be applied in this case.

5.3.5.2.12.3 Airborne Router

5.3.5.2.12.3.1 An Airborne Router implementing the procedures for the optional non-use of IDRP over a Mobile Subnetwork shall simulate the operation of IDRP by maintaining a Loc-RIB for the Security RIB_Att, which is then used to generate FIB information.

5.3.5.2.12.3.2 Through the actions of its IS-SME, an Airborne Router shall derive entries for this Loc-RIB from the ISH PDU received from an Air/Ground Router as follows:

- a) The IS-SME shall insert into the Loc-RIB, a route derived by truncating the NET received on the ISH PDU to the first eleven octets and using the resulting NSAP Address Prefix as the NLRI of a route. This route shall include a security path attribute with the Air/Ground Subnetwork Type and ATSC Class security tags (if any) determined from locally known information.

Note.— This provides routing information for destinations in the Air/Ground Router's RD and assumes that the eleven octet prefix of the Air/Ground Router's NET is common to all destinations in that RD.

- b) The IS-SME shall insert into the Loc-RIB other routes available through the Air/Ground Router determined using locally known information. These routes shall include a security path attribute with the Air/Ground Subnetwork Type and ATSC Class security tags (if any) determined from locally known information.

Note.— As these routes are not subject to dynamic update, their availability must be ensured by the operator of the Air/Ground Router, within the limits specified for the applications that will use them.

5.3.5.2.13 Air/Ground Route Termination

Note 1.— The "Leave Event" is defined to signal when subnetwork connectivity with a remote ATN Router over a Mobile Subnetwork ceases to be available. This event may be generated by (a) the subnetwork itself using mechanisms outside of the scope of this specification, or (b) the SND CF when it receives a clear indication from the subnetwork reporting either a network or a user initiated call clearing. The Leave Event is always reported to the IS-SME.

Note 2.— When a Leave Event is generated by a subnetwork, it applies to all subnetwork connections to a given DTE. When it is generated locally by the SNDCF, it typically applies to a single subnetwork connection.

5.3.5.2.13.1 Recommendation. — A “Leave Event” should not be generated by the Mobile SNDCF when a subnetwork connection is closed due to the expiration of the X.25 Idle timer, except if this subnetwork connection fails to be re-established.

5.3.5.2.13.2 When a Mobile Subnetwork does not provide a network generated Clear Indication (e.g. to indicate that an aircraft has left the range of the Mobile Subnetwork, or when some other communication failure occurs, etc.), an ATN Router shall maintain a “watchdog” timer for each affected subnetwork connection and clear each such subnetwork connection once activity has ceased for a configurable period.

5.3.5.2.13.3 When such a “watchdog” timer expires, this shall be reported as a “Leave Event” for that subnetwork connection.

5.3.5.2.13.4 Recommendation.— The timer should be configurable according to the characteristics of the subnetwork.

Note.— An ATN Router maintains a “watch-dog” timer for each applicable subnetwork connection to detect the event of an aircraft leaving coverage (or other communication failure), if such an event detection is not provided by the subnetwork.

5.3.5.2.13.5 When an IS-SME receives a Leave Event for a subnetwork connection or a DTE on a subnetwork, then it shall ensure that respectively, either the affected subnetwork connection or all subnetwork connections on that subnetwork and with the identified DTE, are cleared.

5.3.5.2.13.6 If, as a result of this procedure, no other subnetwork connection exists anymore on that subnetwork and with the identified DTE, then the IS-SME shall remove the Configuration Information that was extracted from the ISH previously received from that DTE on that specified subnetwork, without waiting for the expiration of the Configuration Information Holding Timer.

5.3.5.2.13.7 If, as a result of this procedure or subsequent to the execution of the ISO/IEC 9542 “Flush Old Configuration” function, Configuration Information, that was extracted from an ISH previously received from that DTE still exists, then,

- a) In the case of an ATN Air-Ground Router having established a BIS-BIS connection with that ATN Router, or having simulated a BIS-BIS connection if that ATN Router implements the procedures for the optional non-use of IDRP, then,
 - 1) The IS-SME shall cause the update of the Security path attribute’s security information of all routes contained in the Adj-RIB-In associated with the remote ATN Airborne Router, and,

- 2) The IS-SME shall cause the IDRP Routing Decision function to be invoked in order to rebuild the FIB, the Loc_RIB and relevant Adj-RIB-Out(s) taking into account the loss of subnetwork connectivity, and,
 - 3) The Air-Ground Router shall re-advertise all routes affected by the change in subnetwork connectivity that are contained in the Adj-RIB-Out(s) subsequent to the update of the security path attribute's security information of these routes as specified in 5.8.
- b) In the case of an Airborne Router implementing the procedures for the optional non-use of IDRP, the IS-SME shall update the Security path attribute's security information of all routes in the loc-RIB that had been inserted according to the procedures of 5.3.5.2.12.3 as a result of an ISH PDU having been received from the Air/Ground Router for which loss of connectivity is reported.

5.3.5.2.13.8 If, as a result of the procedure 5.3.3.2.13.6 or subsequent to the execution of the ISO/IEC 9542 "Flush Old Configuration" function, no Configuration Information exists anymore for the ATN Router for which loss of connectivity is reported, then,

- a) In the case of an ATN Router having established a BIS-BIS connection with that ATN Router, an IDRP deactivate action shall be invoked to terminate that BIS-BIS connection.

Note.— As a consequence of the deactivate action and following normal IDRP operation, the IDRP Routing Decision process will be invoked, the local FIB updated and routes previously available via the remote ATN Router may be withdrawn if suitable alternatives are not available.

- b) In the case of an Air/Ground Router having simulated a BIS-BIS connection to an ATN Airborne Router, implementing the procedures for the optional non-use of IDRP, all routes shall be removed from the Loc-RIB that had been inserted into it according to the procedures of 5.3.5.2.12.2. as a result of an ISH PDU having been received from the Airborne Router for which a loss of connectivity is reported.
- c) In the case of an Airborne Router implementing the procedures for the optional non-use of IDRP, all routes shall be removed from the loc-RIB that had been inserted into it according to the procedures of 5.3.5.2.12.3. as a result of an ISH PDU having been received from the Air/Ground Router for which a loss of connectivity is reported.

5.3.5.2.13.9 If the BIS-BIS connection is not re-established within a period configurable from 1 minute to 300 minutes, or when the resources are required for other use, then the adjacent BIS Managed Object associated with the initiating BIS shall be deleted, and the initiating BIS's NET removed from the external BISNeighbor attribute of the BIS's idrpConfig Managed Object.

5.3.5.2.14 Subnetwork Handoff

Note 1.—Handoff is implemented by some subnetworks, for example, the VHF Digital Link (VDL), when an aircraft moves out of the coverage of a Ground Station it is currently using and into the coverage of another – typically operated by the same Service Provider. When the change of Ground Station also requires a change of ATN Air/Ground Router then the subnetwork may simply generate a Join Event for the new Air/Ground Router, followed by a Leave Event for the old Air/Ground Router. However, when the Air/Ground accessed through the old Ground Station is also accessible through the new Ground Station then a different procedure is required if the full overhead of Route Initiation is to be avoided.

Note 2.—A further event – the “Handoff Event” - and additional to the “Join” and “Leave” events is defined to initiate such a procedure. A Handoff Event may be received by an Airborne or an Air/Ground Router irrespective of whether the subnetwork is Air or Ground initiated, or both. The Handoff Event is also processed by the IS-SME.

Note 3.—The parameters of a Handoff Event are the same as those for a Join Event and include the DTE Address of the system for which Handoff is to take place, and may also include subnetwork specific information (e.g. to direct a Connect Request via a specific Ground Station). In the case of VDL Mode 2, this information will also include an indication of whether or not the Ground Station supports Ground X.121 Addresses.

5.3.5.2.14.1 On receipt of a Handoff Event, the IS-SME shall check to see if a subnetwork connection already exists with the DTE identified by the Handoff Event. If it does not, then the Handoff Event shall be processed identically to a Join Event.

5.3.5.2.14.2 If a subnetwork connection already exists with the identified DTE, then the ATN Router shall issue an ISO 8208 Call Request to that DTE.

5.3.5.2.14.3 If a different DTE Address to the originally called DTE Address was reported when a connection had previously been made to that DTE, then the returned Called DTE Address shall be used and not the originally called DTE Address.

5.3.5.2.14.4 However, in the case of VDL Mode 2, if the Handoff Event reports that the Ground Station does not accept Ground X.121 Addresses, then the originally called DTE Address shall be used irrespective of whether or not the returned called address is the same as the originally called DTE Address.

Note..- A VDL Mode 2 Ground Station must support the Ground X.121 Address format if Handoffs are to successfully complete, unless the VDL Specific Address format used on Data Link Initiation unambiguously identifies one and only one ATN Router.

5.3.5.2.14.5 If more than one subnetwork connection exists with the identified DTE, each with a distinct subnetwork connection priority, then a new subnetwork connection shall be initiated for each such subnetwork connection priority.

Note.—If the Maintenance/Initiation of Local Reference Directory Option is selected (see 5.7.6.2.1.5.12), the subnetwork connection(s), once established, may become part of the same subnetwork connection group as the old subnetwork connection(s) (see 5.7.6). If this is the case then the LREF Directory will be taken over by the new subnetwork connection(s).

5.3.5.2.14.6 When the subnetwork connection(s) have been successfully established, the SNDCF shall use these subnetwork connection(s) in preference to the old subnetwork connection(s).

Note.— No further action needs to be taken once the subnetwork connection has been successfully established. This is because no change is implied to the Routing Information Base and the underlying subnetwork is responsible for timing out and disconnecting the old subnetwork connections, once it all data in transit has been delivered.

5.3.5.2.15 APRL for Air/Ground Route Initiation

5.3.5.2.15.1 General

Item	Description	ATN SARPs Reference	ATN Support
njSubnet	Support of Subnetworks that do not provide a Join Event	5.3.5.2	O.1
jSubnet	Support of Subnetworks that do provide a Join Event	5.3.5.2	O.1
giSubnet	Support of Ground-Initiated Subnetworks	5.3.5.2	O.2
aiSubnet	Support of Air-Initiated Subnetworks	5.3.5.2	O.2
agSubnet	Support of Air or Ground-Initiated Subnetworks	5.3.5.2	O.2
fsSubnet	Support of Subnetworks that support Fast Select	-	O
noIDRP-a	Support of optional non-use of IDRP by Airborne BIS	5.3.2.12.3	O
noIDRP-ag	Support of optional non-use of IDRP by Air/Ground BIS	5.3.2.12.2	M
lvSubnet	Support of Subnetworks that provide a Leave Event	5.3.2.13	M
<u>HoSubnet</u>	<u>Support of Subnetworks that provide a Handoff Event</u>	<u>5.3.2.14</u>	<u>O</u>

5.3.5.2.15.2 Airborne Router - Subnetwork Connection Responder

Item	Description	ATN SARPs Reference	ATN Support
respAR-ar	Response to incoming Call Request	5.3.5.2.2	giOragSubnet: M
valCR-ar	Validation of incoming Call Request	5.3.5.2.2	giOragSubnet:O
RespISH-ar	Generation of ISH PDU	5.3.5.2.6	giOragSubnet: M
ISHinCC-ar	Encoding ISH PDU in Call Accept User Data	5.3.5.2.6	RespISH-ar and fsSubnet: O
negNoIDRP-ar	Transmission of ISH PDU with SEL field of NET set to Feh	5.3.5.2.6	noIDRP-a:M
negIDRP-ar	Transmission of ISH PDU with SEL field of NET set to zero	5.3.5.2.6	^noIDRP-a:M
autoRoute-ar	Inference of available routes from received NET of A/G Router	5.3.5.2.12	noIDRP-a:M
initIDRP-ar	IDRP startup procedures - Invoke activate action	5.3.2.10	^noIDRP-a:M
supISH-ar	Suppression of multiple ISH PDUs	5.3.5.2.10	^noIDRP-a: O
valNET-ar	Validation of received NET	5.3.5.2.7	^noIDRP-a: O
<u>Handoff-ar</u>	<u>Processing of Handoff Event</u>	<u>5.3.5.1.14</u>	<u>HoSubnet: M</u>

giOragSubnet: giSubnet or agSubnet

5.3.5.2.15.3 Airborne Router - Subnetwork Connection Initiator

Item	Description	ATN SARPs Reference	ATN Support
Polling-ai	Procedures for polling a list of subnet addresses	5.3.5.2.3.1	pollReq: M
backoff-ai	Backoff Procedure	5.3.5.2.3.1.2	pollReq: M
connect-ai	Connect on receipt of Join Event	5.3.5.2.3.2	EventDrvn: M
ValJoin-ai	Validation of Join Event	5.3.5.2.3.2	EventDrvn: O
SendISH-ai	Generation of ISH PDU	5.3.5.2.6	EventDrvn or pollReq:M
ISHinCR-ai	Encoding of ISH PDU in Call Request	5.3.5.2.6	SendISH-ar and fsSubnet: O
negNoIDRP-ai	Transmission of ISH PDU with SEL field of NET set to FEh	5.3.5.2.8	noIDRP-a:M
negIDRP-ai	Transmission of ISH PDU with SEL field of NET set to zero	5.3.5.2.8	^noIDRP-a:M
autoRoute-ai	Inference of available routes from received NET of A/G Router	5.3.5.2.12.3	noIDRP-a:M
initIDRP-ai	IDRP startup procedures - listenForOpen set to true	5.3.5.2.10	^noIDRP-a:M
supISH-ai	Suppression of multiple ISH PDUs	5.3.5.2.10	^noIDRP-a: O
valNET-ai	Validation of received NET	5.3.5.2.7	^noIDRP-a: O
RelatedTE-ai	Maintain relationship between originally called and Modified Called DTE Address	5.3.5.2.3.1.1.5	HoSubnet: M
Handoff-ar	Processing of Handoff Event	5.3.5.1.14	HoSubnet: M

pollReq: aiSubnet and njSubnet

EventDrvn: jSubnet and (aiSubnet or agSubnet)

5.3.5.2.15.4 Air/Ground Router - Subnetwork Connection Responder

Item	Description	ATN SARPs Reference	ATN Support
respAR-agr	Response to incoming Call Request	5.3.5.2.2	aiOragSubnet: M
valCR-agr	Validation of incoming Call Request	5.3.5.2.2	aiOragSubnet:O
emgncy-agr	Emergency Procedures	5.3.5.2.2	M
ResplSH-agr	Generation of ISH PDU	5.3.5.2.6	aiOragSubnet: M
ISHinCC-agr	Encoding ISH PDU in Call Accepted User Data	5.3.5.2.6	ResplSH-agr and fsSubnet: O
negNoIDRP-agr	Receipt of ISH PDU with SEL field of NET set to FEh	5.3.5.2.8	M
negIDRP-agr	Receipt of ISH PDU with SEL field of NET set to zero	5.3.5.2.8	M
autoRoute-agr	Inference of available routes from received NET of Airborne Router	5.3.5.2.12.2	M
initIDRP-agr	IDRP startup procedures - Invoke activate action	5.3.5.2.10	M
suplSH-agr	Suppression of multiple ISH PDUs	5.3.5.2.10	O
valNET-agr	Validation of received NET	5.3.5.2.7	O
<u>Handoff-ar</u>	<u>Processing of Handoff Event</u>	<u>5.3.5.1.14</u>	<u>HoSubnet: M</u>

aiOragSubnet: aiSubnet or agSubnet

5.3.5.2.15.5 Air/Ground Router - Subnetwork Connection Initiator

Item	Description	ATN SARPs Reference	ATN Support
connect-agi	Connect on receipt of Join Event	5.3.5.2.4	goOragSubnet: M
ValJoin-agi	Validation of Join Event	5.3.5.2.4	connect-agi: O
SendlSH-agi	Generation of ISH PDU	5.3.5.2.6	connect-agi: M
ISHinCR-agi	Encoding of ISH PDU in Call Request	5.3.5.2.6	Send-ISH-agi and fsSubnet: O

negNoIDRP-agi	Receipt of ISH PDU with SEL field of NET set to FEh	5.3.5.2.8	M
negIDRP-agi	Receipt of ISH PDU with SEL field of NET set to zero	5.3.5.2.8	M
autoRoute-agi	Inference of available routes from received NET of Airborne Router	5.3.5.2.12.2	M
initIDRP-agi	IDRP startup procedures - listenForOpen set to true	5.3.5.2.10	M
supISH-agi	Suppression of multiple ISH PDUs	5.3.5.2.10	O
valNET-agi	Validation of received NET	5.3.5.2.7	O
RelatedTE-agi	Maintain relationship between originally called and Modified Called DTE Address	5.3.5.2.4.2	HoSubnet: M
<u>Handoff-ar</u>	<u>Processing of Handoff Event</u>	<u>5.3.5.1.14</u>	<u>HoSubnet: M</u>

goOragSubnet: giSubnet or agSubnet

5.3.5.2.15.6 Termination Procedures

Item	Description	ATN SARPs Reference	ATN Support
lvEvent	Processing of Leave Event	5.3.5.2.13	M
Watchdog	Watchdog Timer	5.3.5.2.13	M
ConfigWD	Configurability of Watchdog for Subnetwork Characteristics	5.3.5.2.13	O
conLeave	Processing of a per connection Leave Event	5.3.5.2.13	M
subnetLeave	Processing of a per subnetwork Leave Event	5.3.5.2.13	M