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TECHNICAL SPECIFICATION

Satellite Earth Stations and Systems (SES); Family SL Satellite Radio Interface (Release 1); Part 4: Enhanced Services and Applications; Sub-part 2: Aeronautical Safety Services

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Contents

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Satellite Earth Stations and Systems (SES).

The present document is part 4, sub-part 2 of a multi-part deliverable. Full details of the entire series can be found in ETSI TS 102 744-1-1 [16].

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

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Introduction

This multi-part deliverable (Release 1) defines a satellite radio interface that provides UMTS services to users of mobile terminals via geostationary (GEO) satellites in the frequency range 1 518,000 MHz to 1 559,000 MHz (downlink) and 1 626,500 MHz to 1 660,500 MHz and 1 668,000 MHz to 1 675,000 MHz (uplink).

1 Scope

The present document specifies the mandatory requirements for the Aeronautical Safety Services for the Family SL satellite network.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

[1] ETSI TS 102 744-1-4: "Satellite Earth Stations and Systems (SES); Family SL Satellite Radio Interface (Release 1); Part 1: General Specifications; Sub-part 4: Applicable External Specifications, Symbols and Abbreviations".

[2] ICAO: "Global Operational Data Link Document (GOLD)", Appendix B.2 RCP 240 Specification, June 2010.

[3] ARINC Characteristic 741P2-10 Aviation Satellite Communication System, Part 2: "System Design and Equipment Functional Description", Jan 2009.

[4] ETSI TS 102 744-3-1: "Satellite Earth Stations and Systems (SES); Family SL Satellite Radio Interface (Release 1); Part 3: Control Plane and User Plane Specifications; Sub-part 1: Bearer Control Layer Interface".

[5] ICAO DOC 8643: "Aircraft Type Designators", Latest Version.

[6] ETSI TS 102 744-1-2: "Satellite Earth Stations and Systems (SES); Family SL Satellite Radio Interface (Release 1); Part 1: General Specifications; Sub-part 2: System Operation Overview".

[7] ETSI TS 123 067 (V9.0.0): "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); enhanced Multi-Level Precedence and Pre-emption Service (eMLPP); Stage 2 (3GPP TS 23.067 version 9.0.0 Release 9)".

[8] ETSI TS 124 083 (V9.0.0): "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Call Waiting (CW) and Call Hold (HOLD) supplementary services; Stage 3 (3GPP TS 24.083 version 9.0.0 Release 9)".

[9] IETF RFC 4412: "Communications Resource Priority for the Session Initiation Protocol (SIP)".

[10] ICAO SATCOM: "Voice Guidance Material (SVGM)", First Edition, July 2012.

[11] IETF RFC 3261: "SIP: Session Initiation Protocol".

[12] ETSI TS 124 081 (V9.0.0): "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Line Identification supplementary services; Stage 3 (3GPP TS 24.081 version 9.0.0 Release 9)".

[13] IETF RFC 3323: "A Privacy Mechanism for the Session Initiation Protocol (SIP)".

[14] ETSI TS 102 744-4-1: "Satellite Earth Stations and Systems (SES); Family SL Satellite Radio Interface (Release 1); Part 4: Enhanced Services and Applications; Sub-part 1: Multiple Voice Services".

[15] ETSI TS 102 744-3-2: "Satellite Earth Stations and Systems (SES); Family SL Satellite Radio Interface (Release 1); Part 3: Control Plane and User Plane Specifications; Sub-part 2: Bearer Control Layer Operation".

[16] ETSI TS 102 744-1-1: "Satellite Earth Stations and Systems (SES); Family SL Satellite Radio Interface (Release 1); Part 1: General Specifications; Sub-part 1: Services and Architectures".

[17] ETSI TS 124 008: " Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; Mobile radio interface Layer 3 specification; Core network protocols; Stage 3 (3GPP TS 24.008)".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

Not applicable.

3 Symbols and abbreviations

3.1 Symbols

For the purposes of the present document, the symbols given in ETSI TS 102 744-1-4 [1], clause 3 apply.

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in ETSI TS 102 744-1-4 [1], clause 3 apply.

4 Overview of Aeronautical Safety Services

4.1 General

The Aeronautical Safety Service provides the following safety services simultaneously via a single channel unit on an aircraft to Class 6, Class 7 and Class 4 terminals:

- ACARS
- Prioritized IP data
- Voice (two channels)

The Aeronautical Safety Service is an application of the Family SL platform. ACARS and voice gateways are introduced into the Airborne Earth Station (AES) and the peer gateways are introduced in the ground.

Figure 4.1 provides an overview of the Aeronautical Safety Service architecture.

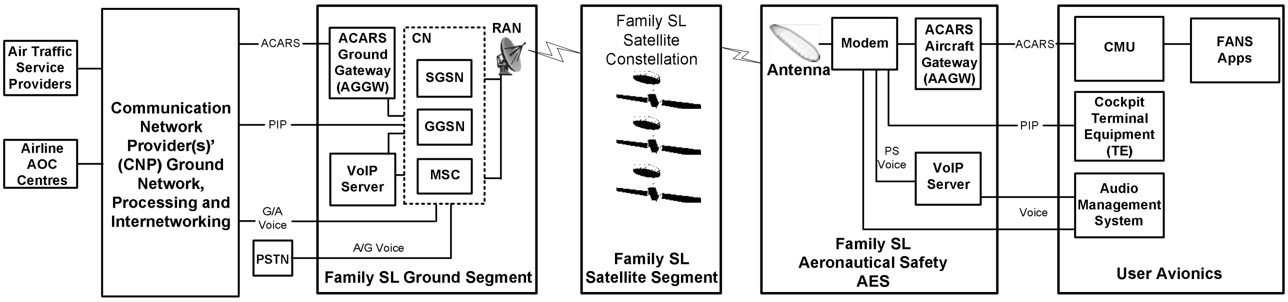


Figure 4.1: Aeronautical Safety Service Architecture

The elements comprising the block diagram in Figure 4.1 are defined in Table 4.1.

Table 4.1: Aeronautical Safety Architectural Elements

AAGW	ACARS Aircraft Gateway - A functional block within the AES that is responsible for that is responsible for choosing which satellite sub-network to use and for encapsulating ACARS messages in a wrapper to allow them to be sent via the Family SL network. The aircraft gateway does not provide a guaranteed delivery of messages to (or from) the ground gateway. Rather, it is responsible for ensuring a communications link with the ground, where permitted by the AES resources and network availability. The ultimate responsibility for ensuring message delivery is at the ACARS messaging layer.
AGGW	ACARS Ground gateway - The peer of the AAGW. This function is located on the ground and provides a connection point to the Family SL network. The AGGW also maintains a record of the log-on status of each aircraft, and monitors the performance of the Family SL ACARS data service with respect to the requirements of RCP240 in the ICAO GOLD Document [2].
AES	Aircraft Earth Station. The equipment located on the aircraft that provides a communication link via satellite. In the context of the present document, AES relates to the entirety of the airborne system and Aeronautical Safety AES relates to the Family SL channel within the AES providing the Aeronautical Safety service.
CMU	Communication Management Unit. The equipment located on the aircraft that interfaces with various pieces of radio equipment, including the AES. It is responsible for routing data communications between the aircraft and the ground. The CMU manages communication across multiple satellite and/or terrestrial links.
SAS	Satellite Access Station. The entity on ground that connects terrestrial telephony and data networks to the Family SL network.

4.2 Priority and Pre-emption

The Aeronautical Safety Service uses priority and pre-emption mechanisms provided within the Family SL infrastructure to ensure that required service availability is maintained during network congestion scenarios.

4.3 ACARS

The Aircraft Communications Addressing and Reporting System (ACARS) is a digital data-link system for the transmission of short, relatively simple messages between aircraft and ground stations via radio or satellite.

ACARS messages have the following characteristics:

Single block messages:

- Short ACARS messages can be transmitted as a single block of up to 238 bytes long, of which up to 220 bytes is message content.

Multi-block messages:

- Longer messages may be split up into a number of standard length ACARS blocks. These are sent one at a time in sequence over the radio sub-network. The ACARS protocol demands that an acknowledgement for each block is received before the next block in the sequence is sent.

Larger message blocks:

- Message blocks of a larger size (known as super-blocks) may be sent. The use of larger block sizes is not supported by the Aeronautical Safety service.

The Aeronautical Safety ACARS service is based on using the Background Class Radio Access Bearers (augmented with priority) with air and ground gateways surrounding it. These gateways encapsulate the ACARS messages in IP/UDP packets, as well as performing the key function of determining link failure, and thus enabling a switch to alternate networks supporting aeronautical safety services.

The Aeronautical Safety ACARS service shall meet the communication performance requirements specified in Appendix B of ICAO's GOLD requirements (Global Operations data Link Document) [2]. The GOLD document [2] uses the concept of performance measurement against defined RCP (Required Communication Performance) criteria. The ACARS system design also includes the ability to measure delays and analyse performance as implied by GOLD, at both the ACARS and FANS levels.

A position reporting service is provided as part of the technical implementation of ACARS.

4.4 Voice

The Aeronautical Safety voice service provides two channels of cockpit voice, call priority and pre-emption both at the UE and in network congestion scenarios. The AES is responsible for 'Intra-AES' pre-emption for both air-to-ground and ground-to-air calls. The Aeronautical Safety voice service can also provide Caller Line Identity for mobile terminated (ground-to-air) and mobile originated (air-to-ground) calls. Ground-to-air calls are delivered to the Family SL network by Communication Service Providers (CSP) using a number format that includes the 24 bit ICAO AES ID and a priority indication. Air-to-ground calls are delivered into the PSTN. Two voice channels are provided per Family SL 200 kHz channel on an aircraft. The first call uses the CS domain, and the second call uses Voice over IP (VoIP) on the PS domain if the CS domain is busy. The use of VoIP is transparent to CSPs and pilots.

4.5 Prioritized IP

The key characteristic of the prioritized IP service is the ability to request and deliver higher priority on the air interface between the RAN and the Aeronautical AES. The AES only offers such a service on cockpit Ethernet ports to ensure that cockpit service cannot be flooded by cabin IP traffic. Further, the USIM cards will be provisioned (activated) such that they contain a 'ceiling' for the level of priority that the RAN will deliver to that terminal.

5 ACARS Data Service

5.1 Aeronautical Safety ACARS data service overview

This clause provides some information on the ACARS data service and the functional elements that together provide the Aeronautical Safety ACARS service.

A diagram showing peer-peer communications within the system is shown in Figure 5.1.

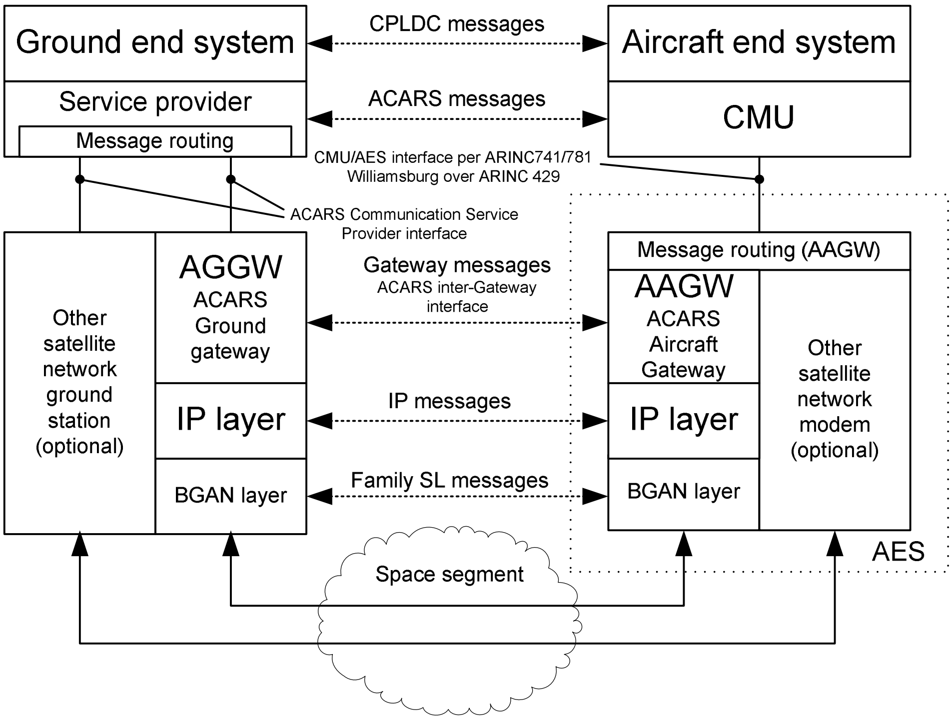


Figure 5.1: ACARS Air and Ground Stacks

5.2 AAGW Design Description

The use cases defined in Annex A prescribe the mandatory requirements for the Aeronautical Safety AES and AAGW providing the Aeronautical Safety ACARS data service capability.

This clause provides an SDL description of an AAGW design that satisfies the normative requirements of the use cases in Annex A.

Figure 5.2 provides a key to the SDL descriptions in this clause. The AIGI message types referred to in the SDL descriptions are listed in clause 5.3.

The AAGW state transitions are illustrated in Figure 5.3, while the procedures operating between the different states are illustrated in Figures 5.4 to 5.18. A mapping between the state transitions and the relevant figures in this clause is provided in Table 5.1.

Table 5.1: Mapping of state transitions to figures

State Transition		Main Events (not all events or branches listed)	Figure
From	**To**		
Idle	AES Camped	Acquire satellite link	Figure 5.4
Camped	AES Registered and Attached	Register and attach successful	Figure 5.5
Camped	Idle	Register and attach failed	Figure 5.5
AES Registered and Attached	DNS Lookup	PDP Context Successful	Figure 5.6
AES Registered and Attached	Idle	PDP Context Failure	Figure 5.6
DNS Lookup	ACARS Login	DNS Response	Figure 5.7
DNS Lookup	Idle	DNS Response timeout	Figure 5.7
ACARS Login	ACARS Logged In	Logon response from AGGW	Figure 5.8
ACARS Login	Idle	Logon response timeout	Figure 5.8
ACARS Logged In	ACARS Logged In	Generic handling of messages from AGGW	Figure 5.9
ACARS Logged In	ACARS Logged In	ACARS message from CMU ACARS ack from AGGW ACARS ack timeout	Figure 5.10
ACARS Logged In	ACARS Logged In	Keepalive received from AGGW AIGI test message received from AGGW Ping sent from AGGW originated by CSP	Figure 5.11
ACARS Logged In	ACARS Logging Off	Transition to NOCOMM from CMU	Figure 5.12
ACARS Logged In	Idle	Logoff notification from AGGW PDP Disconnect from CMU	Figure 5.13
ACARS Logged In	ACARS Login	Logoff notification from AGGW	Figure 5.13
ACARS Logged In	AES Registered and Attached	PDP Disconnect from CMU	Figure 5.13
ACARS Logged In	ACARS Logging Off	Handover imminent (higher preference link available) Edge of coverage reached	Figure 5.14
ACARS Logged In	ACARS Login	Timeout of keepalive ack	Figure 5.15
ACARS Logged In	ACARS Logging Off	Aircrew termination Higher preference link available	Figure 5.16
ACARS Logged In	Idle	Loss of sync with forward bearer	Figure 5.16
ACARS Logging Off	Idle	Logoff ack received from ground (loss of coverage)	Figure 5.17
ACARS Logging Off	AES Camped	Logoff ack received from ground (satellite change)	Figure 5.17
ACARS Logging Off	Idle	Logoff ack received from ground (NOCOMM) Logoff ack received from ground (dwell timer)	Figure 5.18
ACARS Logging Off	ACARS Login	Logoff ack received from ground (dwell timer)	Figure 5.18

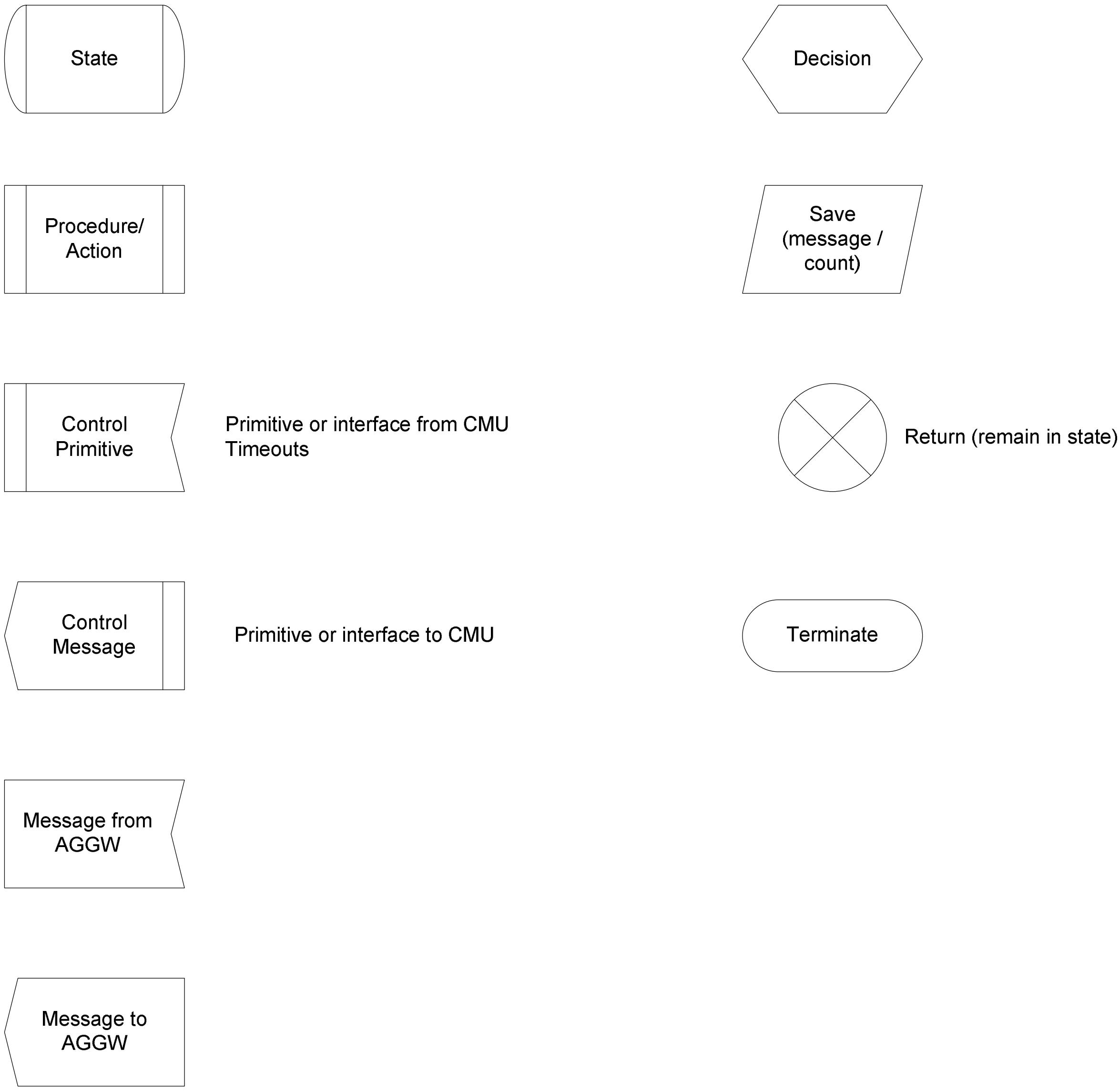
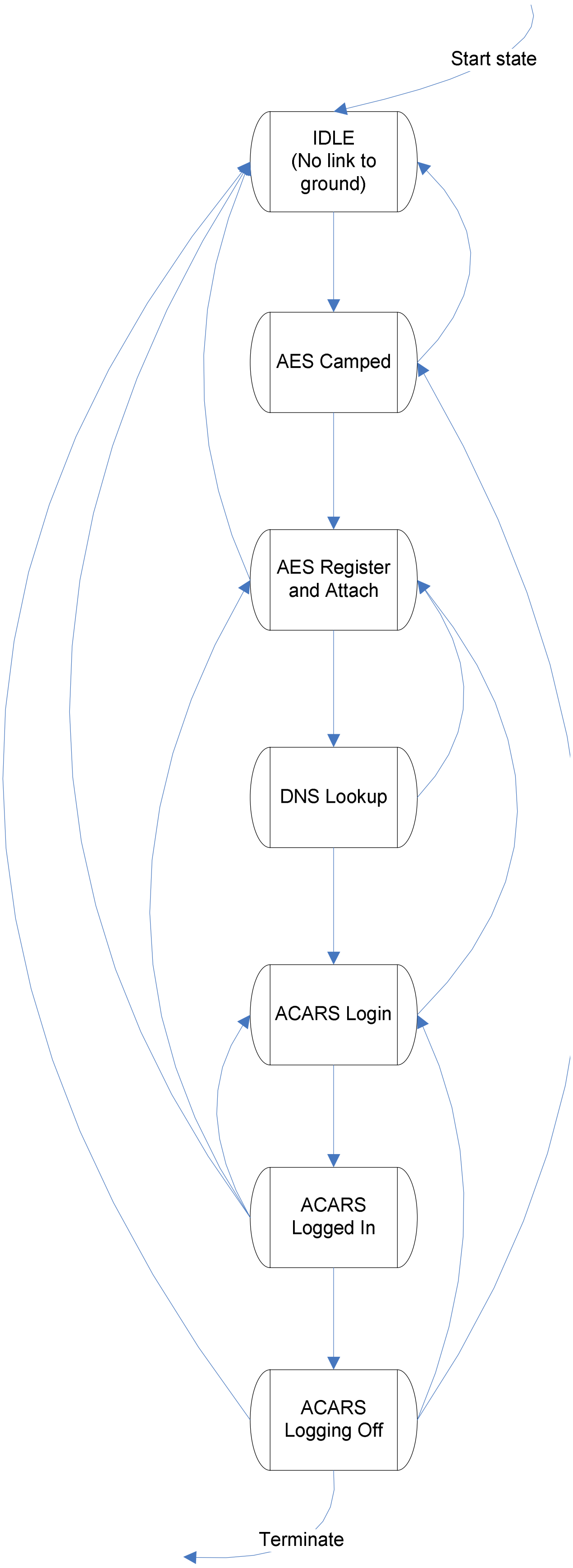
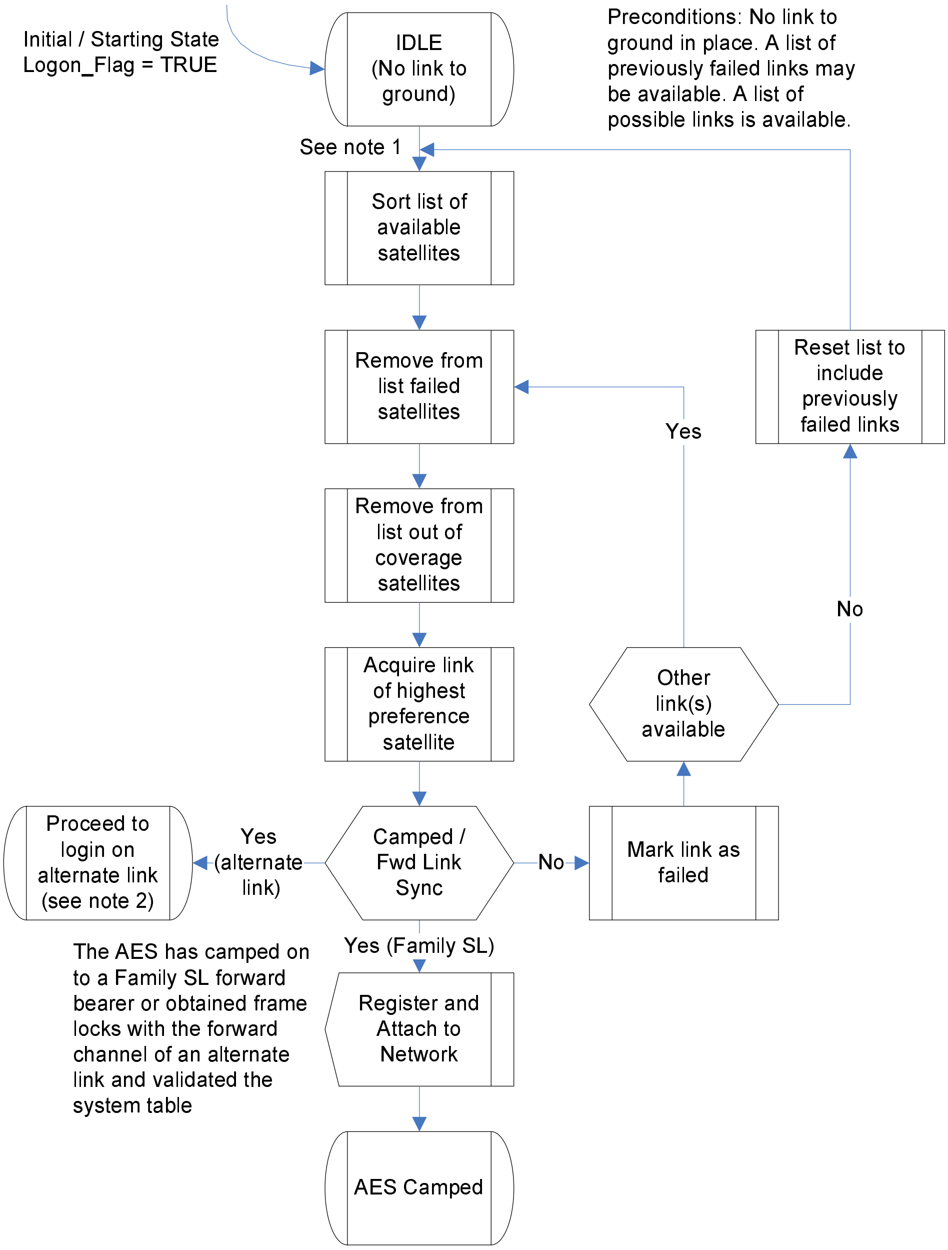


Figure 5.2: SDL Legend



NOTE: This state transition diagram does not show transitions to stay in the same state, nor does it show the AAGW Message Generic Handling.

Figure 5.3: State transitions



NOTE 1: The behaviour is informational. It is expected to be manufacturer specific.
NOTE 2: Manufacturer specific transition to alternate link is outside of these state machines.

Figure 5.4: Idle

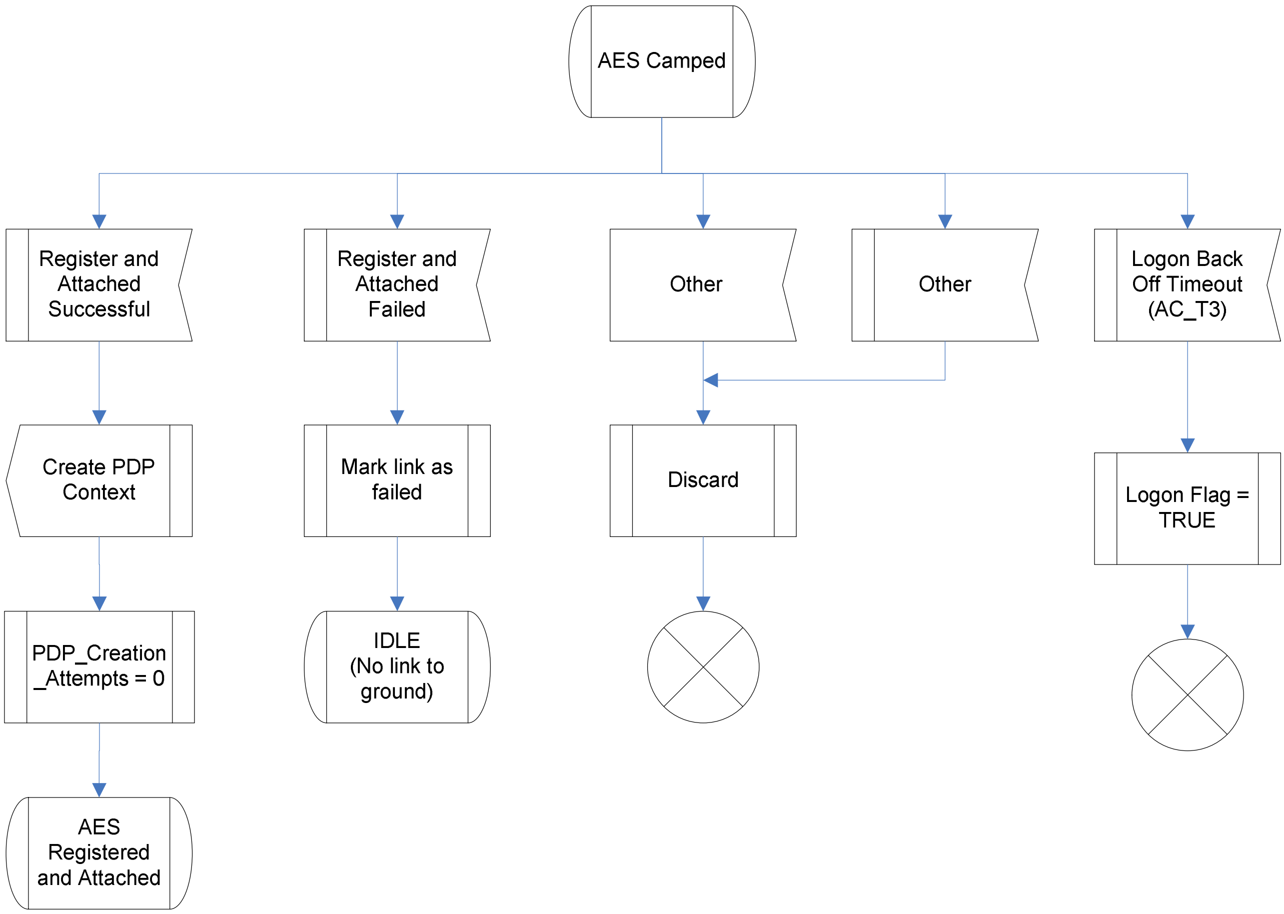


Figure 5.5: AES camped

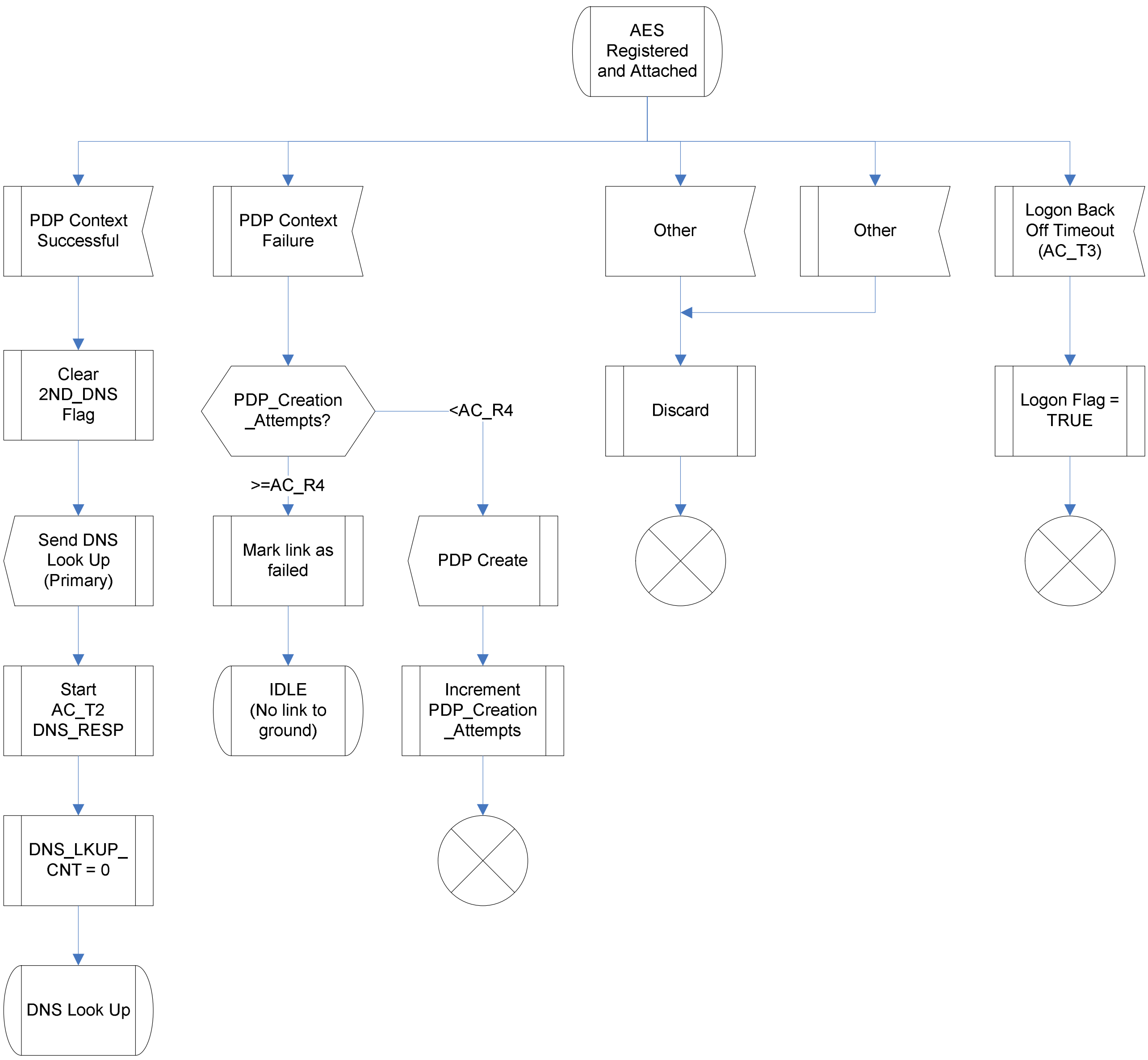


Figure 5.6: AES registered and attached

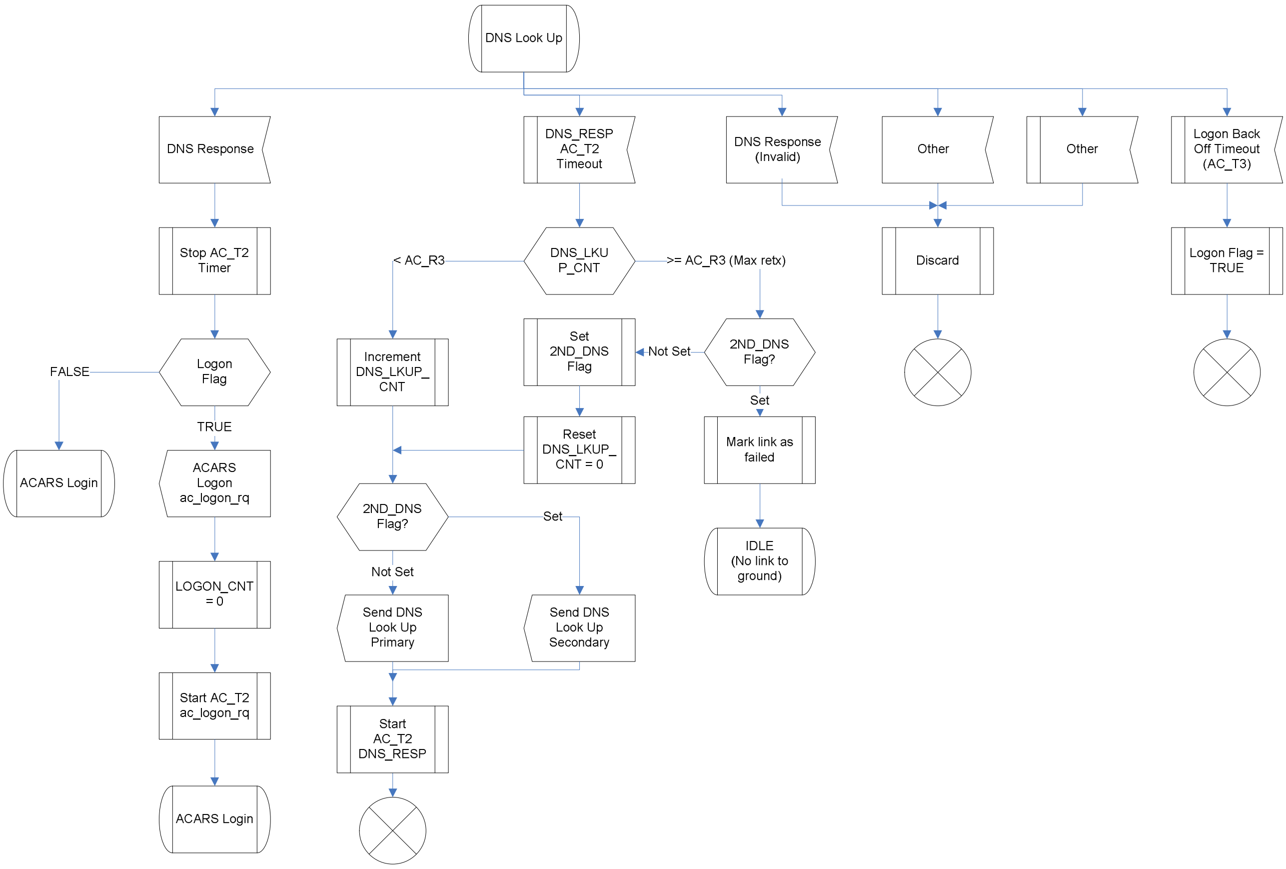


Figure 5.7: AES DNS look-up

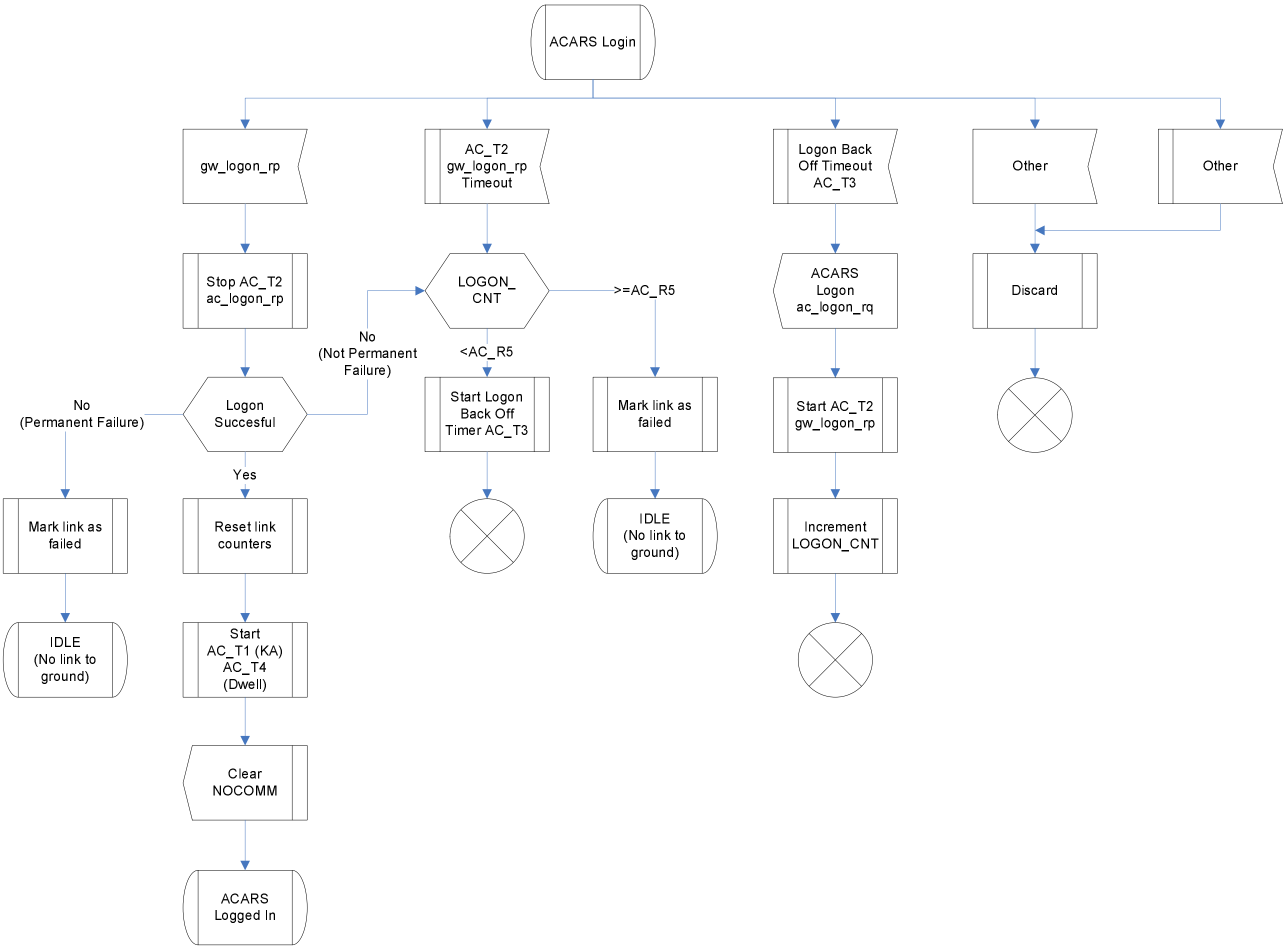
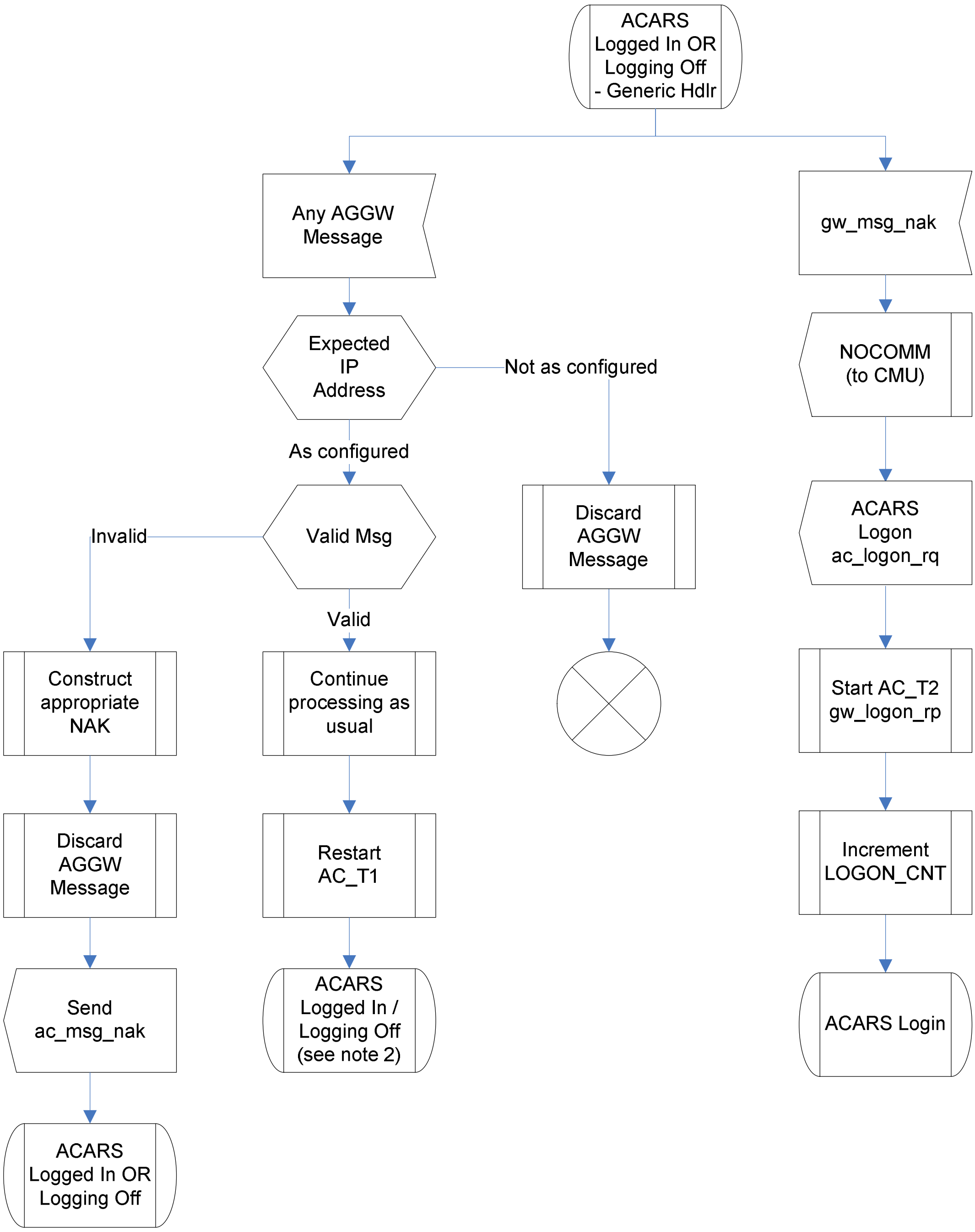


Figure 5.8: ACARS log-in



NOTE 1: This diagram shows the generic message handling that applies to all messages received from the AGGW by the AAGW in the 'ACARS Logged In' and 'Logging Off' state. To show this behaviour for each message in the following diagrams would distract from the flow and be repetitious. It is an implementation detail on how this behaviour is handled across the states for which the behaviour is applicable.

NOTE 2: This is the expected processing path, with the message passed/returned to the appropriate state.

Figure 5.9: AAGW generic message handling

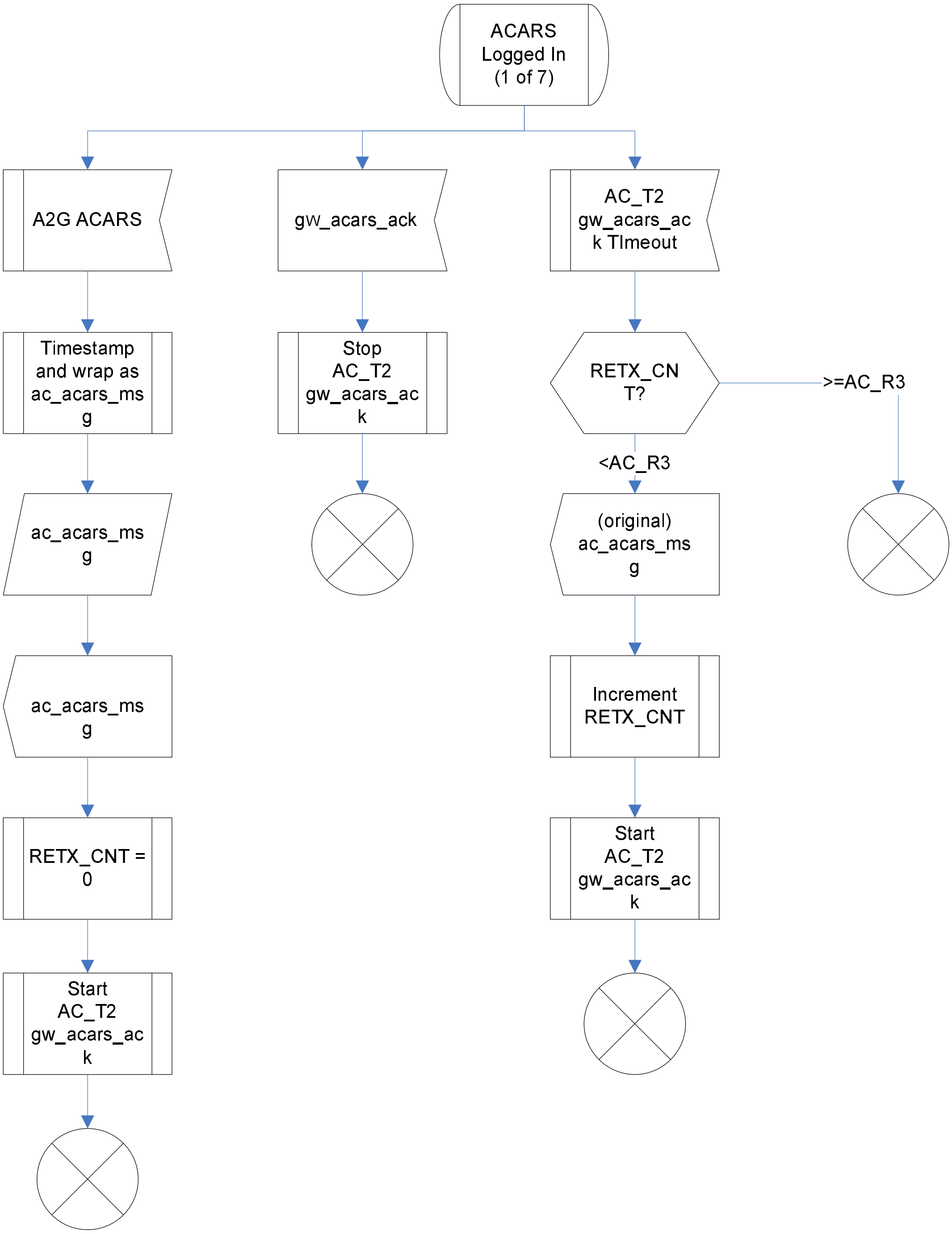


Figure 5.10: ACARS logged in (1)

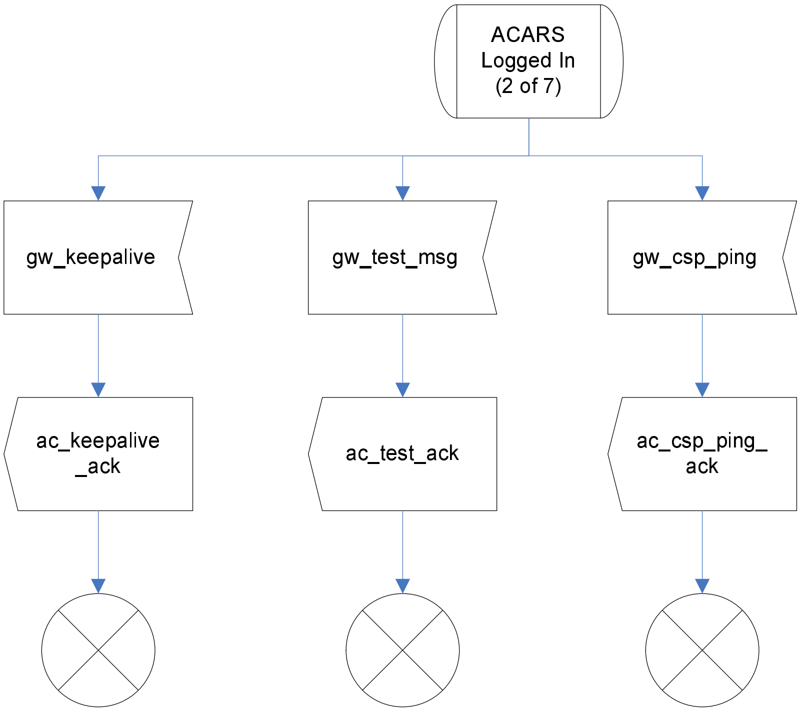
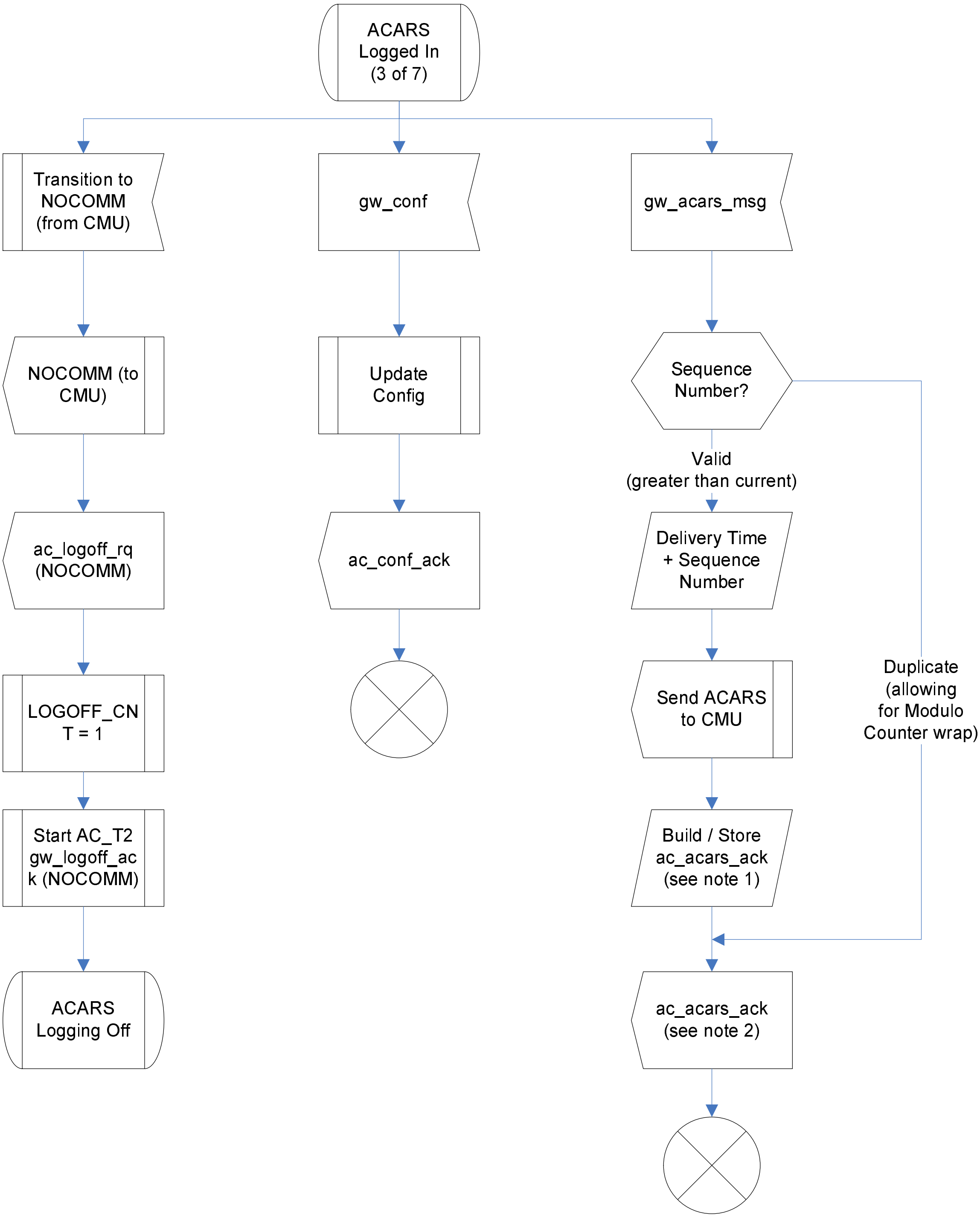
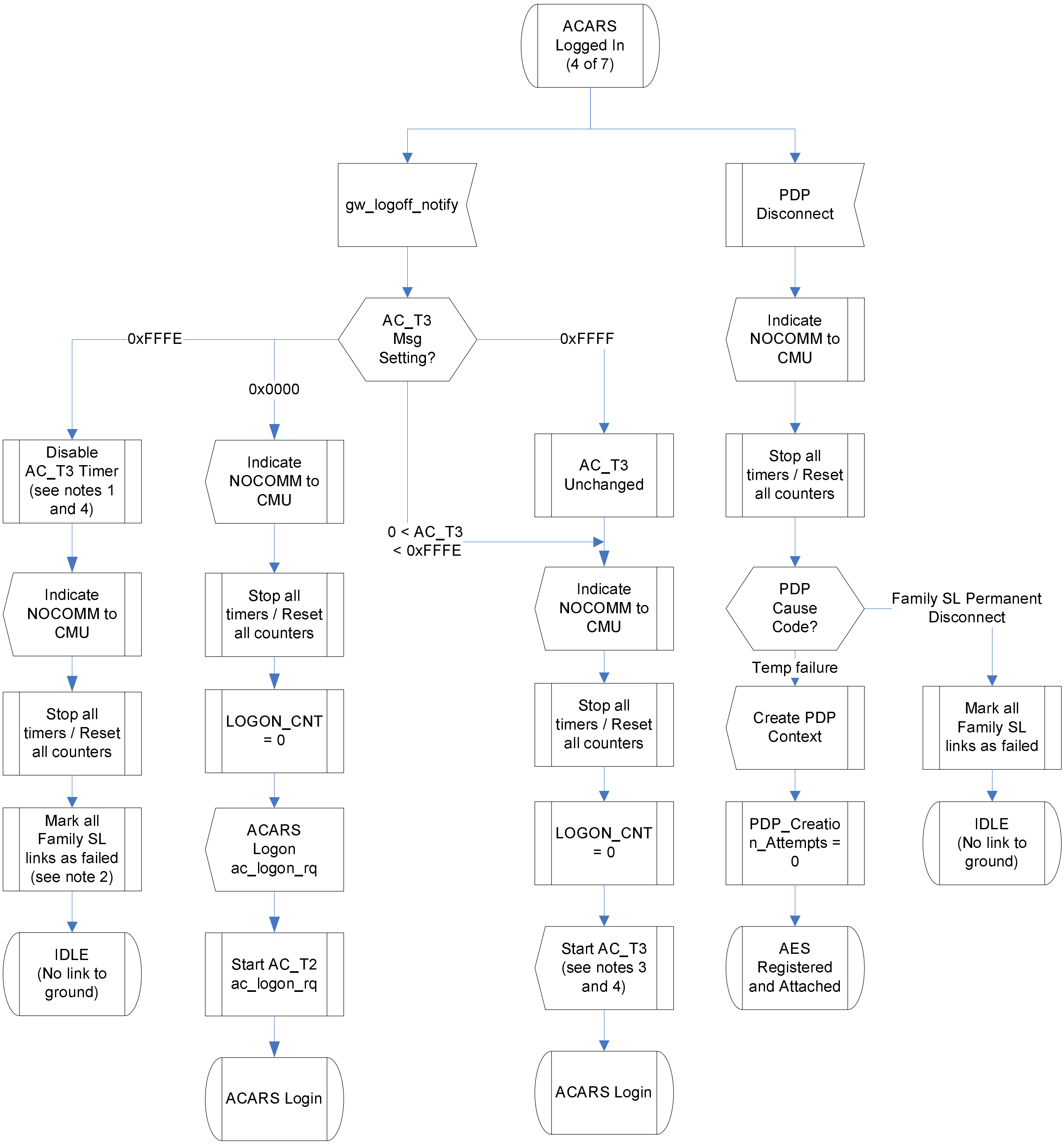


Figure 5.11: ACARS logged in (2)



NOTE 1: Include timestamp delivery time.
NOTE 2: Tx stored original if applicable.

Figure 5.12: ACARS logged in (3)



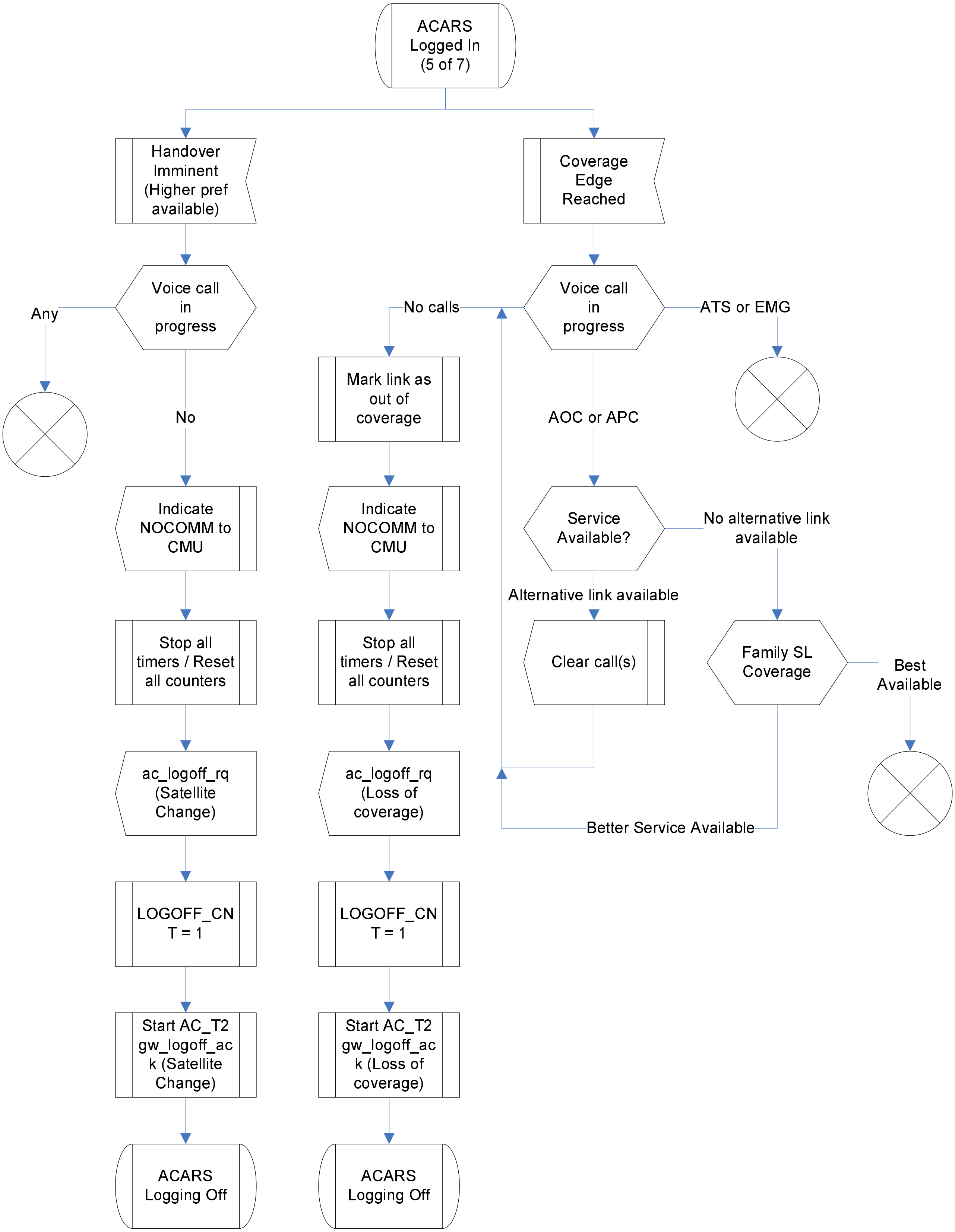
NOTE 1: Not start at all if required to be disabled - implementation can determine the best way to approach this.

NOTE 2: This still allows/leaves an alternative link as a carrier in the list.

NOTE 3: Timer implementation may not support 0 so alternative approaches might be sought - very short timer or logon_flag manipulation.

NOTE 4: This is a temporary change to the AC_T3. After initiating the timer, the value of AC_T3 will revert to that configured/default.

Figure 5.13: ACARS logged in (4)



NOTE: The behaviour shown in this figure is for information purposes only. It is expected to be manufacturer dependent.

Figure 5.14: ACARS logged in (5)

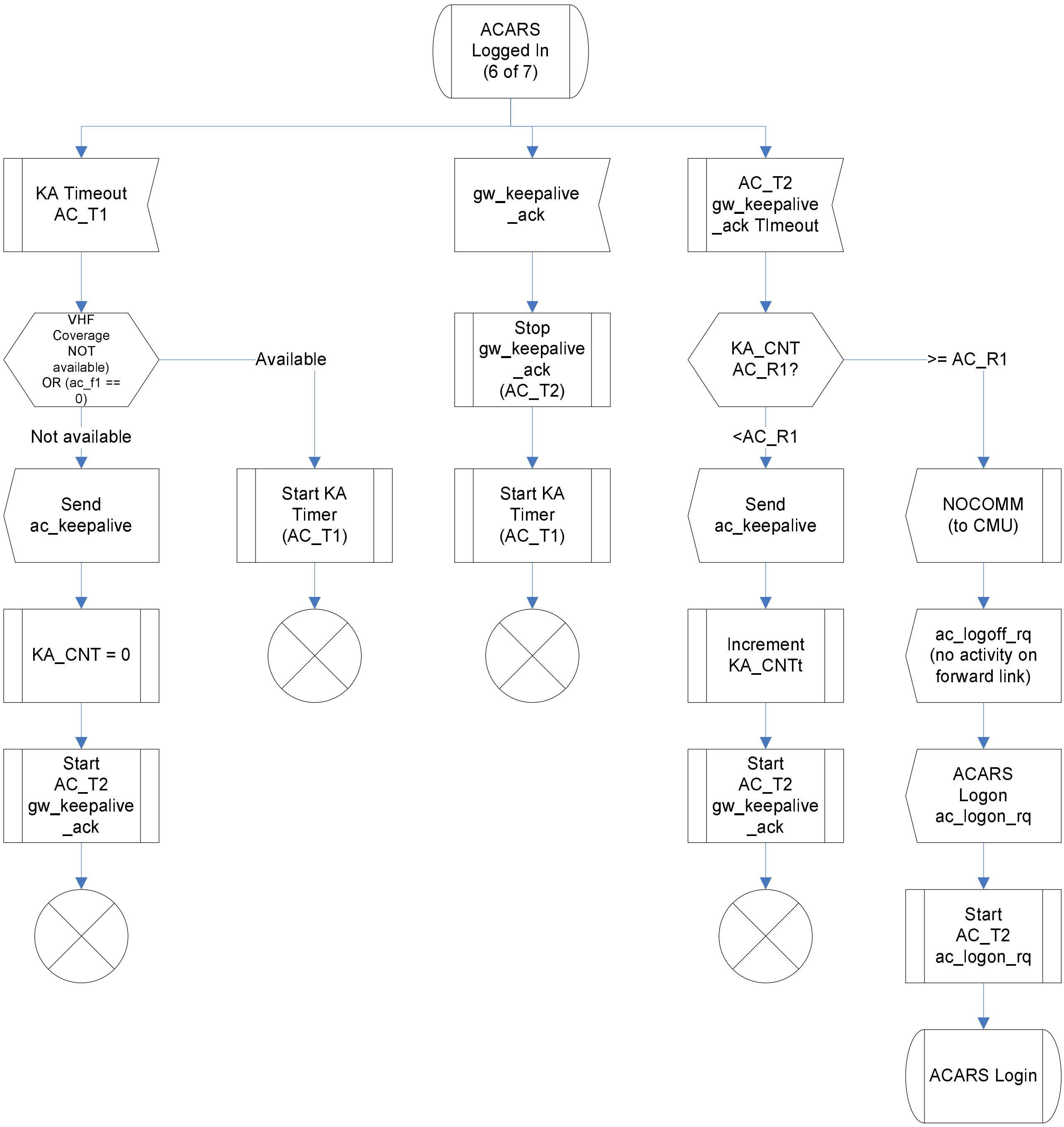
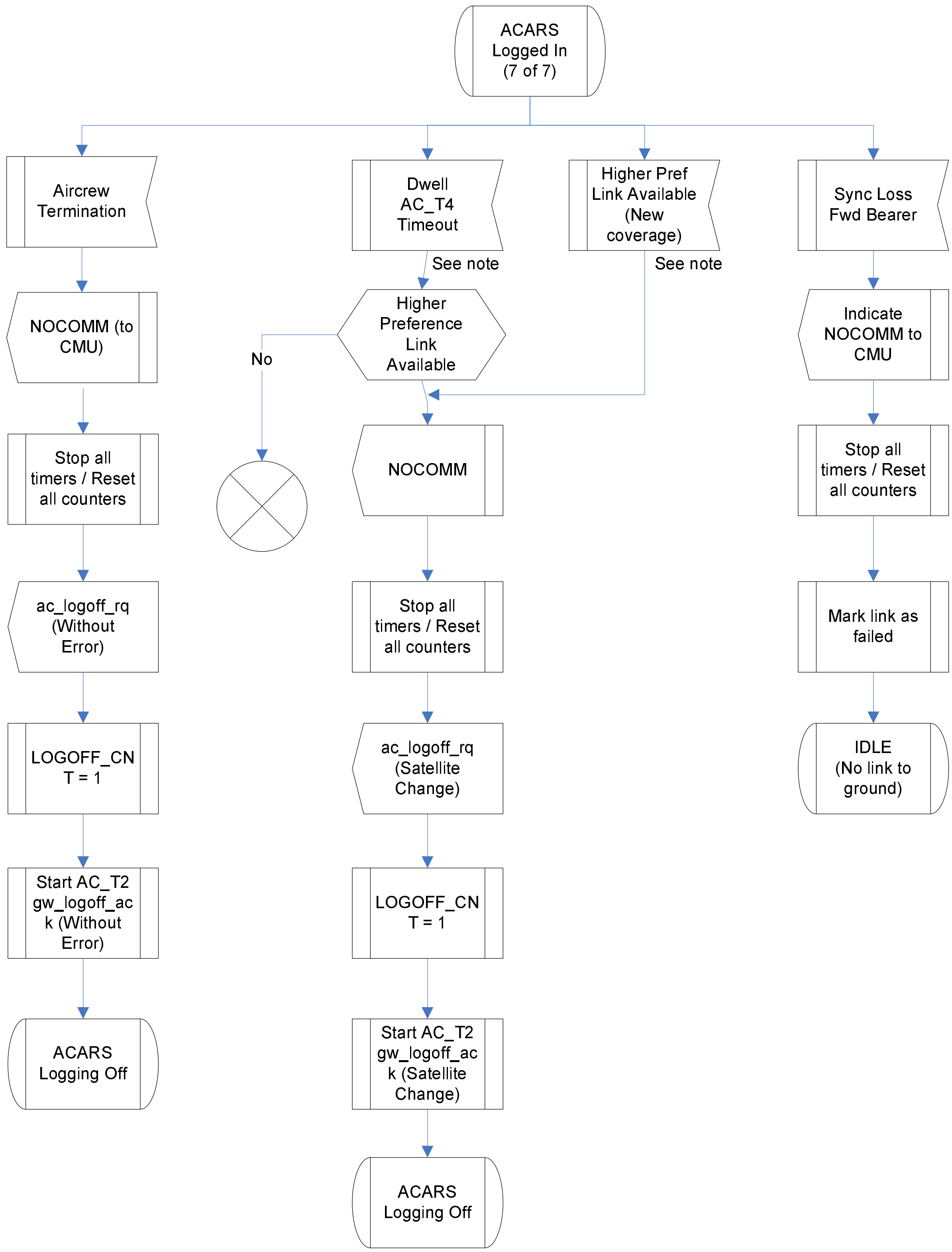


Figure 5.15: ACARS logged in (6)



NOTE: The behaviour shown for these events is for information purposes only. It is expected to be manufacturer dependent.

Figure 5.16: ACARS logged in (7)

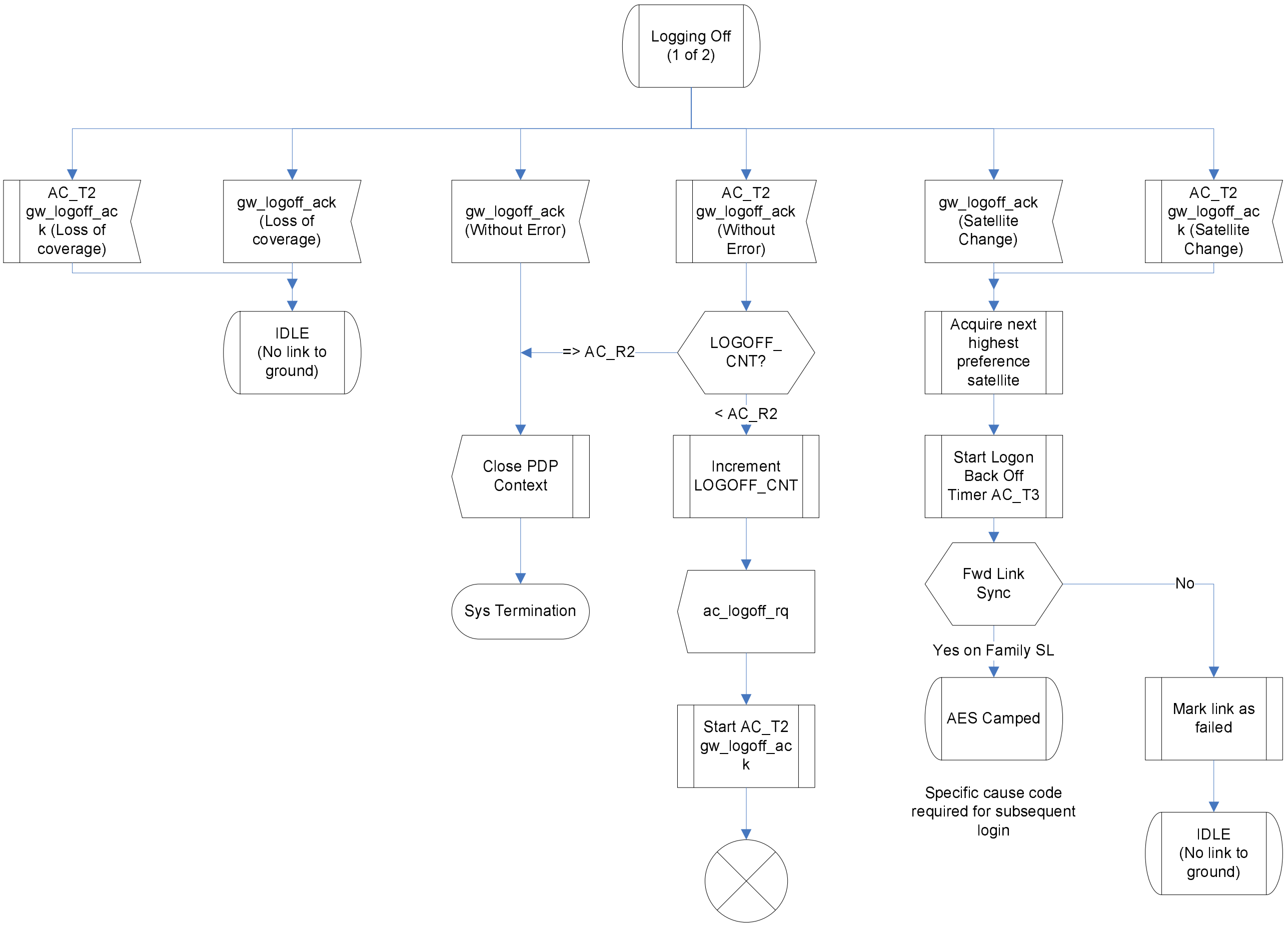


Figure 5.17: ACARS logging off (1)

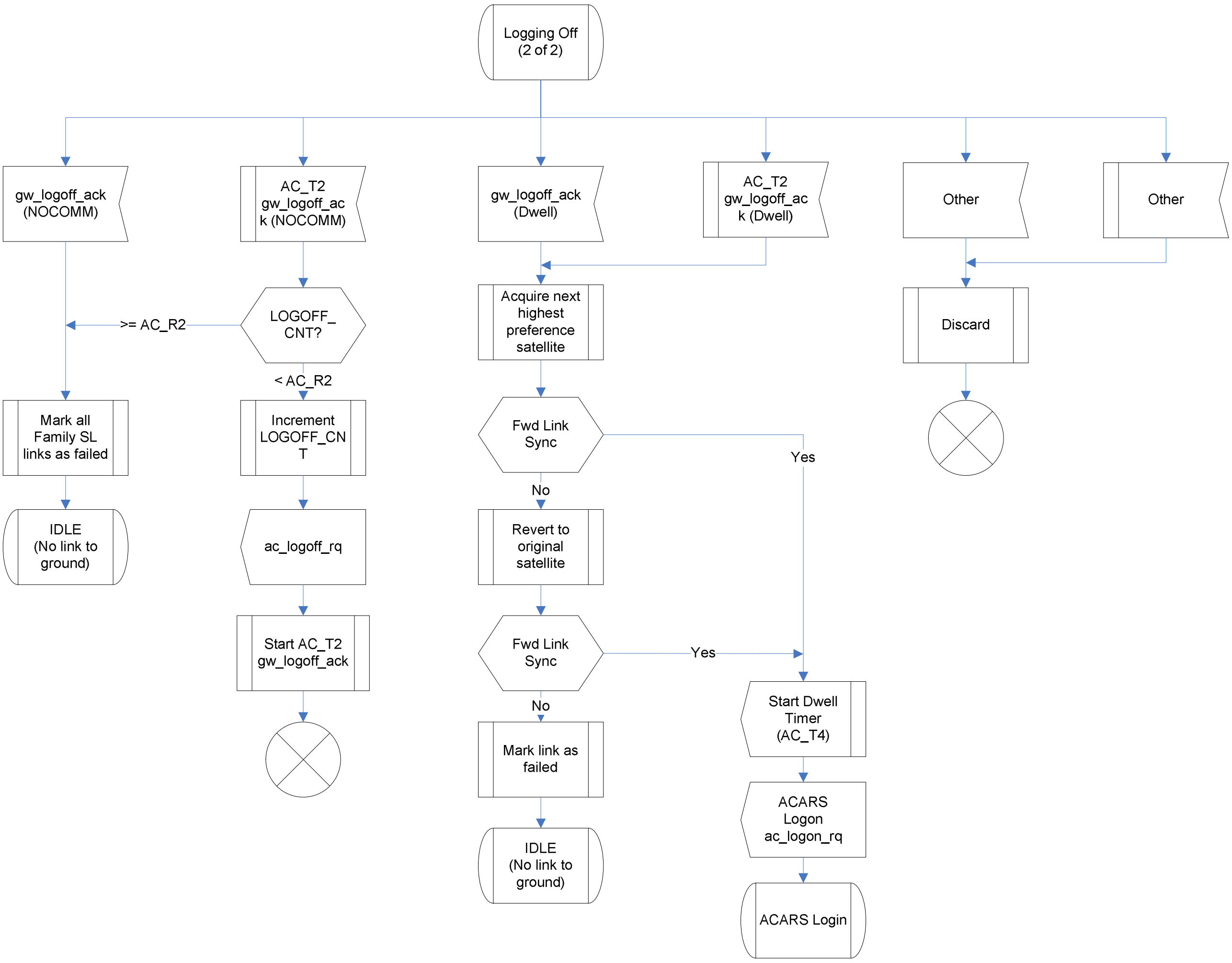


Figure 5.18: ACARS logging off (2)

5.3 Inter-ACARS Gateway Interface Description

5.3.0 General

This clause specifies the interface between the ground gateway and its peer on the aircraft, known as the Inter-ACARS Gateway Interface or AIGI.

5.3.1 Connection to ACARS Ground Gateway interface

The parameters in Table 5.2 are required for accessing and tailoring the Aeronautical Safety ACARS service by the AAGW and are referenced throughout the rest of this clause. An indication on whether these parameters should be configurable by external means (i.e. ORT) is also given.

Table 5.2: Aeronautical Safety ACARS service parameters

Parameter	Description	Configurable Externally	Default Value
[*apn_name*]	Access Point Name (APN) string for ACARS Service	Yes	Configurable by network
[*aggw_domain_name*]	SIP Domain Name string	Yes	Configurable by network
[*position_reporting*]	Control whether or not position reports are appended to AIGI messages.	Yes	Disabled
[*udp_dst_port*]	UDP Destination port number used in AAGW and AGGW messages	No	30000
[*udp_src_port*]	AAGW UDP source port number	No	30001

On start-up the Aeronautical Safety AES shall attach to the PS Domain and the AAGW shall proceed to activate a Primary Background PDP Context towards the APN [*apn_name*] dedicated to the provision of IP transport for the ACARS service.

After successful activation of the primary PDP Context, the AAGW shall resolve the IP address of the AGGW through a DNS Lookup to the domain name [*aggw_domain_name*].

5.3.2 AIGI Message Format

All AIGI messages between the AAGW and AGGW shall be encapsulated in UDP/IP.

The UDP header already contains a checksum, and all AIGI messages will be sent one per UDP packet.
No re-transmission request mechanism is implemented within this protocol to take advantage of error detection. An error in the ACARS message payload will be detected outside the AAGW/AGGW domain using the ACARS checksums.

The message structure is defined below, with structure as shown in Figure 5.19:

- AIGI message-type (1 byte)
- ac_acars_msg AIGI message body (27 bytes)
- ac_acars_msg ACARS payload (largest size 238 bytes)

The length of the largest AIGI message (the largest message being *ac_acars_msg* with a position report appended, see clause 5.3.3.7) is thus 266 bytes.

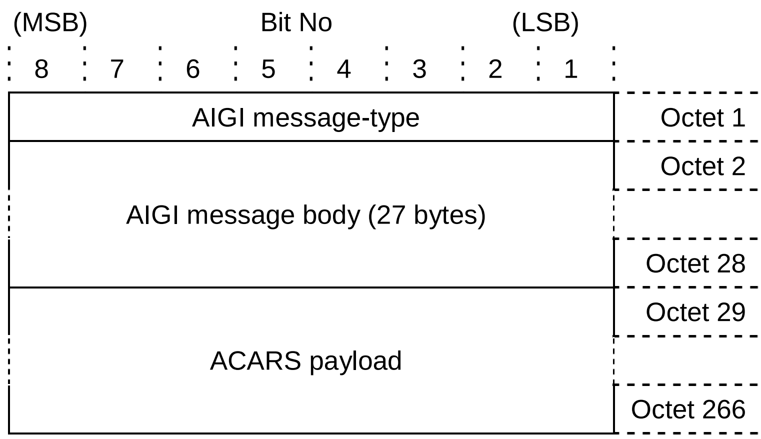


Figure 5.19: AIGI Message Structure (largest message size shown)

5.3.3 AIGI Message Definitions

5.3.3.0 General

The following clause and its subclauses define the structure and content of AIGI messages.

5.3.3.1 Message Types

Table 5.3 defines all AIGI message types. Each AIGI message can contain aircraft position information if [*position_reporting*] is enabled. Messages with the name format of ac_xxxx_n indicate a message with no position reporting information present, i.e. [*position_reporting*] is disabled.

Table 5.3: Message Type Identifiers and Description

Message name	Originating Source	message-type	Description	Response
ac_logon_rq (ac_logon_rq_n)	AAGW	0x01 (0x81)	Log on request	*gw_logon_rp*
gw_logon_rp	AGGW	0x41	Log on response	None
ac_logoff_rq (ac_logoff_rq_n)	AAGW	0x02 (0x82)	Log off request	*gw_logoff_ack*
gw_logoff_ack	AGGW	0x42	Log off acknowledgement	None
gw_logoff_notify	AGGW	0x43	Log off notification	None
ac_acars_msg (ac_acars_msg_n)	AAGW	0x04 (0x84)	air-to-ground Single block ACARS message	*gw_acars_ack*
gw_acars_ack	AGGW	0x44	AGGW response to receipt of ac_acars_msg	None
gw_acars_msg	AGGW	0x45	ground-to-air Single block ACARS message	*ac_acars_ack (ac_acars_ack_n)*
ac_acars_ack (ac_acars_ack_n)	AAGW	0x05 (0x85)	AAGW response to receipt of gw_acars_msg	None
gw_conf	AGGW	0x46	Update of AES configurable parameters	*ac_conf_ack (ac_conf_ack_n)*
ac_conf_ack (ac_conf_ack_n)	AAGW	0x06 (0x86)	Configuration update acknowledgement	None
ac_keepalive (ac_keepalive_n)	AAGW	0x07 (0x87)	"keep-alive"	*gw_keepalive_ack*
gw_keepalive_ack	AGGW	0x47	"keep-alive" acknowledgement	None
gw_keepalive	AGGW	0x48	"keep-alive" sent from AGGW	*ac_keepalive_ack (ac_keepalive_ack_n)*
ac_keepalive_ack (ac_keepalive_ack_n)	AAGW	0x08 (0x88)	AAGW response to AGGW "keep-alive"	None
gw_csp_ping	AGGW	0x49	"ping" sent from AGGW originated by CSP	*ac_csp_ping_ack (ac_csp_ping_ack_n)*
ac_csp_ping_ack (ac_csp_ping_ack_n)	AAGW	0x09 (0x89)	AAGW response to AGGW "ping" that originated from the CSP	None
gw_test_msg	AGGW	0x4A	AIGI Traffic Test	*ac_test_ack (ac_test_ack_n)*
ac_test_ack (ac_test_ack_n)	AAGW	0x0A (0x8A)	AAGW response to receipt of gw_test_msg	None
ac_msg_nak (ac_msg_nak_n)	AAGW	0x3F (0xBF)	Message invalid	None
gw_msg_nak	AGGW	0x7F	Sent AGGW in response to any AAGW message to indicate that the AES is not logged on to the AGGW	None

The message-type values in Table 5.4 are structured on the format shown in Figure 5.20.

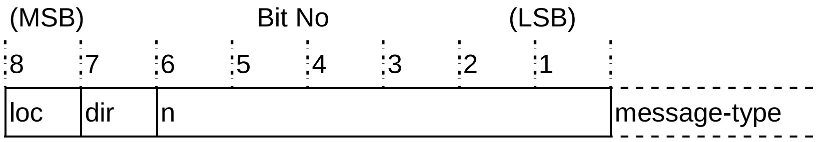


Figure 5.20: Message-type Octet Format

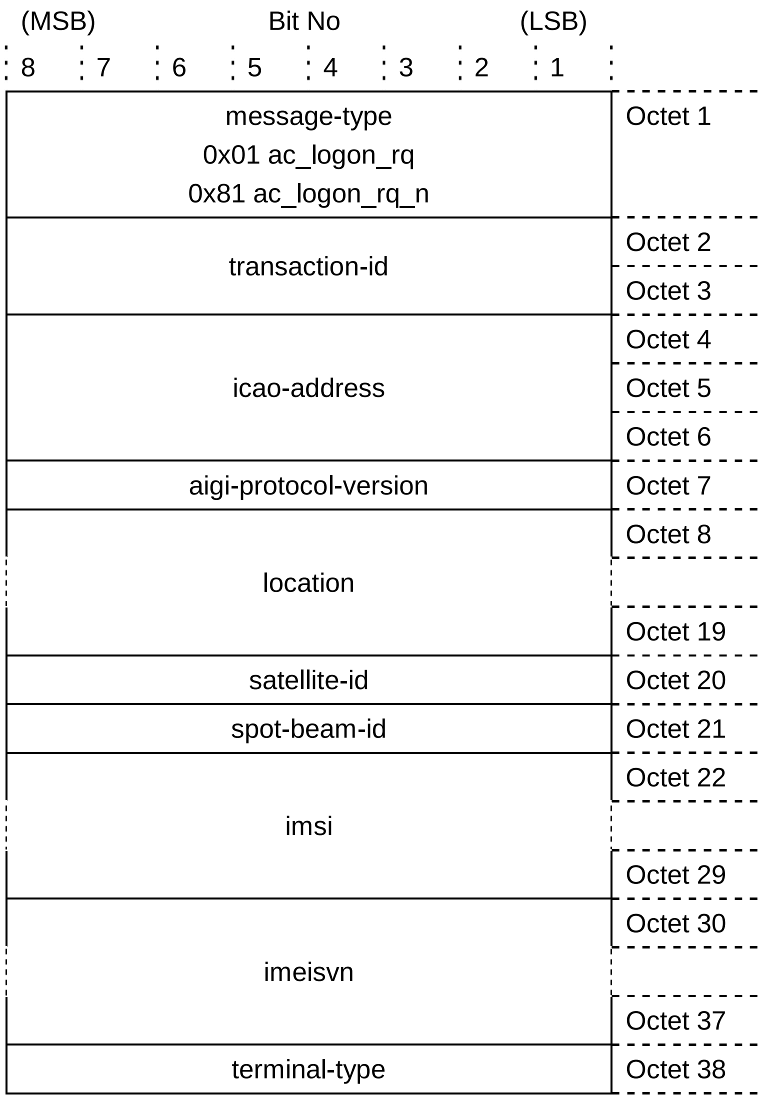
Table 5.4: Message-type Parameter Descriptions

Parameter	Description
loc	0 = Messages from the AAGW including location field or messages from AGGW 1 = Messages from the AAGW excluding location field
dir	0= Messages from the AAGW 1= Messages from the AGGW
n	message-type-identifier

5.3.3.2 Message *ac_logon_rq (ac_logon_rq_n)*: Log-on request

5.3.3.2.0 General

This message is sent by the AAGW during log-on. The *ac_logon_rq_n* message has the same contents as defined below with the exclusion of the *location* field. The message structure is defined in Figure 5.21 and the message contents are specified in Table 5.5.



(MSB) Bit No (LSB)	
type-approval-code	Octet 39 … Octet 44
sdu-vendor	Octet 45 … Octet 60
system-designation	Octet 61 … Octet 76
sdu-hw-pn	Octet 77 … Octet 92
sdu-sw-pn	Octet 93 … Octet 108
antenna-hw-pn	Octet 109 … Octet 124
antenna-sw-pn	Octet 125 … Octet 140
aircraft-tail-number	Octet 141 … Octet 147
aircraft-type	Octet 148 … Octet 154
flight-id	Octet 155 … Octet 160
logon-reason	Octet 161

Figure 5.21: *ac_logon_req* message structure

Table 5.5: *ac_logon_req* parameter descriptions

Parameter	Description	Length (octets)
message-type	AIGI message identifier as defined in Table 5.3.	1
transaction-id	A transaction ID number as detailed in clause 5.3.3.2.1.	2
icao-address	ICAO address of the aircraft.	3
aigi-protocol-version	Protocol Version number (set to 1).	1
location	The aircraft location, speed and heading information as defined in clause 5.3.3.2.2.	12
satellite-id	Satellite Identifier of the current satellite.	1
spot-beam-id	Spot Beam Identifier The spot beam that is currently being transmitted in.	1
imsi	AES IMSI number (15 digits coded in BCD with unused nibbles within the 15 digits of the IMSI should be set to 0xF, spare nibbles should be set to 0x0).	8
imeisvn	International Mobile Equipment Identity/Software Version Number (16 digits coded in BCD with unused nibbles set to 0xF) (SVN should identify the Aeronautical Safety AES).	8
terminal-type	Identifies the terminal type as defined in clause 5.3.3.2.3.	1
type-approval-code	Type Approval ID (6 ASCII characters) - optional, null data is all spaces.	6
sdu-vendor	Satellite Data Unit vendor. ASCII string, null data is all spaces.	16
system-designation	Short descriptive name of avionics. ASCII string, null data is all spaces.	16
sdu-hw-pn	SDU Hardware Part Number. ASCII string, null data is all spaces.	16
sdu-sw-pn	SDU Software Part Number. ASCII string, null data is all spaces.	16
antenna-hw-pn	Antenna hardware part number. ASCII string, null data is all spaces.	16
antenna-sw-pn	Antenna Software Part Number. ASCII string, null data is all spaces.	16
aircraft-tail-number	Aircraft Tail Number. ASCII string, null data is all spaces.	7
aircraft-type	The aircraft type designator as detailed in [5] (typically obtained from SDU ORT). ASCII string, typically 4 characters long, null data is all spaces. (e.g. A319, A346, A388, B772, B744, B788). For test systems (i.e. lab testing) it is advised to populate this field with "GND" or "LAB".	7
flight-id	The flight identifier. First few characters should indicate the airline operator. ASCII string, null data is all spaces.	6
logon-reason	Cause code specifying the reason for log-on as detailed in clause 5.3.3.2.4.	1

5.3.3.2.1 Transaction ID

The parameter transaction-id is a number is to be included in the content of all AIGI messages in order to track delayed message responses. The AAGW and AGGW maintain their own transaction ID numbers. The originator of a message transaction (a transaction being an originating message and response from its peer) populates the field and the receiver of the message copies the received transaction ID into the corresponding message response. It starts at 1 and is incremented by 1 on every originating message transaction that is sent (including retransmissions). The transaction ID is reset on every new logon session.

5.3.3.2.2 Location

The *location* field is common to all air to ground messages when [*position_reporting*] is enabled. The current aircraft location, altitude, heading and speed shall always be used for every air to ground message transmitted, i.e. if a message is retransmitted, the new aircraft location shall be provided. The message structure is defined in Figure 5.22 and the message contents are specified in Table 5.6.

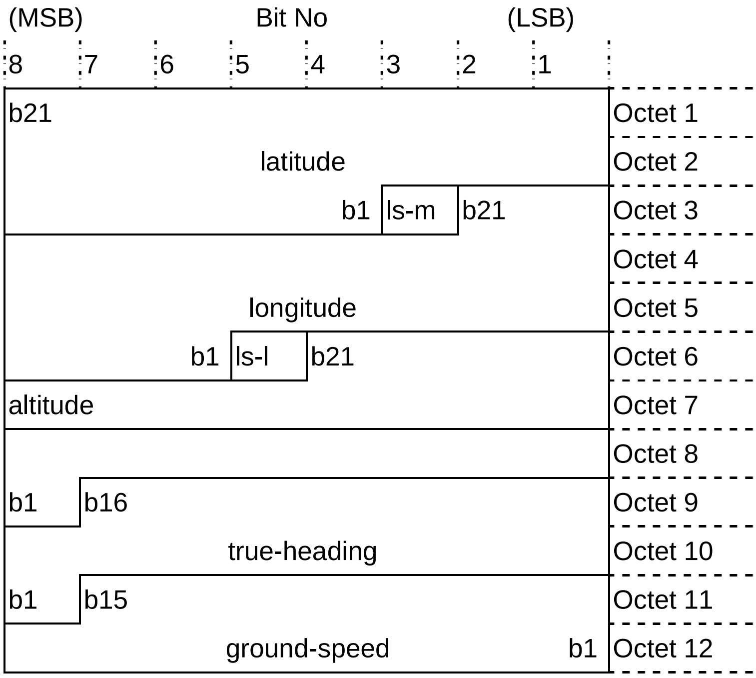


Figure 5.22: Location field structure

Table 5.6: Location field parameter descriptions

Parameter	Description	Length (bits)
latitude	Degrees of latitude of the current aircraft position. b1 is the least significant bit with a resolution of 0,000172 degrees of latitude. b21 is the sign bit equating to -180,0 degrees of latitude and when set indicates latitudes in the southern hemisphere.	21
longitude	Degrees of longitude of the current aircraft position. b1 is the least significant bit with a resolution of 0,000172 degrees of longitude. b21 is the sign bit equating to -180,0 degrees of longitude and when set indicates latitudes in the western hemisphere.	21
altitude	Absolute altitude; height in feet above sea level of the aircraft. b1 is the least significant bit with a resolution of 0,125 feet. b21 is the sign bit equating to -131 072 feet and when set indicates heights below sea level.	21
true-heading	Heading of the aircraft in degrees relative to True North. b1 is the least significant bit with a resolution of 0,005493 degrees. b16 is the sign bit and equates to -180,0 degrees.	16
ground-speed	Ground speed of the aircraft in knots. b1 is the least significant bit with a resolution of 0,125 knots.	15
ls-m and ls-l	Location Source of the position data - see Table 5.7.	2

Table 5.7: Location source

ls-m	ls-l	Location Source
0	0	Inertial Reference System
0	1	GPS
1	0	Hybrid
1	1	Reserved

5.3.3.2.3 Terminal type

The parameter *terminal-type* identifies the class of the Aeronautical Safety AES and whether alternative satellite services are supported as a fall back service. The message structure is defined in Figure 5.23 and the message contents are specified in Table 5.8.

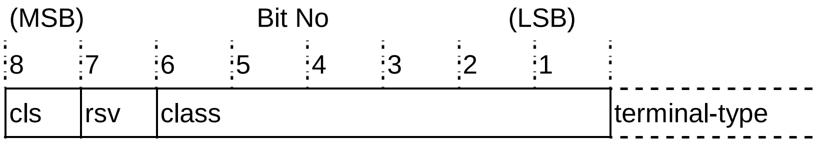


Figure 5.23: Terminal-type Parameter Structure

Table 5.8: Terminal-type Parameter Descriptions

Parameter	Description	Length (bits)
cls	Alternative satellite link supported, 0 if not, 1 if so.	1
rsv	Reserved, set to 0.	1
class	Class of terminal (i.e. 4 for Class 4, 6 for Class 6, 7 for Class 7, etc.)	6

5.3.3.2.4 Logon Reason

The parameter *logon-reason* conveys the event that has initiated the Aeronautical Safety AES log-on request to the AGGW. The defined *logon-reason* codes are provided in Table 5.9.

Table 5.9: *logon-reason* Parameter Definition

Logon Reason Code	Description
0x00	1st Log-on after Factory Settings Restart
0x01	1st Log-on after power up
0x02	Manual Log-on
0x03	Automatic Log-on (but not 1st Log-on after power up)
0x04	Satellite Handover e.g. in overlap region
0x05	Log on after using non preferred service e.g. after dwell timer ac_t4 expired
0x06	Log on after entering Family SL coverage
0x07	Logon after Failure
0x08	Logon after being Logged out by AGGW
0x10..0x2F	Manufacturer Specific Codes
0x30..0xFE	Reserved
0xFF	Undefined Reason

5.3.3.3 Message *gw_logon_rp*: log on response

5.3.3.3.0 General

This message is sent by the AGGW during log-on. The message structure is defined in Figure 5.24 and the message contents are specified in Table 5.10.

(MSB) Bit No (LSB): 8 7 6 5 4 3 2 1	
message-type 0x41 gw_logon_rp	Octet 1
transaction-id	Octet 2 Octet 3
icao-address	Octet 4 Octet 5 Octet 6
response	Octet 7
session-id	Octet 8 Octet 9
aggw-id	Octet 10
dp-id	Octet 11
csp-id	Octet 12
ges-id	Octet 13

Figure 5.24: *gw_logon_rp* Message Structure

Table 5.10: *gw_logon_rp* Parameter Descriptions

<table>
<tr><th>Parameter</th><th>Description</th><th>Length (octets)</th></tr>
<tr><td>message-type</td><td>AIGI message identifier as defined in Table 5.3.</td><td>1</td></tr>
<tr><td>transaction-id</td><td>A transaction ID number as detailed in clause 5.3.3.2.1. Populated from equivalent field in ac_logon_rq.</td><td>2</td></tr>
<tr><td>icao-address</td><td>ICAO address of the aircraft.</td><td>3</td></tr>
<tr><td>response</td><td>Response to log-on request as defined in Table 5.11.
Log-on failures shall be classed as temporarily failed, or permanently failed as shown in Table 5.11. For temporary log-on failures, the AAGW shall reattempt log-on in accordance with the use case in clause A.2 before declaring the Family SL link as failed. For permanent log-on failures, the AAGW shall not attempt to log-on to that AGGW again in accordance with the use case in clause A.2. It is implicit that external remedial action is required to access this AGGW for permanent log-on failures.
The AAGW behaviour will follow the AIGI protocol as defined in the use cases in Annex A. The setting of configuration item ac_r5 should ensure that in cases where the AES needs to retry a logon (e.g. for a primary CSP failure), the AES will attempt to logon again ensuring that if a backup CSP is provisioned, it can regain Aeronautical Safety Service.</td><td>1</td></tr>
<tr><td>session-id</td><td>Two byte identifier for current log-in session, starts at 1, increments by 1 for each successful Login of that AES, and wraps around.
Coding (Hex)
0x0000 - Invalid Session ID (i.e. if logon was unsuccessful)
0x0001 to 0xFFFF - Valid Session IDs.</td><td>2</td></tr>
<tr><td>aggw-id</td><td>Identifies the specific AGGW.</td><td>1</td></tr>
<tr><td>dp-id</td><td>Indicates the DP for the AES.<table><tr><td>Code</td><td>DP</td></tr><tr><td>0x01</td><td>DP1</td></tr><tr><td>0x02</td><td>DP2</td></tr><tr><td>0x03..0xFE</td><td>Reserved</td></tr><tr><td>0xFF</td><td>Undefined</td></tr></table></td><td>1</td></tr>
<tr><td>csp-id</td><td>Indicates the CSP allocated.<table><tr><td>Code</td><td>CSP</td></tr><tr><td>0x01</td><td>DP1</td></tr><tr><td>0x02</td><td>DP2</td></tr><tr><td>0x03..0xFE</td><td>Reserved</td></tr><tr><td>0xFF</td><td>Undefined</td></tr></table></td><td>1</td></tr>
<tr><td>ges-id</td><td>Identifies the Family SL GES ID to be provided to the CMU
Coding (Hex)
0 Invalid GES ID
1 to FE Valid GES Ids
FF all GES's.</td><td>1</td></tr>
</table>

5.3.3.3.1 Response

The parameter response provides the Aeronautical Safety AES with some information regarding its attempt to log-on, whether it succeeded or failed and can influence further actions taken. The AAGW behaviour will follow the AIGI protocol as defined in the use cases in Annex A.

Log-on failures shall be classed as either temporarily failed, or permanently failed as indicated in the response descriptions in Table 5.11.

For temporary log-on failures, the AAGW shall reattempt log-on in accordance with the use case in clause A.2 before declaring the Family SL link as failed.

For permanent log-on failures, the AAGW shall not attempt to log-on to that AGGW again in accordance with the use case in clause A.2 until the Aeronautical Safety AES has been power cycled. It is implicit that external remedial action is required to access this AGGW for permanent log-on failures.

The defined logon response codes are provided in Table 5.11.

Table 5.11: *response* Parameter Definition

Response Code	Description	AES Behaviour
0001 nnnn	Log-on accepted	
0001 0001 (0x11)	Log-on accepted with preferred service provider	Normal log-on, proceed as per clause A.2
0001 0010 (0x12)	Log-on accepted with non-preferred service provider	
1000 nnnn	Log-on fail invalid parameter	
1000 1111 (0x8F)	Log on fail due to invalid parameter in log-on request of undefined type	Mark Family SL link as temporarily unavailable and proceed as per clause A.2
1001 nnnn	Log-on fail service provider unavailable	
1001 0001 (0x91)	Log-on failed: no service provider available to this aircraft	Mark Family SL link as temporarily unavailable and proceed as per clause A.2
1001 0010 (0x92)	Log-on failed: no service provider available to any aircraft	Mark Family SL link as temporarily unavailable and proceed as per clause A.2
1010 nnnn	Log-on fail gateway failure - reserved	
1011 nnnn	Log-on failed AES not authorized	
1011 0001 (0xB1)	Log on failed: AES 24 bit ICAO address not present in AGGW authorization table. This code is also used if neither the 24 bit ICAO address nor IMSI is in the authorization table	Mark Family SL link as permanently unavailable and proceed as per clause A.2
1011 0010 (0xB2)	Log on failed: AES IMSI not present in AGGW authorization table	Mark Family SL link as permanently unavailable and proceed as per clause A.2
1011 0011 (0xB3)	Log-on failed: AES deactivated	Mark Family SL link as permanently unavailable and proceed as per clause A.2
1011 0100 (0xB4)	Log-on failed: RADIUS authentication failure	Mark Family SL link as permanently unavailable and proceed as per clause A.2
1111 nnnn	Undefined log-on fail	
1111 1111 (0xFF)	Log-on fail for undefined reason	Mark Family SL link as temporarily unavailable and proceed as per clause A.2

5.3.3.4 Message *ac_logoff_rq* (*ac_logoff_rq_n*): Log off request

5.3.3.4.0 General

This message is sent by the AAGW. The *ac_logoff_rq_n* message has the same contents as defined below with the exclusion of the *location* field. The message is used to end a session with the AGGW. The message structure is defined in Figure 5.25 and the message contents are specified in Table 5.12.

(MSB) Bit No (LSB) 8 7 6 5 4 3 2 1	
message-type 0x02 ac_logoff_rq 0x82 ac_logoff_rq_n	Octet 1
transaction-id	Octet 2 Octet 3
icao-address	Octet 4 Octet 5 Octet 6
cause-code	Octet 7
blocks-received	Octet 8 Octet 9
blocks-delivered	Octet 10 Octet 11
blocks-delivered-retries	Octet 12 Octet 13
retries	Octet 14 Octet 15
blocks-failed	Octet 16 Octet 17
delayed-acks	Octet 18 Octet 19
spot-beam-id	Octet 20
location	Octet 21 Octet 32

Figure 5.25: *ac_logoff_rq* Message Structure

Table 5.12: ac_logoff_rq Parameter Descriptions

Parameter	Description	Length (octets)
message-type	AIGI message identifier as defined in Table 5.3.	1
transaction-id	A transaction ID number as detailed in clause 5.3.3.2.1.	2
icao-address	ICAO address of the aircraft.	3
cause-code	Reason for terminating the connection as defined in Table 5.13.	1
blocks-received	Number of ACARS blocks successfully received during a session excluding duplicates. (0xFFFF is reserved for >=0xFFFF blocks sent, i.e. counter does not wrap).	2
blocks-delivered	Number of ACARS blocks delivered OK from the CMU to the AGGW with or without retries during session. (0xFFFF is reserved for >=0xFFFF blocks sent, i.e. counter does not wrap).	2
blocks-delivered-retries	Number of ACARS blocks delivered OK from the CMU to the AGGW with one or more retries during a session. (0xFFFF is reserved for >=0xFFFF blocks sent, i.e. counter does not wrap).	2
retries	Number of retries for delivered ACARS blocks during a session (including second and subsequent retries) (0xFFFF is reserved for >=0xFFFF blocks sent, i.e. counter does not wrap).	2
blocks-failed	Number of ACARS blocks from CMU that failed (still no acknowledgement after retry) i.e. Blocks failed pertains to an ACARS message transaction, excluding retries (0xFFFF is reserved for >=0xFFFF blocks sent, i.e. counter does not wrap).	2
delayed-acks	Number of ACARS blocks sent where the AGGW ACARS Ack (gw_acars_ack) for the initial transaction was received before the last retry times out but was outside the acknowledged message timeout (ac_t2) for the initial transmission.	2
spot-beam-id	Spot Beam Identifier The spot beam that is currently being transmitted in.	1
location	The aircraft location speed and heading information as defined in clause 5.3.3.2.2.	12

5.3.3.4.1 Cause Code

The parameter *cause-code* provides a reason as to why the Aeronautical Safety AES has logged off of the AGGW. The defined logoff cause codes are provided in Table 5.13.

Table 5.13: *cause-code* Parameter Definition

Cause code	Meaning
0000 nnnn	Reserved as used by alternative satellite link on terrestrial ACARS interface
0001 nnnn	Normal session termination
0001 0001 (0x11)	Session terminated by pilot
0010 nnnn	Session terminated by aircraft moving outside coverage region
0010 0001 (0x21)	Session terminated due to pending satellite change. (e.g. aircraft in overlap region)
0010 0010 (0x22)	Session terminated due to aircraft leaving area of Family SL coverage
0010 0011 (0x23)	Reserved for use on terrestrial interface to indicate an implicit session termination due to log-on to another satellite region
0011 nnnn	Session terminated by due to failed / failing link
0011 0001 (0x31)	Session terminated due to time-out loss of ground to air connection (no activity on forward link)
0011 0010 (0x32)	Session terminated due to CMU indication of NOCOMM
0100 nnnn	Session terminated by AES
0100 0001 ~ 0100 1110	Manufacturer defined AES cause codes
1000 1111 (0x8F)	Session terminated due to undefined AES fault

5.3.3.5 Message *gw_logoff_ack*: Log-off acknowledgement

This message is sent by the AGGW. The message is used to acknowledge that a log-off request message has been received. The message structure is defined in Figure 5.26 and the message contents are specified in Table 5.14.

(MSB) 8 · 7 · 6 · 5 · Bit No 4 · 3 · 2 · 1 (LSB)	
message-type 0x42 gw_logoff_ack	Octet 1
transaction-id	Octet 2
	Octet 3
icao-address	Octet 4
	Octet 5
	Octet 6

Figure 5.26: *gw_logoff_ack* Message Structure

Table 5.14: *gw_logoff_ack* Parameter Descriptions

Parameter	Description	Length (octets)
message-type	AIGI message identifier as defined in Table 5.3	1
transaction-id	A transaction ID number as detailed in clause 5.3.3.2.1. Populated from equivalent field in ac_logoff_req or ac_logoff_req_n	2
icao-address	ICAO address of the aircraft	3

5.3.3.6 Message *gw_logoff_notify*: log off notification

5.3.3.6.0 General

This message is sent by the AGGW to terminate a connection with the AAGW. The message structure is defined in Figure 5.27 and the message contents are specified in Table 5.15.

(MSB) 8 · 7 · 6 · 5 · Bit No 4 · 3 · 2 · 1 (LSB)	
message-type 0x43 gw_logoff_notify	Octet 1
transaction-id	Octet 2
	Octet 3
icao-address	Octet 4
	Octet 5
	Octet 6
reason	Octet 7
ac_t3	Octet 8
	Octet 9

Figure 5.27: *gw_logoff_notify* Message Structure

Table 5.15: *gw_logoff_notify* Parameter Descriptions

<table>
<tr><th>Parameter</th><th>Description</th><th>Length (octets)</th></tr>
<tr><td>message-type</td><td>AIGI message identifier as defined in Table 5.3.</td><td>1</td></tr>
<tr><td>transaction-id</td><td>A transaction ID number as detailed in clause 5.3.3.2.1.
(Note: no response is expected to this originating message).</td><td>2</td></tr>
<tr><td>icao-address</td><td>ICAO address of the aircraft.</td><td>3</td></tr>
<tr><td>reason</td><td>Reason for log-off notification. Reason codes are defined in Table 5.16.</td><td>1</td></tr>
<tr><td>ac_t3</td><td>Range for randomized (RAND) re-connection timer.
AES shall wait RAND(ac_t3) seconds before attempting re-connection.
<table>
<tr><td>0x0000</td><td>AES may attempt immediate log-on</td></tr>
<tr><td>0xFFFE</td><td>AES shall not attempt to log-on again to Aeronautical Safety Service for duration of current flight.</td></tr>
<tr><td>0XFFFF</td><td>AES to use current setting</td></tr>
</table>
Used to mitigate "log-on storm" effect.
The ac_t3 setting in gw_logoff_notify is a temporary setting and does not override the configured value permanently.</td><td>2</td></tr>
</table>

5.3.3.6.1 Reason

The parameter *reason* provides the Aeronautical Safety AES with some information regarding why the AGGW issued the log-off notification. The AAGW behaviour will follow the AIGI protocol as defined in the use case in clause A.14. The setting of configuration item ac_r5 (see clause 5.3.3.11) will ensure that in cases where the AES needs to retry a logon (e.g. for a primary CSP failure), the AES will attempt to logon again ensuring that if a backup CSP is provisioned, it can regain Aeronautical Safety ACARS service.

The defined logon response codes are provided in Table 5.16.

Table 5.16: *reason* Cause Codes

Reason Code	Meaning	AES Behaviour
1001 nnnn	Session terminated due to service provider failure	
1001 0001 (0x91)	Session terminated due to failed connection to service provider	Attempt to log back into the AGGW as per use case A.14
1010 nnnn	Session terminated by AGGW operator	
1010 0001 (0xA1)	Session terminated by AGGW operator	Attempt to log back into the AGGW as per use case A.14
1010 0010 (0xA2)	Session terminated by AGGW operator performing a site switch	Attempt to log back into the AGGW as per use case A.14
1011 nnnn	Session terminated due to gateway failure - reserved	
1100 nnnn	Session terminated due to fault in AES behaviour - reserved	
1101 nnnn	Session terminated due to signalling issues	
1101 0010 (0xD1)	Session terminated due to return link inactivity	Attempt to log back into the AGGW as per use case A.14
1111 nnnn	Undefined session termination	
1111 1110 (0xFE)	Session terminated for undefined reason	Attempt to log back into the AGGW as per use case A.14
1111 1111 (0xFF)	Reserved as used by alternative satellite link on terrestrial ACARS interface	

5.3.3.7 Message *ac_acars_msg* (*ac_acars_msg_n*): Single block ACARS message

This message is sent by the AAGW. The *ac_acars_msg_n* message has the same contents as defined below with the exclusion of the *location* field. The message is used to by the AAGW to send a single block ACARS message to the ground. The message structure is defined in Figure 5.28 and the message contents are specified in Table 5.17.

(MSB) Bit No (LSB) 8 7 6 5 4 3 2 1	
message-type 0x04 ac_acars_msg 0x84 ac_acars_msg_n	Octet 1
transaction-id	Octet 2
	Octet 3
icao-address	Octet 4
	Octet 5
	Octet 6
length	Octet 7
	Octet 8
spot-beam-id	Octet 9
location	Octet 10
	Octet 21
timestamp	Octet 22
	Octet 23
message-sequence	Octet 24
	Octet 25
	Octet 26
	Octet 27
retry-indicator	Octet 28
acars-message	Octet 29
	Octet (length)

Figure 5.28: *ac_acars_msg* message structure

Table 5.17: *ac_acars_msg* Parameter Descriptions

Parameter	Description	Length (octets)
message-type	AIGI message identifier as defined in Table 5.3.	1
transaction-id	A transaction ID number as detailed in clause 5.3.3.2.1.	2
icao-address	ICAO address of the aircraft.	3
length	Length of message in bytes. The UDP header already provides for an overall length field. This length field is to be included in contents of variable length messages and contains the length of the AIGI message only.	2
spot-beam-id	Spot Beam Identifier The satellite spot beam that is currently being transmitted in.	1
location	The aircraft location speed and heading information as defined in clause 5.3.3.2.2.	12
timestamp	Timestamp (see clause A.5.1). Time of arrival from CMU, number of tenths of seconds since 'top of the hour' in UTC (unsigned d_word) for example 17:12:27.2 ⇔ 0x1D30.	2
message-sequence	A message sequence number is to be included in the contents of message types where delivery status is to be tracked (AIGI messages containing an ACARS message). It starts at 0 after log-on and increments by 1 for each message and it wraps around. It is formed of the session identifier (2 bytes, see clause 5.3.3.3) and a sequence number (2 bytes).	4
retry-indicator	Indicates number of retries of this message (0 to 255) 0 - first attempt 1 - first retry 2 - second retry Etc.	1
acars-message	ACARS message.	238 max

5.3.3.8 Message *gw_acars_ack*: Acknowledgement of ACARS message receipt

This message is sent by the AGGW. It is used to confirm delivery of the message. The AAGW will re-send the message (once) if this message is not received. The re-transmission timeout of the CMU (180 s) is too long to ensure delivery within the latency bounds of RCP240. The message structure is defined in Figure 5.29 and the message contents are specified in Table 5.18.

(MSB) 8 · 7 · 6 · 5 · Bit No 4 · 3 · 2 · 1 (LSB)	
message-type 0x44 gw_acars_ack	Octet 1
transaction-id	Octet 2 Octet 3
icao-address	Octet 4 Octet 5 Octet 6
message-sequence	Octet 7 Octet 8 Octet 9 Octet 10

Figure 5.29: *gw_acars_ack* Message Structure

Table 5.18: *gw_acars_ack* Parameter Descriptions

Parameter	Description	Length (octets)
message-type	AIGI message identifier as defined in Table 5.3.	1
transaction-id	A transaction ID number as detailed in clause 5.3.3.2.1. Populated from originating message ac_acars_msg or ac_acars_msg_n.	2
icao-address	ICAO address of the aircraft.	3
message-sequence	Message sequence number. Formed of the session identifier (2 bytes, see clause 5.3.3.3) and a sequence number (2 bytes). This is the message sequence number of the message being acknowledged.	4

5.3.3.9 Message gw_acars_msg: Single block ACARS message

This message is sent by the AGGW. The message is used to by the ground (ACARS) gateway to send a single block ACARS message to the aircraft. The message structure is defined in Figure 5.30 and the message contents are specified in Table 5.19.

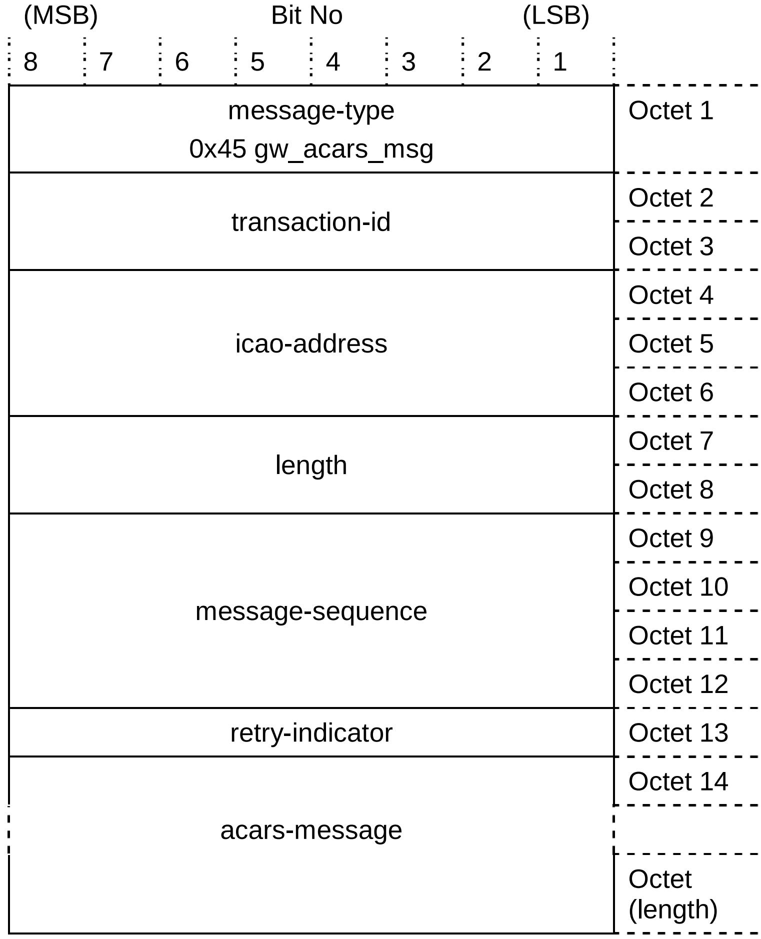


Figure 5.30: *gw_acars_msg* Message Structure

Table 5.19: gw_acars_msg parameter descriptions

Parameter	Description	Length (octets)
message-type	AIGI message identifier as defined in Table 5.3.	1
transaction-id	A transaction ID number as detailed in clause 5.3.3.2.1.	2
icao-address	ICAO address of the aircraft.	3
length	Length of message in bytes.	2
message-sequence	Message sequence number. Formed of the session identifier (2 bytes, see clause 5.3.3.3) and a sequence number (2 bytes).	4
retry-indicator	Indicates number of retries of this message (0 to 255) 0 - first attempt 1 - first retry 2 - second retry, etc.	1
acars-message	ACARS message.	238 (max)

5.3.3.10 Message *ac_acars_ack* (*ac_acars_ack_n*): Acknowledgement of ACARS message receipt

This message is sent by the AAGW. The *ac_acars_ack_n* message has the same contents as defined below with the exclusion of the location field. The message is used by the AGGW to monitor the latency and reliability of forward ACARS messages. It is also used to confirm delivery of the message. The AAGW will re-send the message ac_r3 times if this message is not received. The message structure is defined in Figure 5.31 and the message contents are specified in Table 5.20.

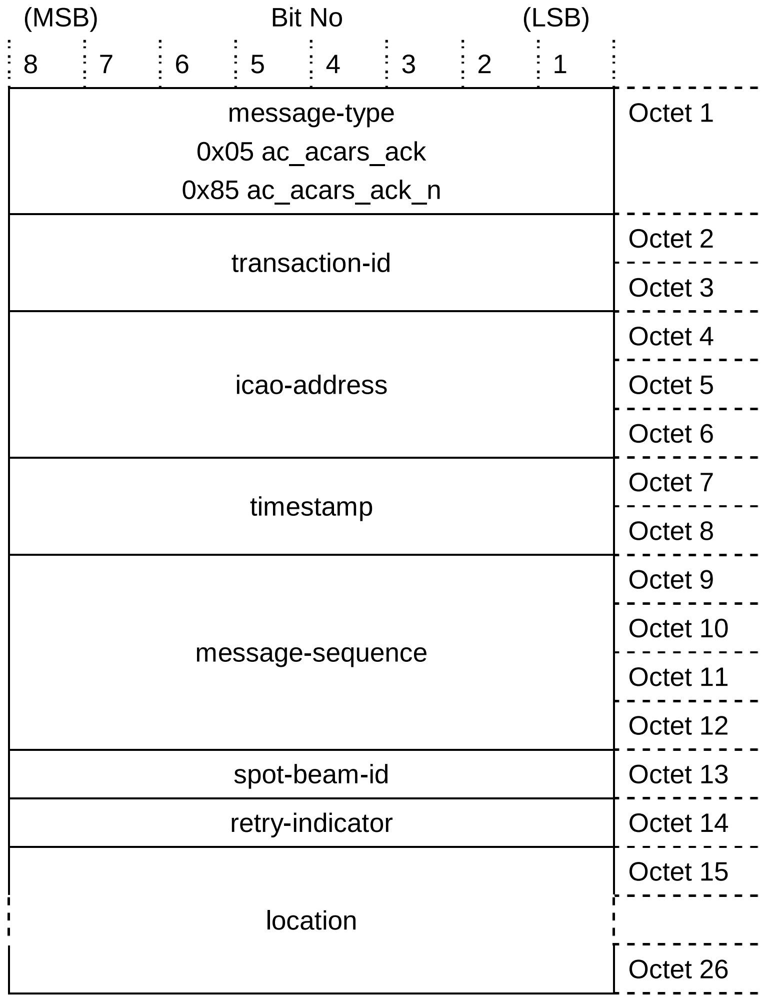


Figure 5.31: *ac_acars_ack* Message Structure

Table 5.20: *ac_acars_ack* parameter descriptions

Field name	Description	Length (bytes)
message-type	AIGI message identifier as defined in Table 5.3.	1
transaction-id	A transaction ID number as detailed in clause 5.3.3.2.1. Populated from originating message gw_acars_msg.	2
icao-address	ICAO address of the aircraft.	3
timestamp	Timestamp (see clause A.5.1). Time of delivery of message to CMU, number of tenths of seconds since 'top of the hour' in UTC.	2
message-sequence	Message sequence number. Formed of the session identifier (2 bytes, see clause 5.3.3.3) and a sequence number (2 bytes). This is the message sequence number of the message being acknowledged.	4
spot-beam-id	Spot Beam Identifier The spot beam that is currently being transmitted in.	1
retry-indicator	Indicates which retry this acknowledgement is associated with (0 to 255) 0 - first attempt 1 - first retry 2 - second retry, etc.	1
location	The aircraft location speed and heading information as defined in clause 5.3.3.2.2.	12

5.3.3.11 Message *gw_conf*: Update of AAGW configurable parameters

5.3.3.11.0 General

This message is sent by the AGGW. The message is used to configure the AAGW, and is sent after an AES has logged on. The AAGW does not store this data over an Aeronautical Safety AES power cycle. The message structure is defined in Figure 5.32 and the message contents are specified in Table 5.21.

(MSB) 8 7 6 5 Bit No 4 3 2 1 (LSB)	
message-type 0x46 gw_conf	Octet 1
transaction-id	Octet 2 Octet 3
icao-address	Octet 4 Octet 5 Octet 6
ac_t1	Octet 7 Octet 8
ac_t2	Octet 9 Octet 10
ac_t3	Octet 11 Octet 12
ac_t4	Octet 13
ac_r1	Octet 14
ac_r2	Octet 15
ac_r3	Octet 16
ac_r4	Octet 17
ac_r5	Octet 18
ac_f1	Octet 19

Figure 5.32: *gw_conf* Message Structure

Table 5.21: *gw_conf* parameter descriptions

Parameter	Description	Length (octets)	Default	Min	Max
message-type	AIGI message identifier as defined in Table 5.3.	1	NA	NA	NA
transaction-id	A transaction ID number as detailed in clause 5.3.3.2.1.	2	Next transaction ID	NA	NA
icao-address	ICAO address of the aircraft.	3	ICAO address of the aircraft	NA	NA
ac_t1	Timeout period in seconds on forward message reception. After receiving any message in the forward direction, the AAGW starts a timer. When the timer exceeds ac_t1 (the activity timeout period) the AAGW sends a "keep-alive" and waits for an acknowledgement to allow the timer to be re-set. Reserved values 0x0000: Disable use of link connection polling 0xFFFF: Use current default value.	2	300 seconds (0x012C)	0	65 535

Parameter	Description	Length (octets)	Default	Min	Max
ac_t2	Timeout period for acknowledged messages. After sending an acknowledged message the AAGW starts a timer. When the timer exceeds ac_t2 the AAGW assumes that the message has been lost. Reserved values 0xFFFF = Use current default value.	2	30 seconds (0x001E)	1	65 535
ac_t3	Range for randomized re-connection timer. Used to mitigate "log-on storm" effect. AAGW shall wait RAND(ac_t3) seconds before attempting connection to alternative satellite service following disconnection from Aeronautical Safety service. AAGW shall wait RAND(ac_t3) seconds between connection attempts to Aeronautical Safety services. This does not apply to the first attempt to connect to the Aeronautical Safety service, or the first attempt to re-establish connection following a link failure. Reserved values 0x0000: Set to zero to allow AES to attempt immediate log-on. 0xFFFE: AES shall not attempt to log-on again to Aeronautical Safety Service for duration of current flight. Note the AES is allowed to logon to an alternative satellite link. 0xFFFF: Use current AES value.	2	60 seconds (0x003C)	0	65 535
ac_t4	Non-preferred service dwell timer. The time in seconds that the aircraft shall use non-preferred service before attempting to switch back to use the preferred service. Does not include transitions based on coverage. Transition to preferred service may be deferred if it is known not to be available (cabin Family SL out of service) Reserved values 0x0000: Do not attempt connection to higher preference service based on timer 0xFFFF: Use current AES timeout value.	2	1 200 seconds (0x0480)	0	65 535
ac_r1	Number of times the AAGW should re-try sending a "keep-alive" without acknowledgement before deciding that the link to the gateway has failed. Reserved value 0xFF: use AES default setting.	1	1	0	255
ac_r2	Maximum number of times the AAGW should send a log-out message, including retries, if an acknowledgement is not received. Reserved value 0xFF: use AES default setting (see note 1)	1	2	0	255
ac_r3	Number of times the AAGW should re-try sending air to ground messages.	1	1	0	255
ac_r4	Number of times the AAGW should re-try creating a PDP context.	1	1 (i.e. 2 attempts in total)	0	255
ac_r5	Number of times the AAGW should re-try logging in to the AGGW service	1	1 (i.e. 2 attempts in total)	0	255
ac_f1	0xFF = disable keep-alives if in VHF coverage 0x00 = activate keep-alives if in VHF coverage (see note 2)	1	0xFF	0	255
NOTE 1: the AAGW should not re-send a log-out message if the connection has failed due to no forward traffic available. NOTE 2: ac_t1 takes precedence. I.e. keep-alives are not sent at all if ac_t1 is set to 0x0000.					

5.3.3.11.1 AGGW Configuration Items

The configuration items in Table 5.22 are used by the AGGW and are provided here for completeness in defining the AIGI protocol.

Table 5.22: AGGW Configuration Items

Configuration Item	Description	Default	Min	Max
gw_t1	Timeout period in seconds on return link message reception. After receiving any message in the return direction, the AGGW starts a timer. When the timer exceeds gw_t1 (the activity timeout period) the AGGW sends a "keep-alive" and waits for an acknowledgement to allow the timer to be re-set. If no acknowledgement is received, the AGGW proceeds to logout the AAGW. Reserved values 0x0000: Disable use of link connection polling 0xFFFF: Use current default value.	3 600 seconds (0x0E10)	0	65 535
gw_t2	Timeout period for acknowledged messages. After sending an acknowledged message the AGGW starts a timer. When the timer exceeds ac_t2 the AGGW assumes that the message has been lost. Reserved value 0xFFFF: Use current default value.	30 seconds (0x001E)	1	65 535
gw_t3	Period between AIGI test messages. After sending an AIGI test message the AGGW starts a timer. When the timer expires the AGGW sends another AIGI test message.	30 seconds	1	255
gw_r1	Number of times the AGGW should re-try sending a "keep-alive" without acknowledgement before deciding that the link to the AES has failed. Reserved value 0xFF: use AES default setting.	1	0	255
gw_r2	Number of times the AGGW should re-try sending ground to air messages.	1	0	255

5.3.3.12 Message *ac_conf_ack* (*ac_conf_ack_n*): Configuration update acknowledgement

This message is sent by the AAGW. The *ac_conf_ack_n* message has the same contents as defined below with the exclusion of the location field. The message is used to confirm receipt of a configuration message from the AGGW. The message structure is defined in Figure 5.33 and the message contents are specified in Table 5.23.

(MSB) Bit No (LSB)

8 7 6 5 4 3 2 1	
message-type 0x06 ac_conf_ack 0x86 ac_conf_ack_n	Octet 1
transaction-id	Octet 2 Octet 3
icao-address	Octet 4 Octet 5 Octet 6
spot-beam-id	
location	Octet 12 Octet 13 Octet 14

Figure 5.33: *ac_conf_ack* Message Structure

Table 5.23: *ac_conf_ack* Parameter Descriptions

Parameter	Description	Length (octets)
message-type	AIGI message identifier as defined in Table 5.3.	1
transaction-id	A transaction ID number as detailed in clause 5.3.3.2.1. Populated from originating message gw_conf.	2
icao-address	ICAO address of the aircraft.	3
spot-beam-id	Spot Beam Identifier The spot beam that is currently being transmitted in.	1
location	The aircraft location speed and heading information as defined in clause 5.3.3.2.2.	12

5.3.3.13 Message *ac_keepalive* (*ac_keepalive_n*): keep-alive

This message is sent by the AAGW. The *ac_keepalive_n* message has the same contents as defined below with the exclusion of the location field. The message is used as a keep-alive to test that the link between the AAGW and the AGGW is operational. The message structure is defined in Figure 5.34 and the message contents are specified in Table 5.24.

(MSB) 8 7 6 5 Bit No 4 3 2 1 (LSB)	
message-type 0x07 ac_keepalive 0x87 ac_keepalive_n	Octet 1
transaction-id	Octet 2 Octet 3
icao-address	Octet 4 Octet 5 Octet 6
spot-beam-id	
location	Octet 12 Octet 13 Octet 14

Figure 5.34: *ac_keepalive* Message Structure

Table 5.24: *ac_keepalive* parameter descriptions

Parameter	Description	Length (octets)
message-type	AIGI message identifier as defined in Table 5.3.	1
transaction-id	A transaction ID number as detailed in clause 5.3.3.2.1.	2
icao-address	ICAO address of the aircraft.	3
spot-beam-id	Spot Beam Identifier The spot beam that is currently being transmitted in.	1
location	The aircraft location speed and heading information as defined in clause 5.3.3.2.2.	12

5.3.3.14 Message gw_keepalive_ack: keep-alive acknowledgement

This message is sent by the AGGW. The message is used by the aircraft gateway to confirm that the link to the AGGW is operational. The message structure is defined in Figure 5.35 and the message contents are specified in Table 5.25.

(MSB) 8 7 6 5 Bit No 4 3 2 1 (LSB)	
message-type 0x47 gw_keepalive_ack	Octet 1
transaction-id	Octet 2 Octet 3
icao-address	Octet 4 Octet 5 Octet 6

Figure 5.35: *gw_keepalive_ack* Message Structure

Table 5.25: *gw_keepalive_ack* Parameter Descriptions

Parameter	Description	Length (octets)
message-type	AIGI message identifier as defined in Table 5.3.	1
transaction-id	A transaction ID number as detailed in clause 5.3.3.2.1. Populated from originating message ac_keepalive.	2
icao-address	ICAO address of the aircraft.	3

5.3.3.15 Message *gw_keepalive*: keep-alive

This message is sent by the AGGW. The message is used by the ground gateway to test that the link to the AAGW is operational. The message structure is defined in Figure 5.36 and the message contents are specified in Table 5.26.

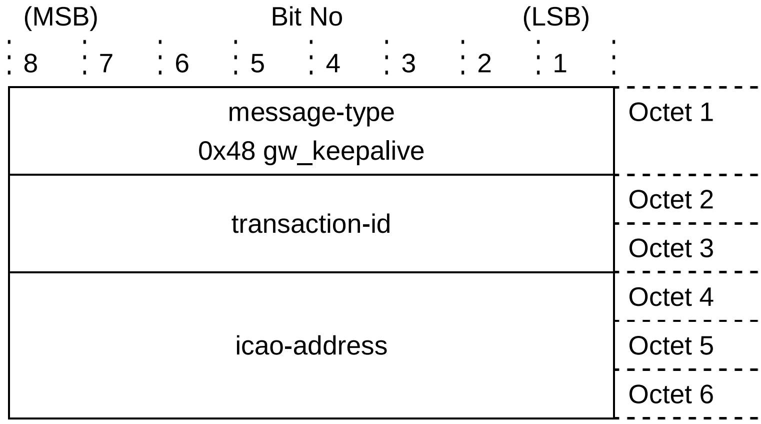


Figure 5.36: *gw_keepalive* Message Structure

Table 5.26: *gw_keepalive* Parameter Descriptions

Parameter	Description	Length (octets)
message-type	AIGI message identifier as defined in Table 5.3.	1
transaction-id	A transaction ID number as detailed in clause 5.3.3.2.1.	2
icao-address	ICAO address of the aircraft.	3

5.3.3.16 Message *ac_keepalive_ack* (*ac_keepalive_ack_n*): keep-alive acknowledgement

This message is sent by the AAGW. The *ac_keepalive_ack_n* message has the same contents as defined below with the exclusion of the *location* field. The message is used to confirm the link between gateways is operational. The message structure is defined in Figure 5.37 and the message contents are specified in Table 5.27.

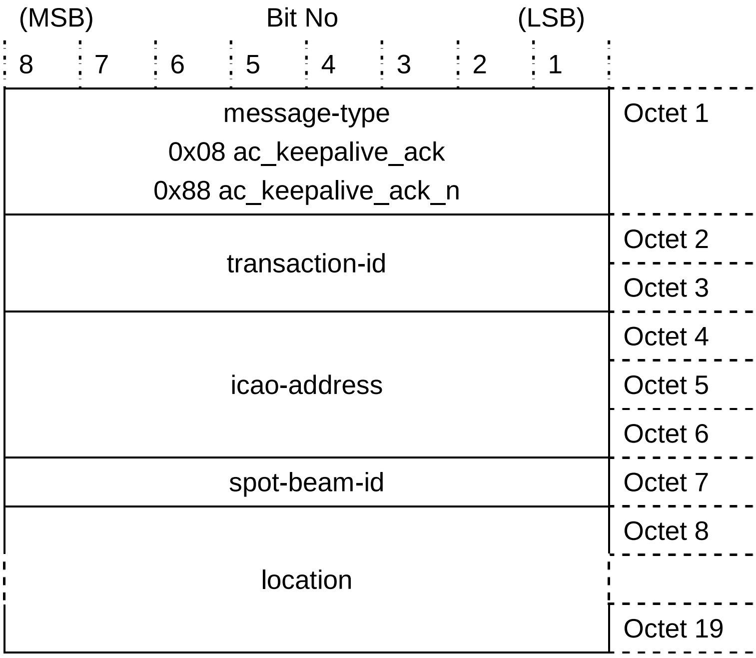


Figure 5.37: *ac_keepalive_ack* Message Structure

Table 5.27: *ac_keepalive_ack* Parameter Descriptions

Parameter	Description	Length (octets)
message-type	AIGI message identifier as defined in Table 5.3.	1
transaction-id	A transaction ID number as detailed in clause 5.3.3.2.1. Populated from originating message gw_keepalive.	2
icao-address	ICAO address of the aircraft.	3
spot-beam-id	Spot Beam Identifier The spot beam that is currently being transmitted in.	1
location	The aircraft location speed and heading information as defined in clause 5.3.3.2.2.	12

5.3.3.17 Message *gw_csp_ping*: ping

This message is sent by the AGGW. The message is used by the ground gateway to test that the link to the AAGW is operational. The sending of this message is triggered by the CSP. The message structure is defined in Figure 5.38 and the message contents are specified in Table 5.28.

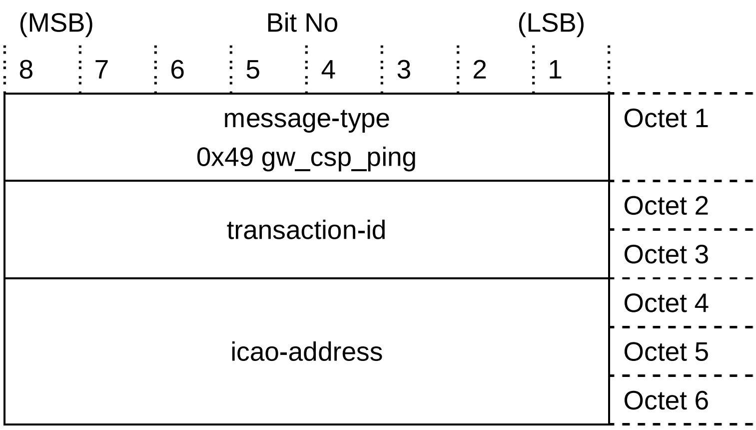


Figure 5.38: *gw_csp_ping* Message Structure

Table 5.28: *gw_csp_ping* Parameter Descriptions

Parameter	Description	Length (octets)
message-type	AIGI message identifier as defined in Table 5.3.	1
transaction-id	A transaction ID number as detailed in clause 5.3.3.2.1.	2
icao-address	ICAO address of the aircraft.	3

5.3.3.18 Message ac_csp_ping_ack (ac_csp_ping_ack_n): ping acknowledgement

This message is sent by the AAGW. The *ac_csp_ping_ack_n* message has the same contents as defined below with the exclusion of the *location* field. The message is used to confirm the link between gateways is operational. The response of this message is forwarded to the CSP. The message structure is defined in Figure 5.39 and the message contents are specified in Table 5.29.

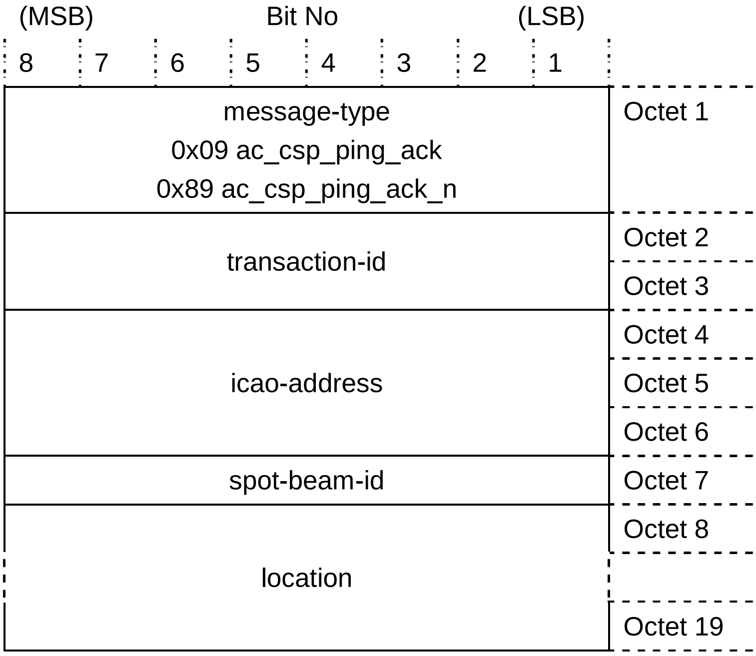


Figure 5.39: *ac_csp_ping_ack* Message Structure

Table 5.29: *ac_csp_ping_ack* Parameter Descriptions

Parameter	Description	Length (octets)
message-type	AIGI message identifier as defined in Table 5.3.	1
transaction-id	A transaction ID number as detailed in clause 5.3.3.2.1. Populated from originating message gw_csp_ping.	2
icao-address	ICAO address of the aircraft.	3
spot-beam-id	Spot Beam Identifier The spot beam that is currently being transmitted in.	1
location	The aircraft location speed and heading information as defined in clause 5.3.3.2.2.	12

5.3.3.19 Message gw_test_msg: AIGI Traffic Test

This message is sent by the AGGW. The message is used to confirm the link between gateways is operational and to put a traffic load on the AIGI protocol. The message structure is defined in Figure 5.40 and the message contents are specified in Table 5.30.

(MSB) 8	7	6	5 Bit No 4	3	2	(LSB) 1	
message-type 0x4A gw_test_msg							Octet 1
transaction-id							Octet 2
							Octet 3
icao-address							Octet 4
							Octet 5
							Octet 6
test-message-sequence-number							Octet 7
							Octet 8
							Octet 9
							Octet 10

Figure 5.40: *gw_test_msg* Message Structure

Table 5.30: *gw_test_msg* Parameter Descriptions

Parameter	**Description**	**Length (octets)**
message-type	AIGI message identifier as defined in Table 5.3.	1
transaction-id	A transaction ID number as detailed in clause 5.3.3.2.1.	2
icao-address	ICAO address of the aircraft.	3
test-message-sequence-number	Test Message sequence number (separate from ACARS sequence number). Formed of session identifier (2 bytes) and sequence number (2 bytes).	4

5.3.3.20 Message *ac_test_ack* (*ac_test_ack_n*): AIGI Traffic Test Acknowledgement

This message is sent by the AAGW. The *ac_test_ack_n* message has the same contents as defined below with the exclusion of the location field. The message is used to acknowledge the AIGI test message sent by the AGGW. The message is used to confirm the link between gateways is operational and to put a traffic load on the AIGI protocol. The message structure is defined in Figure 5.41 and the message contents are specified in Table 5.31.

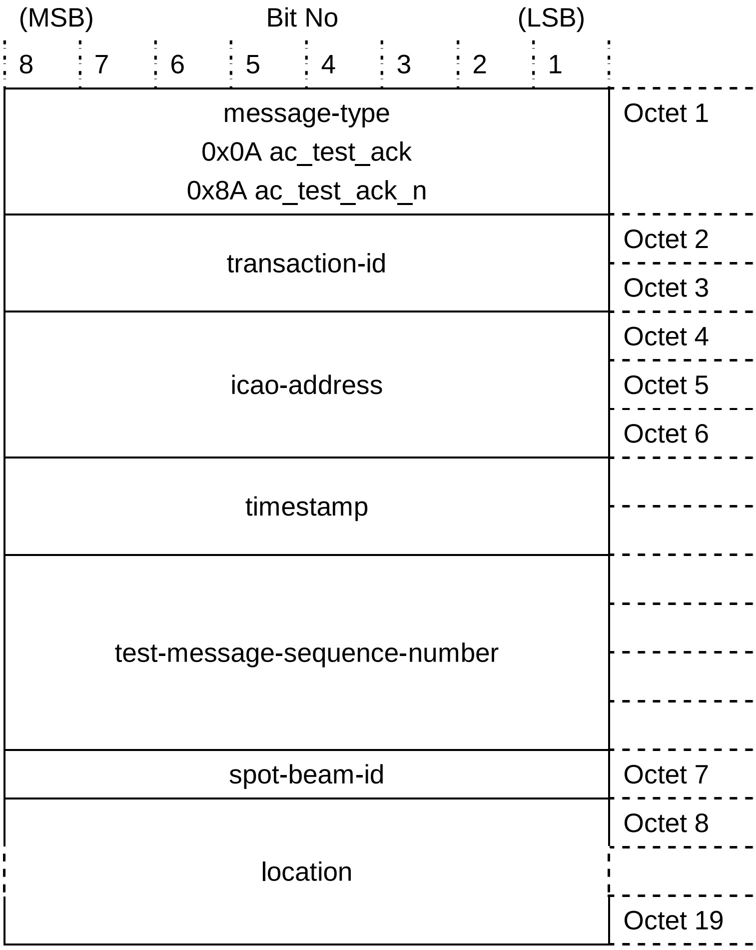


Figure 5.41: *ac_test_ack* Message Structure

Table 5.31: *ac_test_ack* Parameter Descriptions

Parameter	Description	Length (octet)
message-type	AIGI message identifier as defined in Table 5.3.	1
transaction-id	A transaction ID number as detailed in clause 5.3.3.2.1. Populated from originating message gw_test_msg.	2
icao-address	ICAO address of the aircraft.	3
timestamp	Timestamp (see clause A.5.1). Time of receipt of message at AAGW, number of tenths of seconds since 'top of the hour' in UTC.	2
test-message-sequence-number	Test Message sequence number (separate from ACARS sequence number). This is the Test Message Sequence number received in the corresponding gw_test_msg.	4
spot-beam-id	Spot Beam Identifier The spot beam that is currently being transmitted in.	1
location	The aircraft location speed and heading information as defined in clause 5.3.3.2.2.	12

5.3.3.21 Message *ac_msg_nak* (*ac_msg_nak_n*): Invalid AGGW message

This message is sent by the AAGW. The *ac_msg_nak_n* message has the same contents as defined below with the exclusion of the location field. The message is used to indicate that an originating message received from the AGGW was invalid. This message will only be sent by the AAGW in place of an expected message pair response, as shown in Table 5.3 under the Response column. The AAGW shall not send this message to the AGGW when a response is not expected. The message structure is defined in Figure 5.42 and the message contents are specified in Table 5.32.

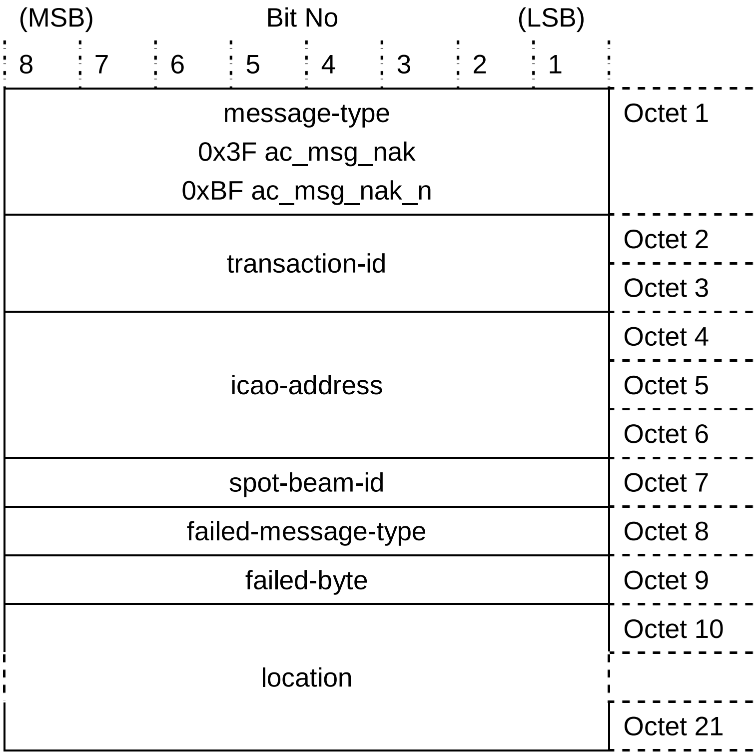


Figure 5.42: *ac_msg_nak* Message Structure

Table 5.32: *ac_msg_nak* Parameter Descriptions

Parameter	Description	Length (octets)
message-type	AIGI message identifier as defined in Table 5.3.	1
transaction-id	A transaction ID number as detailed in clause 5.3.3.2.1. Populated from originating AGGW message.	2
icao-address	ICAO address of the aircraft.	3
spot-beam-id	Spot Beam Identifier The spot beam that is currently being transmitted in.	1
failed-message-type	The content of the message type field of the invalid message.	1
failed-byte	The first byte that caused the received message to be deemed invalid (excluding the IPv4 and UDP header). Byte numbering starts from 1.	1
Location	The aircraft location speed and heading information as defined in clause 5.3.3.2.2.	12

5.3.3.22 Message gw_msg_nak

This message is sent by the AGGW in response to any message received from an AAGW, within an ocean region that the AGGW is serving, that is not contained in the AGGW's AES Logon table. The message structure is defined in Figure 5.43 and the message contents are specified in Table 5.33.

(MSB) 8	7	6	5	Bit No 4	3	2	(LSB) 1	
message-type 0x7F gw_msg_nak								Octet 1
transaction-id								Octet 2
								Octet 3
icao-address								Octet 4
								Octet 5
								Octet 6
aggw-id								Octet 7

Figure 5.43: *gw_msg_nak* Message Structure

Table 5.33: *gw_msg_nak* Parameter Descriptions

Parameter	Description	Length (octet)
message-type	AIGI message identifier as defined in Table 5.3.	1
transaction-id	A transaction ID number as detailed in clause 5.3.3.2.1. Populated from originating AAGW message.	2
icao-address	ICAO address of the aircraft.	3
aggw-id	Identifies the specific AGGW server. Integer with range 1 to 255.	1

5.4 Provisions for ACARS Authentication

The AES shall be upgradeable to add in the future a security mechanism for the ACARS messages such that authentication of the ACARS messages in both directions is achieved. The AES shall have appropriate hardware provisions such that an upgrade would be limited to adding an additional Universal Integrated Circuit Card (UICC) to the SDU Configuration Module (SCM) in order to store keys and a security application, and a software change to the AES. Hence the AES shall have a spare UICC slot and the ability for the AAGW to communicate with it. The security mechanism (if required) is not known at this time but possible mechanisms are IPSEC or the addition of a security checksum in the inter ACARS gateway messages. It is expected that such a security mechanism would only be introduced if certification authorities of the ground network required it.

5.5 Prioritized Access to the Family SL Network

The Aeronautical Safety AES shall have prioritized access to the Family SL network in the event of a Family SL SAS switch. (A Family SL SAS switch may occur due to planned maintenance activities or in the event of a failure in the ground network).

In the event of a Family SL SAS switch, all user terminals will attempt to register with the network in a short period of time, potentially creating a log-on storm which may delay access to the network until the majority of terminals have registered successfully.

To mitigate against such delays in providing service to Aeronautical Safety terminals, the AES shall use a special form of Access Control (see ETSI TS 102 744-1-2 [6], clause 7.3.1.3) for the Aeronautical Safety AES to obtain prioritized access to the Family SL network.

By default the Aeronautical Safety AES is a member of an Access Class group of between 0 and 9 as stored on the USIM of the UE. In addition to this default group, the Aeronautical Safety AES shall also be a member of the 'special' Access Class group 14.

Therefore the Aeronautical Safety AES shall include all Access Class groups that it is a member of when determining whether it is permitted to access the RNC according to the requirements in ETSI TS 102 744-1-2 [6], clause 7.3.1.3.

The membership of Access Class 14 shall not be stored in the USIM at this time and will not be configurable via ORT or System Strap, instead it should form part of the software image that makes up the Aeronautical Safety AES and be controlled via a software key or license. Note that other non Aeronautical Safety UE's operating in parallel with the Aeronautical Safety AES shall not have access to the special Access Class group 14.

6 Prioritized IP Data Service

The Aeronautical Safety Service shall support a prioritized cockpit IP service. This will provide the ability to request and deliver higher priority IP data on the air interface between the RAN and the AES. This shall be supported via both background and streaming class PDP context(s) and will be governed by the use of a specific APN.

The characteristic and requirements of the IP data service architecture is the same as normal IP except that it is augmented with priority on the air interface.

The prioritized IP data service, although provisioned with higher priority than 'normal' users, shall have a lower priority than the ACARS data service to ensure delivery of ACARS data.

In addition the following controls are needed to ensure that only bona fide users can access priority capability.

- In an AES certain physical pins on the ARINC 600 connector are allocated to priority service. The priority field referred above will only be passed on to the air interface if it is received on a priority interface (i.e. 'cockpit Ethernet port').
- Priority IP data service will only be allowed with SIMs provisioned for that level of priority.

7 Aeronautical Safety Voice service

7.0 General

This clause provides a description of operation for voice services over Family SL in support of Aeronautical Safety Services.

7.1 Key Features

The key features of the Aeronautical Safety AES Voice Service are listed below and elaborated further in the following clauses:

1) All ground-to-air cockpit calls are delivered to the Aeronautical Safety AES using a single number for the aircraft that is based on the ICAO 24 bit address.
2) Air-to-ground calls are delivered into the PSTN.
3) The first cockpit call (either air-to-ground or ground-to-air) always uses the CS domain on both mobile originated and mobile terminated calls.
4) The second cockpit call uses VoIP via the PS domain if the CS domain is busy.
5) The AES supports the Call Waiting supplementary service.
6) VoIP servers are required in the AES and Family SL ground infrastructure.
7) VoIP is delivered on the air interface by RTP on a streaming PDP context (with priority).
8) VoIP is controlled on the air interface by SIP on a background PDP context (with priority).
9) Priority of calls is signalled via MLPP/eMLPP on the CS domain and via the SIP header field Resource-Priority in the PS domain. Additionally, the priority digit is pre-fixed to the Calling Party Number in ground-to-air calls.
10) MLPP/eMLPP is used on the air interface for CS domain 'network priority' processing. Allocation Retention Priority (ARP) is used on the air interface for PS domain 'network priority' processing.

11) AES determines pre-emption of existing calls to that AES for air-to-ground and ground-to-air calls.

12) Presentation of inbound Caller Line Identity to the cockpit is supported and is configurable at the AES. The AES supports the CLIP supplementary service.

13) The AES can restrict (or allow) the presentation of Caller Line Identity of outbound calls and is configurable at the AES. The AES supports the CLIR supplementary service.

14) Dual AES is supported.

7.2 Second Voice Channel

The Family SL network is a 3GPP system which means the MSC can only provide one voice call per device. The second channel of voice is provided via the PS infrastructure using Voice over IP (VoIP). This solution utilizes the existing system infrastructure, whereby additional voice calls are forwarded to a VoIP subsystem for transport via the PS domain when the CS domain is 'busy'.

7.3 Priority and Pre-emption

Four levels of priority are required in the AES for both ground-to-air and air-to-ground calls for the voice service, and this priority is presented to the cockpit for display to the pilot. Furthermore, should an incoming voice call be at a higher level of priority, and both circuits between the AES and the cockpit audio switch are occupied, then the AES shall trigger the automatic release of an existing lower priority voice call to facilitate the presentation of the incoming higher priority voice call to the cockpit audio switch. Further requirements on the AES priority and pre-emption mechanism can be found in clause 7.4.4.3. In the event of network congestion, the network shall trigger pre-emption of any lower priority call to facilitate the presentation of the higher priority voice call.

7.4 Aeronautical Safety AES Voice Requirements

7.4.0 General

To provide the two channels of voice capability, with priority and pre-emption, the AES shall implement session management and control functionality between the CS and PS domains. For the VoIP domain, the AES shall also implement a User Agent in the VoIP Service Domain which is essentially providing a Private Branch Exchange (PBX) in the AES. This combined functionality is referred to as an "AES PBX" throughout the rest of this clause. The AES PBX shall be implemented internal to the aeronautical safety terminal.

The rest of this clause specifies the mandatory requirements for the AES providing this AES PBX capability.

7.4.1 Parameters

The parameters in Table 7.1 are required for accessing and tailoring voice services by the AES PBX and are referenced throughout the rest of this clause. An indication on whether these parameters should be configurable by external means (i.e. ORT) is also given.

Table 7.1: AES Voice service parameters

Parameter	Description	Configurable Externally	Default Value
[*apn_name*]	Access Point Name (APN) string for VoIP Service	Yes	Configurable by network
[*sip_domain_name*]	SIP Domain Name string	Yes	Configurable by network
[*clip_inbound*]	Caller Line Identity Presentation for Inbound Calls	Yes	Disabled
[*clir_outbound*]	Caller Line Identity Restriction for Outbound Calls	Yes	Enabled
[*icao_address*]	24-bit ICAO Address of the Aircraft in octal	No	
[*port_no*]	UDP port Number	No	Configurable by network
[*AEROSAFETYimsi*]	The SIP URI (IMSI prefixed with "AEROSAFETY")	No	
[*pdigit*]	The priority of the SIP Call as per the Calling Party Number Priority digit p1 in Table 7.2	No	
[*priority*]	The priority of the SIP Call as per the Resource-Priority field in Table 7.2	No	

The [*apn_name*] and [*sip_domain_name*] parameters shall contain a default value as advised by the network operator.

7.4.2 Number of Concurrent Calls

The AES PBX shall support a minimum of two concurrent voice calls (one call placed via the CS domain and an additional call placed through the PS domain).

7.4.3 Support for Short Code Dialling

The AES PBX shall support Short Code Dialling in both service domains.

7.4.4 Call Routing, Voice Priority and Pre-emption

7.4.4.0 General

When a call is placed from a cockpit interface connected to the AES PBX, then the AES PBX shall first check whether the CS Domain can be used to place the call. Only if the CS Domain is not available shall the call be placed via the PS Domain over VoIP.

Ground-to-air (mobile terminated) calls shall initially be presented on the CS domain. If the CS domain is free, then the call shall be accepted, if the CS domain is not free, the call is still presented using the Call Waiting supplementary service, then the AES PBX shall make a decision as whether to pre-empt existing calls, or forward onto the PS domain as defined in clause 7.4.4.3.

In order to present calls on the PS domain, the AES PBX shall reject the incoming CS call with a reason code of 'Busy'. The network, on receipt of a Call Reject with a reason code of 'Busy', will proceed to forward the call onto the VoIP domain using the Call Forward on Busy supplementary service. The call will then be presented on the VoIP domain and shall be handled as defined in clause 7.4.4.3.

The AES PBX, by way of an ORT item, shall provide the means to prevent ground to-air public calls (APC) calls (see Table 7.2) being routed to the cockpit. This advice is being made due to concerns about safety and access to the flight deck.

7.4.4.1 AES CS Protocol Requirements for eMLPP

On successful CS attachment, the Aeronautical Safety AES shall proceed to invoke the "Register eMLPP" procedure towards the MSC as specified in ETSI TS 123 067 [7]. If the Aeronautical Safety AES is unable to complete this process, a suitable fault should be raised. Failure to successfully register the eMLPP capability should not inhibit the Aeronautical Safety AES from attempting to establish calls, or receive incoming calls.

The Aeronautical Safety AES shall also interrogate the network to determine the status of the Call Waiting Supplementary Service as specified in ETSI TS 124 083 [8] and proceed as follows:

1) If the Aeronautical Safety AES discovers that the Call Waiting supplementary service is not provisioned then a suitable fault should be raised.

2) If the Call Waiting Supplementary Service is provisioned but is not enabled, the Aeronautical Safety AES shall attempt to activate it automatically. If the Aeronautical Safety AES fails in the activation attempt, a suitable fault should be raised.

7.4.4.2 Priority Signalling

In order for the Aeronautical Safety AES to make decisions regarding pre-emption of in-progress calls, it needs to know the priority of those in-progress calls as well as those calls attempting to be established.

In the CS domain, signalling of priority is achieved by using the native 3G CS priority mechanism of Multi-Level Precedence and Pre-emption (MLPP) in the ground to air direction, and the use of enhanced Multi-Level Precedence and Pre-emption (eMLPP) in the air-to-ground direction. The MLPP/eMLPP value is mapped into the CS call setup CC:Setup message in the Priority Level field. The AES PBX is responsible for mapping the eMLPP call priority to the relevant priority value as defined in Table 7.2 for air-to-ground calls.

In the PS Domain, signalling of priority is achieved by using the SIP header field *Resource-Priority* as defined in RFC 4412 [9] in both the ground-to-air and air-to-ground directions. The *Resource-Priority r-value* to be used is the namespace q.735 with associated priority values. The *Resource-Priority* field is populated into the SIP:Invite message. The AES PBX is responsible for mapping the call priority to the relevant *Resource-Priority* value as defined in Table 7.2.

For the PS domain, there is a second approach for indicating priority and this is to prefix the priority digit of the call to the Calling Party Number within the call signalling in line with the p1 digit as detailed in Table 7.2.

For ground-to-air calls, the soft-switch has the responsibility of extracting the priority digit p1 (as per Table 7.2) from the Called Party Number presented by the CSP 2-part diallers and prefixing the Calling Party Number field with this priority digit. The AES PBX then has the responsibility of extracting this priority digit from the Calling Party Number for use in pre-emption decisions.

For air-to-ground calls, the AES PBX is responsible for prefixing the Calling Party Number with the relevant priority digit as per p1 of Table 7.2. (The priority digit within the Calling Party Number is not used for network resource pre-emption.)

For priority signalling on the PS domain, the AES PBX shall use the SIP header field *Resource-Priority* as the primary priority signalling indication. Only if this field is not present within the SIP header shall the AES PBX use the first digit of the calling party number as the priority indication.

The Aeronautical Safety AES shall present the priority of a call to the cockpit via the appropriate external interface (e.g. MCDU, RMP).

Table 7.2: Priority Levels

Priority Level as per ICAO SVGM Table 2-1 Priority Levels for SATVOICE calls [10]	MLPP ISUP code for ground-to-air	eMLPP code for air-to-ground	Calling Party Number Priority digit p1	Call Priority Octet ETSI TS 124 008 [17], clause 10.5.1.11			Resource-Priority (RFC 4412 [9]) r-value: q735
				Bits			
				3	2	1	
1 / EMG Emergency (highest) Safety of Flight Typical Use: Distress/Urgency call	0	0	4	1	0	1	0
2 / HGH Operational High (second highest) Safety of Flight Typical Use: Air Traffic Service (ATS)	1	1	2	1	0	0	1
3 / LOW Operational Low (third highest) Safety of Flight Typical Use: Airline Operational Control (AOC) or Airline Administrative Control (AAC)	2	2	1	0	1	1	2
4 / PUB Nonoperational (lowest) Nonsafety Typical Use: Airline Passenger Communications (APC)	3	3	0 or 3	0	1	0	3

7.4.4.3 AES Priority and Pre-emption

The AES has the responsibility of making pre-emption decisions for both incoming ground-to-air and outgoing air-to-ground calls. For air-to-ground calls, the AES knows the priority of any in-progress calls and the call being initiated and so can make these decisions locally. For ground-to-air calls, the AES shall extract the priority information of the incoming call before making a decision on whether to pre-empt an existing call or reject the incoming call.

Incoming CS calls for the cockpit shall contain a MLPP priority value information element within the Priority Level field of the of the call setup CC:Setup message. The AES PBX shall extract this MLPP value and shall make routing and pre-emption decisions as specified in Figure 7.1. Incoming CS calls that do not contain an eMLPP priority value information element shall be treated the same as APC (Public) calls.

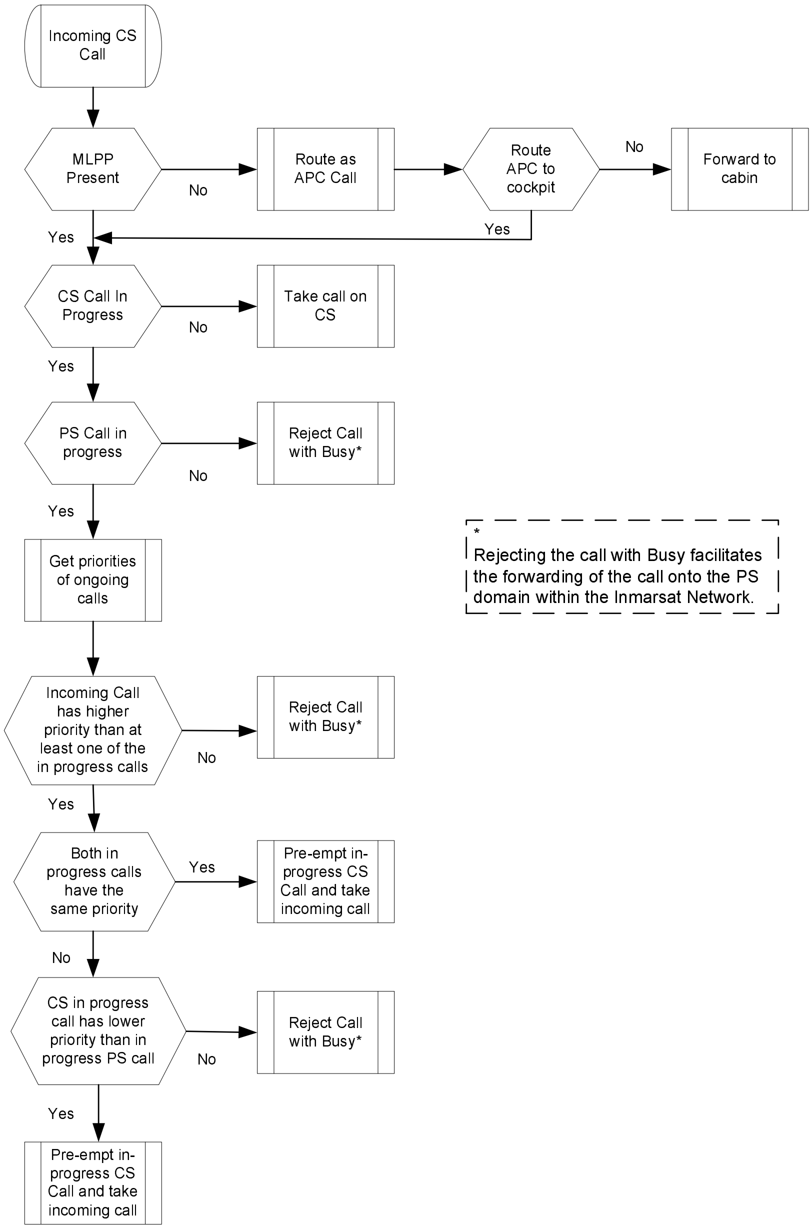


Figure 7.1: Incoming CS Call Decision Logic

Incoming PS calls for the cockpit will contain a Resource-Priority value within the header of the SIP:Invite message of the call setup. The AES shall extract this Resource-Priority value and shall make routing and pre-emption decisions as specified in Figure 7.2. For incoming PS calls that do not contain a Resource-Priority indication the AES PBX shall utilize the first digit of the calling party number field as the priority indication. If this is also missing, then the call shall be treated the same as APC (Public) calls.

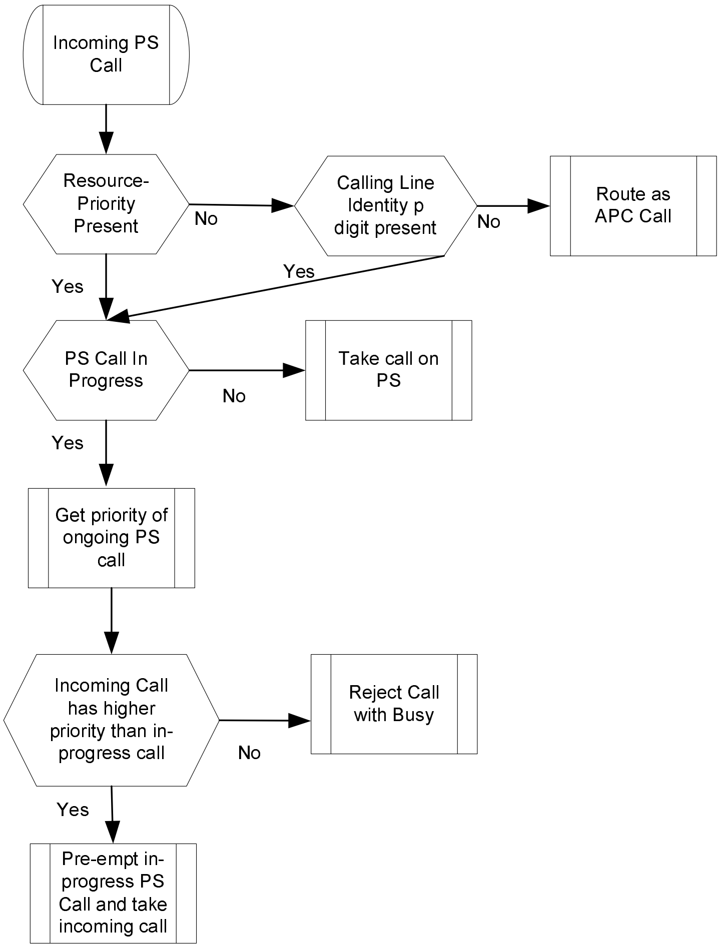


Figure 7.2: Incoming PS Call Decision Logic

7.4.5 VoIP Context Management Requirements

7.4.5.1 Primary PDP Context Establishment

On start-up, the AES PBX shall check that the Aeronautical Safety AES has attached to the PS Domain and if so, proceed to activate a Primary Background PDP Context towards the APN [apn_name] dedicated to the provision of IP transport to the VoIP Service Domain.

On successful activation of the PDP Context, the AES PBX shall retain the IP address assigned to this PDP context [contact_ip] for use in SIP signalling.

7.4.5.2 Secondary PDP Context Definition

A secondary Streaming PDP Context linked to the Primary Background PDP context referred to in clause 7.4.5.1 shall be defined but only activated when a call is being placed via the VoIP service domain. The Traffic Flow Template (TFT) for the secondary Streaming PDP context shall be defined such that only the RTP voice stream is carried on the secondary Streaming PDP context.

The TFT (and equivalent Uplink TFT) may use UDP Port Number ranges or DiffServ Code Point (DSCP) values in the filter definition.

When using UDP Port Number ranges, then it is recommended to use the destination port number range in the (downlink) TFT filter definition which covers the port number range that will be used by the AES PBX for RTP streams. Likewise in the uplink TFT filter definition, a source port number range should be defined with the same values.

Using DSCP values in the TFT filters requires the AES PBX to use a distinctive DSCP value for IP packets carrying RTP streams. The Media Gateway in the Network is configured to use a DSCP value of 46 (101 110) for RTP packets. The AES PBX may chose its own value for RTP packets, however, it is strongly recommended to use the same value of 46.

If RTCP packets are sent from an AES PBX, then the TFT filters shall be configured such that the RTCP packets are carried over the primary (background) PDP Context in order to optimize streaming bandwidth usage.

7.4.5.3 Secondary PDP Context Activation and Deactivation

The AES PBX shall keep track of the status of VoIP calls being set up and cleared:

When the first call is set up in the VoIP Service Domain, the AES PBX shall activate the Secondary PDP Context with a requested Guaranteed Bitrate as specified in clause 7.4.7.2 prior to sending a SIP Invite to the SIP server.

Whenever a call is cleared in the VoIP domain, the AES PBX shall request the Deactivation of the secondary PDP Context.

If a Secondary PDP Context Activation triggered by a ground-to-air (mobile terminated) SIP:INVITE fails, then the AES PBX shall clear the call that is being set up by sending a SIP:CANCEL message to the SIP server.

If a Secondary PDP Context Activation triggered by an air-to-ground (Mobile Originated) call setup, fails, then the AES PBX shall abandon the call setup and signal the call setup failure to the originating interface (e.g. call failure tone).

7.4.6 SIP Protocol Requirements

7.4.6.0 General

The AES PBX shall implement a SIP User Agent as specified in SIP version 2.0 RFC 3261 [11]. UDP transport shall be used for all SIP signalling. The AES PBX shall send all SIP signalling to the SIP server using UDP destination port 5060 but may select a different UDP port to receive SIP messages. If using a port number other than 5060, the AES PBX shall indicate its SIP port in the parameter [port_no] as specified below, otherwise the use of this parameter is optional.

The AES PBX shall support the SIP Resource-Priority header field for priority signalling as specified in RFC 4412 [9], utilizing the Q.735 namespace and associated priority values, see Table 7.2.

7.4.6.1 SIP Registration

After successful activation of the primary PDP Context, the AES PBX shall send a SIP:REGISTER message to the SIP Server at the IP address resolved from the [sip_domain_name] string.

The SIP REGISTER message shall comply with the requirements in RFC 3261 [11] clause 10.

7.4.6.2 SIP Call Setup (originating from Aero PBX)

To originate a SIP call, the Aero PBX shall send a SIP INVITE message, which shall conform to the requirements in RFC 3261 [11] clause 10.

No SDP Offer is required in the SIP:INVITE for air-to-ground initiated calls. The AES PBX shall always adhere to the SDP Answer returned by the SIP Server; in particular the ptime parameter (see clause 7.4.7.2) shall be applied to the outbound RTP stream.

The AES PBX shall provide Call Progress Tones towards the cockpit interface and convert any incoming SIP error messages to appropriate call failure tones.

7.4.6.3 SIP Call Setup (terminating on Aero PBX)

Incoming SIP INVITEs will carry the ICAO based primary MS-ISDN of the AES PBX as the called number in the SIP:To header, the call priority in the SIP:Resource-Priority header, in the format:

Field Name	Field Value
From:	<sip:[priority][calling_number]@[sip_domain_name]>
To:	<sip:[called_number]@[sip_domain_name]>
Resource-Priority:	q735.[priority]

The SIP:From header contains the calling party number prefixed with the priority digit of the call.

The [called_number] is presented in National Number Format, and the last 8 digits represent the ICAO address of the aircraft in octal format.

Incoming SIP:INVITEs will always carry an SDP offer. The AES PBX shall accept the first codec in the list as well as the ptime parameter specified (see clause 7.4.7.2). The AES PBX is not required to provide audible ringback tones towards the caller.

7.4.6.4 SIP Call Maintenance

The network may send SIP reINVITE messages at regular intervals on every SIP call to check that the AES PBX is still contactable and to check that the call is active. The network fails the call if the Aero PBX SIP User Agent does not reply or replies negatively. The AES PBX shall respond positively to the re-INVITE if and only if there is already an active call matching the Call-ID reference that is specified in the re-INVITE.

7.4.6.5 SIP Options

The AES PBX shall respond to SIP OPTIONS polling from the network.

7.4.7 Media Handling Requirements

7.4.7.1 Codec

The Aeronautical Safety AES shall support satellite optimized low data rate codecs for CS and PS calls.

7.4.7.2 PS Codec Frame Packetisation

The Aero PBX shall support sending multiple codec frames in a single RTP packet as determined from the Session Description Protocol (SDP) ptime attribute sent by the network to the Aero PBX in the SIP:INVITE, SIP:183 Session Progress and SIP:200 OK messages. The following ptime values shall be supported: 20, 40, and 80 ms. If no ptime attribute is present in the SDP then the Aero PBX shall use a ptime value of 20 ms.

The Aero PBX shall determine the required Guaranteed Uplink and Downlink Bitrates for the secondary Streaming PDP Context from the ptime attribute as follows:

for ptime = 20 ms: 26 kbps

for ptime = 40 ms: 18 kbps

for ptime = 80 ms: 12 kbps

For ground-to-air (mobile terminated) PS calls, the Aero PBX shall obtain the requested ptime value from the incoming SIP INVITE message to select the appropriate Bitrate for the subsequent Secondary PDP Context Activation or Modification.

For air-to-ground (mobile originated) calls, the Aero PBX shall assume that the last ptime value provided by the SIP server will also apply to the call which is in the process of being set up, to select the appropriate Bitrate for the Secondary PDP Context Activation.

The Aero PBX shall store the last ptime received from the SIP server in non-volatile memory such that the value is retained during a reset/reboot or power cycling of the Aeronautical Safety terminal.

7.4.8 Supplementary Services Requirements

7.4.8.1 CS Domain Supplementary Services Requirements

The Call Forward on Busy (CFB) and Call Waiting (CW) Supplementary Services settings for TS11 (speech) calls configured in the network shall not be modified by the AES PBX as this may cause the Aeronautical Safety Voice service to malfunction.

7.4.8.2 Calling Line Identification Presentation on Inbound Calls

For ground-to-air (mobile terminated) calls delivered over the CS domain, the Calling Number is carried in the CS Call Setup message (within the Calling Party BCD number field). For ground-to-air (mobile terminated) calls delivered via SIP the calling party number is included in the SIP:From header in the format:

<sip:[priority][calling_number]@[sip_domain_name]>

The priority digit p1 (see Table 7.2) is prefixed to the calling number to aid in signalling the priority of the call as detailed in clause 7.4.4.2. The AES PBX shall parse the calling number by removing the priority digit.

The Calling number on Inbound Calls is normally presented in International Format with a leading "+" or "00". If the caller has withheld their number or if the number is not available for other reasons, then the calling number parameter will contain the word "anonymous". The AES PBX should present the Calling Line ID to the cockpit if the [clip_inbound] configurable parameter allows this.

7.4.8.3 Calling Line Identification Restriction on Outbound Calls

7.4.8.3.1 CS Domain

For air-to-ground (mobile originated) calls the restriction in presentation of the Calling Number will be enforced by the network by default. If the Calling Line Identity is to be presented to the remote party, i.e. [clir_outbound] is disabled, then the AES PBX shall send a CLIR suppression information element as detailed in [12]. The AES PBX does not populate the Calling Line Identity within the call signalling messages, this is performed by the MSC.

7.4.8.3.2 PS Domain

For air-to-ground (mobile originated) calls the restriction in presentation of the Calling Number is controlled via the SIP header field Privacy as defined in RFC 3323 [13].

If [clir_outbound] is enabled (default), then the AES PBX shall request the restriction in the Calling Line Identity within the SIP:Privacy header as:

Field Name	Field Value
From:	<sip:[icao_number]@[sip_domain_name]>
To:	<sip:[called_number]@[sip_domain_name]>
Resource-Priority:	q735.[priority
Privacy:	User

If [clir_outbound] is disabled, then the AES PBX shall place no restriction in presenting the Calling Line Identity within the SIP:Privacy header as:

Field Name	Field Value
From:	<sip[icao_number]@[sip_domain_name]>
To:	<sip:[called_number]@[sip_domain_name]>
Resource-Priority:	q735.[priority]
Privacy:	none

The priority digit p1 (see Table 7.2) is prefixed to the calling number to aid in signalling the priority of the call.

7.5 Cabin/Public Calls

An Aeronautical Safety AES as described in the present document, may also optionally provide a non-cockpit based multi-voice service for cabin requirements. This would involve supporting a separate SIP User Agent following the requirements in ETSI TS 102 744-4-1 [14] with the exception that all cabin voice lines are provided through the VoIP domain, i.e. the CS domain is reserved for cockpit Aeronautical Safety services.

Annex A (normative): ACARS Data Service Behavioural Requirements

This annex describes the behaviour of the ACARS data service using use cases.

The use cases defined within this annex prescribe the mandatory requirements for the Aeronautical Safety AES and AAGW providing the Aeronautical Safety ACARS data service capability. The exception to this is the satellite handover behaviour of the Aeronautical Safety AES, described in Use Case 7 (see clause A.7) and Use Case 8 (see clause A.8), which recommended, but not mandated, and for which the operation is left to the terminal manufacturer's discretion.

The use cases cover normal operation, operation in presence of a failing Family SL link, operation when the ground link between an AGGW and a CSP has failed, plus a few miscellaneous cases.

The following use cases occur during normal operation:

No.	Use Case Title
1	AAGW establishes best available link with ground
2	AAGW Logs in to Family SL ACARS service
3	AAGW Logs out of Family SL ACARS service
4	Ground to Air Keep-alive
5	Air to ground ACARS message
6	Ground to air ACARS message
7	Satellite hand-over
8	Out of coverage (no Family SL available)
23	Ground to Air Configuration Message
26	AAGW Receives Uplink while Awaiting Response to a Downlink

The following use cases may be trigged by a failure in the link between the AAGW and AGGW:

#	Use Case Title
9	AGGW logs out aircraft due to return link inactivity
10	AAGW detects unexpected PDP context disconnect
11	AAGW detects loss of synchronisation to Family SL forward bearer
12	AAGW detects forward link inactivity

The following use cases may be trigged by a failure in the link between the AGGW and CSP:

#	Use Case Title
13	CMU asserts ACARS NOCOMM
14	AGGW detects failure of CSP link

Miscellaneous use cases:

#	Use Case Title
15	AGGW receives message from aircraft in logged off state
16	AGGW receives log-on request message from aircraft in logged on state
17	Transition to higher preference service after timeout
18	Transition to higher preference service after entering coverage region
19	AAGW receives AGGW message from unexpected IP address
20	AAGW receives AGGW invalid message
21	CSP Ground to Air Ping
22	AIGI Test Message
24	AGGW receives message from aircraft when not serving an ocean region
25	AGGW receives invalid message from AAGW

A.1 AAGW establishes best available link with ground

1 Title		AAGW establishes best available link with ground
Goal in context	To search for satellite service of highest preference capable of hosting safety service.	
Preconditions	No link to ground is in place. A list of previously failed links is available. A list of possible links is available. The AAGW is indicating NOCOMM to the CMU.	
Success end condition	The AES has either camped on to an Family SL forward bearer and established a background context or obtained frame lock with an appropriate forward link channel of an alternative satellite network and validated the system table.	
Failed End condition	No link with the ground is established.	
Primary Actors	AAGW Aeronautical Safety AES, AES channel of alternative satellite network, AES antenna control function.	
Trigger	From initialisation, or following detection of failed link.	
Description	**Step**	**Action**
	1	AAGW sorts list of available satellite links in order of user preference.
	2	AAGW removes from list satellite links that have failed. The AAGW should maintain link status in a link preference table. Links that have failed should be marked as failed & time of failure time stamped. Link failures should be classed as temporarily failed, or permanently failed. For temporary link failures, the AAGW shall not attempt to re-connect to that link until either the minimum dwell time ac_t4 (see clause 5.3.3.11) has been exceeded or all other links have been attempted. For permanent link failures, the AAGW shall not attempt to re-connect to that link until the AES has been power cycled (assuming external remedial action is required to access those links).
	3	AAGW removes from list satellite links that are out of coverage. Out of coverage means outside achieved coverage volume of AES antenna. AAGW may use any valid coverage data available at the AES. AAGW sorts links of equal preference in order of elevation (higher elevation satellites are preferred).
	4	AAGW attempts to acquire the link of highest preference on the list. The AES antenna is pointed towards the satellite supporting the link, and the AES acquires the applicable forward bearer.
	5	The AES achieves forward link synchronisation. For Family SL the AES should be camped on and the minimum C/No threshold satisfied. For alternative satellite links, synchronisation on the appropriate forward channel should be achieved.
	6	For Family SL links, proceed to register and attach to the Family SL network. For alternative satellite links, proceed to log-on.
Establish connection to AGGW	7	Create a background PDP context of type {PDP context type}.
	8	AAGW sends DNS lookup request to DNS server to locate AGGW service IP address.
	9	DNS Server receiv.es lookup request and responds with the IP address of the AGGW service.
	10	Proceed to use case [AAGW Logs in to Family SL ACARS service].
Extensions	**Step**	**Branching action**
	5a.1	The AES does not achieve synchronisation on the forward link.
	5a.2	The AAGW marks the link as failed.
	5a.3	If other links are available to try, resume from (4).
	5a.4	If no other links are available, reset the list to include the links previously marked as failed or out of coverage, and resume from (1).
	6a.1	Unable to register, and or attach. Mark link as failed and continue from (1).
	7a.1	Unable to create PDP context. Reattempt ac_r4 times and if it fails again mark link as failed and continue from (1).
	9a.1	DNS lookup times out after ac_t2 seconds. AAGW re-tries sending DNS lookup ac_r3 times before continuing to (9a.2).
	9a.2	DNS lookup fails more than ac_r3 times. If Secondary DNS server available, use this and proceed from (8). If unavailable or Secondary DNS Server has already been attempted, proceed from (9a.3).
	9a.3	Unable to locate AGGW. Mark link as failed and continue from (1).
	9b.1	An invalid DNS Response is received (e.g. unresolved address). AAGW discards the message, resume from (9a.1).

A.2 AAGW Logs in to Family SL ACARS service

2	Title	AAGW Logs in to Family SL ACARS service
Goal in context		Log in to Family SL ACARS service to determine if service is available to aircraft and to enable ground to air communications. The configuration of the AAGW is updated by the AGGW. The log-in also forms an association between the aircraft ID and the IP address allocated to the aircraft for the duration of this connection.
Preconditions		AES is camped on to Family SL and has a background PDP context established and NOCOMM is indicated to CMU.
Success end condition		Aircraft is logged on to Family SL ACARS service and NOCOMM condition is cleared.
Failed End condition		Aircraft fails to log in to Family SL ACARS service and starts use case [AAGW establishes best available link with ground].
Primary Actors		AAGW AGGW CSP
Trigger		Link to ground using Family SL has been established and background PDP Context established following search for available links.

Description	**Step**	**Action**
	1	If timer ac_t3 is not running, the AAGW sends a log in request message (ac_logon_rq, see clause 5.3.3.2) to AGGW.
	2	AGGW receives log in request message
	3	AGGW looks up aircraft ID in database, if this AES ID is already logged on with a different IMSI, it will log out the previously logged in AES/IMSI. AGGW selects preferred CSP for the AES ID.
	4	AGGW sends log in response (gw_logon_rp, see clause 5.3.3.3) to aircraft indicating successful log in.
	5	AAGW receives log in response. AAGW removes NOCOMM indication to CMU by clearing the SATCOM Not Logged-On field (bit 17) of the SDU to ACARS MU/CMU Status Word Label 270 as defined in ARINC Characteristic 741, Part 2 [3]. The AAGW shall populate the field GES ID of the SDU to ACARS MU/CMU Join/Leave Message (bits 9-16) as defined in ARINC Characteristic 741, Part 2 [3] with the GES ID received in the logon response message.
	6	AGGW sends log in notification to CSP.
	7	Proceed to use case [Ground to Air Configuration Message].
Extensions	**Step**	**Branching action**
	1a.1	Timer ac_t3 is running, wait for timer to expire then proceed to (1).
	2a.1	AGGW does not receive log in request. Proceed to (5a.1).
	3a.1	AGGW unable to locate aircraft in database. AGGW sends response to log on indicating that service provider is unavailable for this aircraft. Proceed from (4a.2).
	3b.1	Preferred CSP is not available. AGGW selects back-up CSP for aircraft (if in authorization table). Resume from (3).
	4a.1	AGGW sends log in response to aircraft indicating unsuccessful log in.
	4a.2	If the logon response code does not indicate a permanent failure (see reason code in clause 5.3.3.3.1) then start timer ac_t3 (see clause 5.3.3.11). AAGW re-tries sending the logon request ac_r5 (see clause 5.3.3.11) times, resuming from (1). If the logon response code indicates a permanent failure then start timer ac_t3, mark link as permanently failed and start use case [AAGW establishes best available link with ground].
	4a.3	No log-on response from AGGW after ac_r5 attempts. Start timer ac_t3. Mark link as failed and start use case [AAGW establishes best available link with ground].
	5a.1	AAGW does not receive log-on response after ac_t2 timeout. Start timer ac_t3. AAGW re-tries sending the logon request ac_r5 times, resuming from (1).
	5a.2	No log-on response from AGGW after ac_r5 attempts. Start timer ac_t3. Mark link as failed and start use case [AAGW establishes best available link with ground].

A.3 AAGW Logs out of Family SL ACARS service

3	Title	AAGW logs out of Family SL ACARS service	
Goal in context		Graceful termination of service.	
Preconditions		Aircraft is logged in to Family SL ACARS service.	
Success end condition		Aircraft logged out of Family SL ACARS service.	
Failed End condition		Aircraft terminates Family SL ACARS service without completing log-off transaction.	
Primary Actors		AAGW AGGW	
Trigger		May be triggered by control from aircrew. Experience from existing service shows that this transaction is often not performed.	
Description		**Step**	**Action**
Start of log-off		1	AAGW indicates communication status as NOCOMM towards the CMU.
		2	AAGW sends log-off message (ac_logoff_rq see clause 5.3.3.4) indicating that session is terminating without error.
		3	AGGW receives log-off request.
		4	AGGW sends log-off notification to the CSP.
		5	AGGW sends log-off acknowledgement (gw_logoff_ack see clause 5.3.3.5) to AAGW.
		6	AAGW receives log-off acknowledgement.
		7	AAGW terminates Family SL connection (closes PDP context).
Extensions		**Step**	**Branching action**
		3a.1	AGGW does not receive log-off request. Continue from (6a.1).
		6a.1	AAGW does not receive log-off acknowledgement. AAGW re-tries sending log-off request ac_r2-1 (see clause 5.3.3.11) times, resuming from (2).
		6a.2	Log-off re-try is not acknowledged, resume from (7).

A.4 Ground to Air keep-alive

4	Title	Ground to Air keep-alive	
Goal in context		There are two envisaged uses of the Ground to Air keep-alive: 1) To check that an AES is still logged in to the AGGW. Ground to Air keep-alives are used when no return traffic has been received from the aircraft for an extended period of time (e.g. for one hour). If no reply then the aircraft is logged off. (There may be no return traffic for example when within range of VHF coverage). 2) An AGGW operator wishes to confirm that an aircraft is logged on or reachable (for on aircraft testing/installation). If there is no reply then there is no logoff action.	
Preconditions		The AAGW is logged in to Aeronautical Safety services.	
Success end condition		The AGGW receives a response to its keep-alive transmission and the logged in status of the aircraft is confirmed.	
Failed End condition		The AGGW does not receive a response to its keep-alive transmission and proceeds to use case [AGGW logs out aircraft due to return link inactivity].	
Primary Actors		AGGW AAGW	
Trigger		Return Link Activity Timer gw_t1 (see clause 5.3.3.11.1) expires (timer is reset each time the AGGW receives a message from the AAGW).	
Description		**Step**	**Action**
		1	AGGW sends "keep-alive" message (gw_keepalive see clause 5.3.3.15) to AAGW.
		2	AAGW receives AGGW "keep-alive", is logged in, and responds with an acknowledgement (ac_keepalive_ack see clause 5.3.3.16).
		3	AGGW receives "keep-alive" acknowledgement from AAGW. AGGW resets return link activity timer.
Extensions		**Step**	**Branching action**
		2a.1	AAGW is not logged in. AAGW does not respond to AGGW. Proceed to (3a.1).
		2b.1	AAGW does not receive AGGW "keep-alive". Proceed to (3a.1).
		3a.1	AGGW does not receive "keep-alive" acknowledgement or any other valid message from AAGW. AGGW resends keep-alive acknowledgement gw_r1 (see clause 5.3.3.11.1) times. Return to (2).
		3a.2	AGGW has not received "keep-alive" acknowledgement but has received valid message from AAGW. No further action.
		3a.3	AGGW has not received valid communications from AAGW. Proceed to use case [AGGW logs out aircraft due to return link inactivity].
		3a.4	AGGW has not received response to operator initiated "keep-alive". No further action.

A.5 Air to ground ACARS message

A.5.0 General

5	Title	Air to ground ACARS message
Goal in context		ACARS message is sent from air to ground.
Preconditions		Aircraft is logged into the Family SL ACARS service.
Success end condition		ACARS message is sent from air to ground and delivered to CSP.
Failed End condition		ACARS message is not received by service provider.
Primary Actors		CMU AAGW AGGW CSP
Trigger		ACARS message arrives at AAGW from CMU.
Description	**Step**	**Action**
	1	AAGW timestamps (see clause A.5.1) message arrival from CMU and wraps the ACARS message into an inter-gateway message (ac_acars_msg see clause 5.3.3.7).
	2	AAGW sends message to AGGW and increments count of number of ACARS messages sent.
	3	AGGW receives message and checks that the AIGI message sequence number to ensure that it is not duplicated.
	4	AGGW sends ACARS message to CSP. AGGW records time at which message was sent to CSP, calculating delivery time. AGGW increments count of number of ACARS messages received.
	5	AGGW sends acknowledgement (gw_acars_ack see clause 5.3.3.8) to AAGW.
	6	AAGW receives acknowledgment from AGGW.
Extensions	**Step**	**Branching action**
Message not delivered to AGGW	3a.1	AGGW does not receive message. Proceed to 6a.1.
	3b.1	AGGW identifies the message as a duplicate from message sequence number. Resume from (5).
Message not delivered to CSP	4a.1	CSP does not receive message. No ACARS message will be sent in response. (Note: CMU will try to re-send message following timeout in receiving ACARS ACK, Multiple timeouts may produce a NOCOMM.) No further action.
AAGW does not receive acknowledgement	6a.1	If an acknowledgement is not received in ac_t2 (see clause 5.3.3.11) seconds the AAGW times out the response. AAGW re-tries sending the message ac_r3 (see clause 5.3.3.11) times. Message is re-sent with original message sequence number and timestamp. AAGW increments count of number of ACARS retransmissions.
	6b.1	AAGW has retried sending the ACARS message ac_r3 times. (Note: CMU will re-try sending the message after no ACARS ACK is received. Multiple re-tries will result in NOCOMM indication from CMU.) No further action.
	6c.1	AGGW responds to AAGW with a negative acknowledgement message (gw_msg_nak see clause 5.3.3.22) indicating that the AAGW is not logged on to this AGGW (site switch has occurred that was not transparent).
	6c.2	AAGW follows the behaviour from step (2) in use case [AGGW receives message from aircraft in logged off state].

A.5.1 AAGW Time Stamping

For AAGW time stamping purposes, and so that all AESs use the same time source, the AAGW shall use the broadcast BCt AVP UTCDateAndTime and BCt AVP Leap-Second (see ETSI TS 102 744-3-1 [4]) as the time reference for time stamping as detailed below:

*UTC Time = Referenced Time + (Frame Number * 80 ms) - Leap Seconds + Satellite to Aircraft Delay + Ground to Satellite Delay*

The UTCDateAndTime value that is broadcast is the time at which the forward bearer broadcast a frame number of 0 from the RNC. The frame number has a range 0 to 4 095 and is sent every 80 ms, hence when the frame number wraps back around to zero, the UTCDateAndTime value will be updated. The AES will need to extrapolate the UTC Date/Time by taking the reference time from the UTCDateAndTime AVP and update it based on the current frame number. The AES should subtract the value of Leap Seconds from the UTC Time (which is actually populated with GPS time) to obtain the true UTC Time. The AES shall compensate for the transit time of the UTCDateAndTime frame to get to the AES by adding the ground to satellite delay and the satellite to aircraft delay. The Ground to Satellite Delay shall be a fixed value of 132 ms based on the satellite having no inclination and a 20° SAS elevation at sea level plus satellite transit delay. The satellite to aircraft delay shall be calculated as per the Delay parameter calculation shown in ETSI TS 102 744-3-2 [15], clause 9.4.12.

The AES shall update its internal clock based on the time reference as calculated above and proceed to use this as the basis for time stamping the AIGI messages.

A.6 Ground to air ACARS message

6	Title	Ground to air ACARS message	
Goal in context		ACARS message sent from ground to air.	
Preconditions		Aircraft is logged in to the Family SL ACARS service.	
Success end condition		ACARS message is delivered to CMU and acknowledgement of message delivery is received by the AGGW.	
Failed End condition		ACARS message not received by CMU.	
Primary Actors		CSP AGGW AAGW CMU	
Trigger		ACARS message arrives at AGGW from CSP.	
Description		**Step**	**Action**
		1	AGGW timestamps message arrival from CSP and wraps the ACARS message into an inter-gateway message (gw_acars_msg see clause 5.3.3.9).
		2	AGGW sends message to AAGW.
		3	AAGW receives message from AGGW. AAGW checks message sequence number to ensure that it is not a duplicated message.
		4	AAGW extracts the ACARS message from the inter-gateway message and sends the message to CMU, recording time of delivery (see clause A.5.1) and increments the count of received ACARS messages.
		5	AAGW sends ACARS acknowledgement (ac_acars_ack see clause 5.3.3.10) receipt (including time of delivery to CMU and message sequence number) to AGGW.
		6	AGGW receives acknowledgment of message delivery and logs time message was sent to CMU, calculating associated latency.
Extensions		**Step**	**Branching action.**
Message not received by aircraft		3a.1	Message is not received at AAGW. No message is delivered to CMU and no ACARS acknowledgement is generated.
Duplicated message		3b.1	Message is identified as duplicate. AAGW sends ACARS acknowledgement receipt (including original timestamp of delivery and message sequence number. The Transaction ID in the ACARS acknowledgement shall be copied from the identified duplicate message). Resume from (6).
Message acknowledgement not received at ground gateway		6a.1	AGGW does not receive message acknowledgement. AGGW re-tries sending message gw_r2 (see clause 5.3.3.11.1) times after timeout. Message is re-sent with original message sequence number. Resume from (3).
		6b.1	AGGW does not receive message acknowledgement and has already retried gw_r2 times. Message is logged as undelivered.

A.7 Satellite hand-over

The decision criteria for satellite hand-over given in this use case are given as an example only. Manufacturers may choose an implementation based on alternative decision criteria for satellite hand-over.

7	Title	Satellite hand-over	
Goal in context		To transition use of Family SL ACARS service to another satellite.	
Preconditions		Aircraft is logged into Family SL ACARS service.	
Success end condition		Transition to Family SL ACARS service on new satellite.	
Failed End condition		Start of use case [AAGW establishes best available link with ground].	
Primary Actors		AAGW AGGW CSP Aeronautical Safety AES	
Trigger		AES signals that Satellite handover is imminent. Family SL coverage from an alternative satellite is available (and highest preference).	
Description		**Step**	**Action**
		1	AAGW checks that there are no cockpit voice calls. AAGW sets communication state to NOCOMM.
		2	AAGW sends log-off request (ac_logoff_rq see clause 5.3.3.4) to AGGW citing pending satellite hand-over.
		3	AGGW receives log-off request.
		4	AGGW sends log-off notification to CSP.
		5	AGGW send log-off acknowledgement (gw_logoff_ack see clause 5.3.3.5) to AAGW.
		6	AAGW receives log-off acknowledgement.
		7	AAGW signals to Aeronautical Safety AES to switch to new satellite.
		8	Aeronautical Safety AES camps on to Family SL service on new satellite.
		9	Start of use case [AGGW Logs in to Family SL ACARS service].
Extensions		**Step**	**Branching action**
		1a.1	There is a cockpit voice call. Exit use case.
		3a.1	AGGW does not receive log-off request. {AGGW will either log out aircraft following an activity timeout, or will reset log-in status on receipt of log-in from new ocean region} Proceed to (6a.1).
		6a.1	AAGW does not receive log-off acknowledgement. Resume from (7) after time out.
		8	Aeronautical Safety AES fails to camp on. AAGW marks (new) Family SL link as failed. Start of use case [AAGW establishes best available link with ground].
Notes		This is just a log-out, followed by a log-in, with a different cause code.	

A.8 Out of Family SL coverage

The decision criteria for satellite hand-over given in this use case are given as an example only. Manufacturers may choose an implementation based on alternative decision criteria for satellite hand-over.

8	Title	Out of Family SL coverage	
Goal in context		To terminate connection to Family SL ACARS service as aircraft moves outside Family SL coverage.	
Preconditions		Aircraft is logged on to Family SL ACARS service.	
Success end condition		Log-off transaction completed and start of use case [AAGW establishes best available link with ground].	
Failed End condition		Log-off transaction not completed. Start of use case [AAGW establishes best available link with ground].	
Primary Actors		AAGW AGGW CSP	
Trigger		Aeronautical Safety AES signals approach of edge of coverage. Family SL coverage from an alternative satellite is not available.	
Description		**Step**	**Action**
		1	AAGW checks there are no voice calls. AAGW sets communication state to NOCOMM. Current link marked as out of coverage.
		2	AAGW sends log-off request (ac_logoff_rq see clause 5.3.3.4) to AGGW citing pending loss of coverage as reason.
		3	AGGW receives log-off request.
		4	AGGW sends log-off notification to CSP.
		5	AGGW sends log-off acknowledgement (gw_logoff_ack see clause 5.3.3.5) to AAGW.
		6	AAGW receives log-off acknowledgement.
		7	Start of use case [AAGW establishes best available link with ground].
Extensions		**Step**	**Branching action**
		1a.1	There is an active voice call at ATS or EMG priority (see Table 7.2). Terminate use case.
		1b.1	There is an active voice call of at AOC or APC priority and AES supports an alternative satellite link and the service is available to it (in coverage, on preference list). AAGW causes voice call to be terminated (optionally indicating satellite loss of coverage as a cause).
		1b.2	AAGW sets communication state to NOCOMM. Current link marked as out of coverage and resumes from (2).
		1c.1	There is an active voice call at AOC or APC priority and an alternative satellite link is not available to AES.
		1c.2	AAGW determines if current Family SL coverage is best available. If better coverage is available resume from (2).
		1c.3	AES is using best coverage available. Terminate use case. (see note)
		3a.1	AGGW does not receive log-off request. AGGW will log-out aircraft following activity timeout. Proceed to (6a.1).
		3b.1	AGGW receives log-off request from an AES not in the log on table. Proceed to (5a.1).
		5a.1	AGGW responds to AAGW with a negative acknowledgement message (gw_msg_nak see clause 5.3.3.22) indicating that the AAGW is not logged on to this AGGW (possible site switch has occurred that was not transparent). Proceed to (7).
		6a.1	AAGW does not receive log-off acknowledgement. Resume from (7) after timeout.
NOTE: An alternative would be to block low priority voice calls while out of coverage.			

A.9 AGGW logs out aircraft due to return link inactivity

9	Title	AGGW logs out aircraft due to return link inactivity	
Goal in context		Remove aircraft from list of logged on aircraft at AGGW, notify service provider that aircraft is logged out.	
Preconditions		Aircraft is logged in to Family SL ACARS service.	
Success end condition		Aircraft is logged out of Family SL ACARS service.	
Failed End condition		Nil.	
Primary Actors		AGGW CSP	
Trigger		The AGGW did not receive a response to a ground to air keep-alive test [Ground to Air keep-alive].	
Description		**Step**	**Action**
Log out with CSP		1	AGGW notifies CSP that aircraft has been logged out of Aeronautical Safety service.
		2	AGGW sends log-out notification (gw_logoff_notify see clause 5.3.3.6) to AAGW with a reason of 'Return Link Inactivity'. AAGW receives log-out notification. If the ac_t3 (see clause 5.3.3.11) value in log out notification is greater than 0, start timer ac_t3. AAGW sets communication status to NOCOMM and starts use case [AAGW Logs in to Family SL ACARS service].
		3	Log-out complete.
Extensions		**Step**	**Branching action**
Aircraft tries to send any message during transitory state of log-out procedure		2a.1	AGGW responds to the message with a negative acknowledgement message (gw_msg_nak see clause 5.3.3.22) indicating that the AAGW is not logged on to this AGGW. AAGW follows the behaviour from step (2) in use case [AGGW receives message from aircraft in logged off state].
		2a.2	AGGW should record attempts to communicate in logged off state (see note).
		2b.1	AAGW does not receive log-out notification.
		2b.2	Timer on forward link traffic ac_t1 (see clause 5.3.3.11) expires at AAGW. Begin use case [AAGW detects loss of forward link activity].
Aircraft attempts to send message (except log-in)		3a.1	AGGW responds to the message with a negative acknowledgement message (gw_msg_nak see clause 5.3.3.22) indicating that the AAGW is not logged on to this AGGW. Proceed to use case [AAGW Logs in to Family SL ACARS service].
		3a.2	AGGW should record attempts to communicate in logged off state (see note).
Aircraft attempts log-in		3b.1	Perform normal log-on.
NOTE: Aircraft exhibiting this behaviour may be blacklisted at the RAN.			

A.10 AAGW detects unexpected PDP context disconnect

10	Title	AAGW detects unexpected PDP context disconnect	
Goal in context		Re-establish link following PDP context disconnect.	
Preconditions		Aircraft is logged in to Family SL ACARS service.	
Success end condition		Connection with Family SL re-established.	
Failed End condition		Fail to establish connection to Family SL ACARS service.	
Primary Actors		AAGW AGGW	
Trigger		PDP context supporting connection to AGGW disconnects without prior log-off transaction. Notice of PDP disconnection received from {Aeronautical Safety AES}. AES is still registered and attached.	
Description		**Step**	**Action**
Re-connect to ACARS Family SL network		1	AAGW sets communication status to NOCOMM.
		2	If the PDP context deactivation message is received with a reason code indicating a permanent failure (e.g. Operator Determined Barring) mark link as permanently failed and start use case [AAGW established best available link with ground] otherwise start use case [AAGW Logs in to Family SL ACARS service].

A.11 AAGW detects loss of synchronisation to Family SL forward bearer

11	Title	AAGW detects loss of synchronisation to Family SL forward bearer	
Goal in context		Re-establish link following loss of synchronisation to Family SL forward bearer.	
Preconditions		Aircraft is logged in to Family SL ACARS service.	
Success end condition		Start of use case [AAGW establishes best available link with ground].	
Failed End condition		Nil.	
Primary Actors		AAGW Aeronautical Safety AES.	
Trigger		Aeronautical Safety AES reports loss of synchronisation to forward bearer.	
Description		**Step**	**Action**
Detection of failure		1	AAGW asserts NOCOMM. Current link mark as failed.
		2	Start of use case [AAGW establishes best available link with ground].
Extensions		**Step**	**Branching action**
Notes		As the Aeronautical Safety AES is unable to synchronise on the forward bearer for this satellite, seeking an alternate link should start immediately this failure condition is detected.	

A.12 AAGW detects forward link inactivity

12	Title	AAGW detects forward link inactivity	
Goal in context		Verify link between AAGW and AGGW is still connected following period without any forward link traffic.	
Preconditions		Aircraft is logged in to Family SL ACARS service.	
Success end condition		Link status is verified.	
Failed End condition		Link failure is detected.	
Primary Actors		AAGW AGGW	
Trigger		Timer maintained by AAGW ac_t1 (reset after every message received in forward direction) expires.	
Description		**Step**	**Action**
		1	AAGW determines that VHF coverage is not available by checking SAL 270 bit 18 from CMU.
AAGW polls AGGW		2	If ac_t1 (see clause 5.3.3.11) is greater than 0, AAGW sends "keep-alive" message (ac_keepalive see clause 5.3.3.13) to AGGW.
		3	AGGW receives "keep-alive" message and logs aircraft location if provided.
		4	AGGW sends "keep-alive" acknowledgement (gw_keepalive_ack see clause 5.3.3.14) to AAGW.
		5	AAGW receives "keep-alive" acknowledgement message.
		6	AAGW resets forward link inactivity (ac_t1) time.
Extensions		**Step**	**Branching action**
		1a.1	VHF coverage is available. If ac_t1 is greater than 0 and ac_f1 (see clause 5.3.3.11) is set to 0xFF resume from (6).
		1b.1	VHF coverage is available. If ac_t1 is greater than 0 and ac_f1 is set to 0x00 resume from (2).
		1c.1	VHF coverage is available. If ac_t1 is 0 and ac_f1 is set to 0x00 resume from (6).
		3a.1	AGGW does not receive "keep-alive" message. Continue from (5a.1).
		3b.1	AGGW receives keep-alive message from an AES that is not in the log on table. Continue from (4a.1).
		4a.1	AGGW sends a negative acknowledgement (gw_msg_nak see clause 5.3.3.22) message indicating that the AAGW is not logged on to this AGGW. Continue from (5b.1).
		5a.1	AAGW does not receive "keep-alive" response message.
		5a.2	AAGW tries re-sending "keep-alive" message ac_r1 (see clause 5.3.3.11) times.
		5a.3	If the message is successfully acknowledged, resume from (5).
		5a.4	AAGW sets communication status to NOCOMM.
		5a.5	AAGW sends log-off message (ac_logoff_rq see clause 5.3.3.4) to AGGW. Start use case [AAGW logs into Family SL ACARS service].
		5b.1	AAGW receives negative acknowledgement indicating the AES is not logged on.

A.13 CMU asserts ACARS NOCOMM

NOTE: In the scenario of a latent failure of the AGGW to CSP link, where the CMU detects this and asserts NOCOMM, currently we are not trying a secondary CSP.

13	Title	CMU asserts ACARS NOCOMM	
Goal in context		Establish link following CMU assertion of NOCOMM.	
Preconditions		Aircraft is logged in to Family SL ACARS service.	
Success end condition		Link is re-established using Family SL or switched over to an alternative satellite link.	
Failed End condition		Link is not re-established.	
Primary Actors		CMU AAGW AGGW	
Trigger		NOCOMM indication from CMU on SAL270.	
Description		**Step**	**Action**
		1	AAGW indicates connection status to CMU as ACARS NOCOMM.
		2	AAGW sends log out request (ac_logoff_req see clause 5.3.3.4) to AGGW indicating ACARS NOCOMM as the reason for disconnection.
		3	AGGW sends log off acknowledge (gw_logoff_ack see clause 5.3.3.5) to AAGW.
		4	AGGW sends log-out notification to CSP.
		5	AAGW receives log off acknowledge from AGGW.
		6	AAGW marks all Family SL links as temporarily failing and begin use case [AAGW establishes best available link with the ground].
Extensions		**Step**	**Branching action**
		5a.1	AAGW does not receive log off acknowledge from AGGW. Retries sending logoff request ac_r2-1 (see clause 5.3.3.11) times before proceeding to (6).

A.14 AGGW detects failure of CSP link

14 Title		AGGW detects failure of CSP link
Goal in context	Log out all aircraft currently logged in with failed CSP.	
Preconditions	AGGW is providing ACARS service to aircraft with CSP.	
Success end condition	All aircraft connected to failed CSP are logged out.	
Failed End condition	Loss of communication to aircraft until alternate link established.	
Primary Actors	CSP, AGGW, AAGW.	
Trigger	AGGW detects that all links with CSP have failed (no activity detected on any link, no response to poll on any link).	
Description	**Step**	**Action**
Send log-out notification	1	AGGW removes all AESs from logged-on table and sends log-off notification message (gw_logoff_notify see clause 5.3.3.6) once to all logged on aircraft (each in turn) giving failed service provider connection as a reason. AGGW may modify ac_t3 (see clause 5.3.3.11) "log on storm back off timers during this process".
	2	AAGW receives log-off notification from AGGW. AAGW sets communication status to NOCOMM. If the ac_t3 value in log out notification is greater than 0, start timer ac_t3. AAGW attempts to re-establish link using use case [AAGW Logs in to Family SL ACARS Service]. (See note.)
	3	AGGW continues to provide service to service providers with which it has a communication link.
	4	AGGW sends out failure notification and attempts to restore connection to CSP.
Extensions	**Step**	**Branching action**
Receive message from aircraft connected to failed CSP	1a.1	No additional action during initial log-out phase.
Receive message requesting log-on to failed CSP	1b.1	No additional action during initial log-out fail (do not respond to message). This includes log-in requests.
No CSP available	2a.1	AGGW will respond that no CSP is available to AES in the log-off notify message. AAGW marks Family SL link as failed and starts use case [AAGW establishes best available link with ground].
	2b.1	AAGW does not receive log off notification.
	2b.2	AAGW eventually sends a message to the AGGW (keep-alive or ACARS) and receives a negative acknowledgement (gw_msg_nak see clause 5.3.3.22) message. AAGW follows the behaviour from step (2) in use case [AGGW receives message from aircraft in logged off state].
NOTE: If AES is using backup CSP, then this step will normally select the backup.		

A.15 AGGW receives message from aircraft in logged off state

15	Title	AGGW receives message from aircraft in logged off state
Goal in context		AGGW rejects message from aircraft currently not logged in by sending a negative acknowledgement to the aircraft
Preconditions		AGGW receives a message from an AAGW not currently logged on to Family SL ACARS service and the AGGW is handling ACARS traffic for an ocean region. Aircraft has established PDP context to allow connection to AGGW.
Success end condition		Aircraft starts use case [AAGW Logs in to Family SL ACARS service].
Failed End condition		Aircraft continues attempts to send messages in logged out state.
Primary Actors		AGGW AAGW
Trigger		AGGW receives message from aircraft not currently logged in to Family SL ACARS service (apart from a log-in request).
Description	**Step**	**Action**
	1	AGGW sends a negative acknowledgement message (gw_msg_nak see clause 5.3.3.22) to the AAGW.
	2	AAGW receives negative acknowledgement message from the AGGW. AAGW sets communication status to NOCOMM and starts use case [AAGW Logs in to Family SL ACARS service].
Extensions	**Step**	**Branching action.**
	2a.1	AAGW does not receive message from AGGW (see note).
	2b.1	AAGW does not attempt log-in.
	2b.2	AAGW sends another message to AGGW.
	2b.3	AGGW receives message from AAGW. Resume from (1).
NOTE: AAGW will either retry sending the message again determined by normal AIGI protocol or will declare no forward link activity.		

A.16 AGGW receives log-on request message from aircraft in logged on state

16	Title	AGGW receives log-on request message from aircraft in logged on state	
Goal in context		AGGW re-sets log-in status of aircraft.	
Preconditions		Aircraft logged in at AGGW but not at AAGW.	
Success end condition		Aircraft log-in status at AGGW refreshed.	
Failed End condition		Log in fails and AAGW attempts to restore link using use case [AAGW establishes best available link with ground].	
Primary Actors		AAGW AGGW CSP	
Trigger		This could happen for a number of reasons: AAGW may have detected a PDP context disconnect AAGW may be restoring link after lost traffic AGGW may have missed log-off prior to satellite hand-over Failure of a single AES in a dual installation First event (prior to step 1) is AAGW sends log-in request.	
Description		**Step**	**Action**
		1	AGGW receives log-in request (ac_logon_rq see clause 5.3.3.2).
		2	AGGW identifies log-in request as originating from aircraft already logged in, but using a different satellite.
		3	AGGW sends log-off notification to CSP.
		4	AGGW sends log-on notification CSP (for current satellite). Each AES satellite - ground link has a corresponding CSP-AGGW link.
		5	AGGW sends log-on response (gw_logon_rp see clause 5.3.3.3) to AAGW. Session link counters are reset at AGGW.
		6	AAGW receives log-on response. Session link counters re-set at AAGW.
Extensions		**Step**	**Branching action**
		1a.1	AGGW does not receive log-on request. AAGW will re-try per normal log-on transaction - resume from (1).
		2a.1	AGGW identifies log-in request as originating from aircraft already logged in, but using same satellite. Resume from (5).
		2b.1	AGGW identifies log-in request as originating from aircraft already logged in, but using a different IMSI (i.e. dual installation).
		2b.2	AGGW sends log off notification to (gw_logoff_notify see clause 5.3.3.6) AAGW for the 'old' IMSI.
		2b.3	AGGW sends log-off notification to CSP.
		2b.4	Resume from (4).
		6a.1	AAGW does not receive log-in response. AAGW will re-try per normal log-in transaction - resume from (1).

A.17 Transition to higher preference service after timeout

17	Title	Transition to higher preference service after timeout	
Goal in context		To transition from a lower preference service to a higher preference service.	
Preconditions		Operational ACARS link using a lower preference link. Aircraft within the defined coverage region of a higher preference link. Higher preference link has previously failed.	
Success end condition		Aircraft transitions to using link of higher preference.	
Failed End condition		Aircraft does not transition to higher preference service, reverting back to the lower preference service.	
Primary Actors		AAGW	
Trigger		Minimum dwell timeout ac_t4 (see clause 5.3.3.11) in AAGW expires.	
Description		**Step**	**Action**
		1	AAGW asserts ACARS NOCOMM.
		2	AAGW initiates log-out from current ACARS link. Start logon backoff timer ac_t3 (see clause 5.3.3.11) and proceed to use case [AAGW establishes best available link with ground].

A.18 Transition to higher preference service after entering coverage region

The decision criteria for satellite hand-over given in this use case are given as an example only. Manufacturers may choose an implementation based on alternative decision criteria for satellite hand-over.

18	Title	Transition to higher preference service after entering coverage region	
Goal in context		To transition from a lower preference service to a higher preference service.	
Preconditions		Operational ACARS link using a lower preference link. Higher preference link has not previously failed Aircraft has been outside coverage of higher preference link.	
Success end condition		Aircraft transitions to using link of higher preference.	
Failed End condition		Aircraft does not transition to higher preference service, reverting back to the lower preference service.	
Primary Actors		AAGW	
Trigger		Aircraft enters coverage region of higher preference service.	
Description		**Step**	**Action**
		1	AAGW asserts ACARS NOCOMM.
		2	AAGW initiates log-out from current ACARS link. Start logon backoff timer ac_t3 (see clause 5.3.3.11) and proceed to use case [AAGW establishes best available link with ground].

A.19 AAGW receives message from unexpected IP address

19	Title	AAGW receives message from unexpected IP address	
Goal in context		The message source should be validated as coming from the expected AGGW IP address before it is processed.	
Preconditions		The AAGW is logged in to Aeronautical Safety services.	
Success end condition		The AAGW discards the message.	
Failed End condition		The AAGW does not validate the message and processes the message.	
Primary Actors		AGGW AAGW	
Trigger		Receipt of message from unexpected IP address.	
Description		**Step**	**Action**
		1	AAGW discards message.
Extensions		**Step**	**Branching action**
		1a.1	AAGW does not validate IP address, potentially passing unintentional data to CMU.

A.20 AAGW receives invalid message

20	Title	AAGW receives invalid message	
Goal in context		The AAGW notifies the AGGW that it has received a message that it has declared invalid. The AAGW discards the message. The AGGW logs the error event but otherwise continues operating normally. The AAGW does not expect the NAK to be acknowledged and does not re-send.	
Preconditions		The AAGW is logged in to Aeronautical Safety services.	
Success end condition		The invalid message id discarded. The AAGW and AGGW carry on as normal.	
Failed End condition		None	
Primary Actors		AGGW AAGW	
Trigger		The AAGW receives a message that has an invalid parameter (for example incorrect ICAO address or out-of-bounds parameter). This message will only be sent by the AAGW in place of an expected message pair response, as shown in Table 5.3 under the Response column.	
Description		**Step**	**Action**
		1	The AAGW discards the message.
		2	The AAGW sends a NAK message (ac_msg_nak see clause 5.3.3.21) to the AGGW indicating that it has received an invalid message. The NAK contains the transaction ID of the invalid message received.
		3	The AGGW logs the receipt of the AAGW NAK.

A.21 CSP Ground to Air Ping

21	Title	CSP Ground to Air Ping	
Goal in context		This allows a CSP operator to test if an aircraft is logged in to the Family SL ACARS service and that the link between air and ground is intact.	
Preconditions		The AAGW is logged in to Aeronautical Safety services.	
Success end condition		The CSP receives a response to its ping transmission and the logged in status of the aircraft is confirmed.	
Failed End condition		The CSP does not receive a response to the ground to air ping from the AES.	
Primary Actors		AGGW AAGW CSP	
Trigger		CSP operator initiates the ping.	
Description		**Step**	**Action**
		1	CSP operator causes ping message to be sent to AGGW.
		2	AGGW sends CSP ping message (gw_csp_ping see clause 5.3.3.17) to AAGW.
		3	AAGW receives CSP ping message, and if logged in responds with an acknowledgement (ac_csp_ping_ack see clause 5.3.3.18).
		4	AGGW receives ping acknowledgement from AAGW. AGGW sends ping acknowledgement message to CSP.
		5	CSP receives ping acknowledgment message from AGGW.
Extensions		**Step**	**Branching action**
		2a.1	AGGW does not receive link test message from CSP. No further action.
		3a.1	AAGW is not logged in. AAGW does not respond to AGGW. After timer gw_t2 (see clause 5.3.3.11.1) expires the AGGW indicates to CSP that there was no response. No further action.
		3b.1	AAGW does not receive AGGW ping message. No further action.
		4a.1	AGGW does not receive "ping" acknowledgement from AAGW. After timer gw_t2 expires the AGGW indicates to CSP that there was no response. No further action.
		5a.1	CSP does not receive ping acknowledgement from AGGW. No further action.

A.22 AIGI Test Message

22 Title		AIGI Test Message
Goal in context	The message is sent by the AGGW to periodically send AIGI traffic to test that the link between the AGGW and AAGW is operational.	
Preconditions	The AAGW is logged in to Aeronautical Safety services.	
Success end condition	The AGGW receives a response to its test message.	
Failed End condition	The AGGW does not receive a response to its test message.	
Primary Actors	AGGW AAGW	
Trigger	AGGW operator sets up the periodic (configurable) sending of the test message.	
Description	**Step**	**Action**
	1	AGGW sends AIGI Test Message (gw_test_msg see clause 5.3.3.19).
	2	AAGW receives AIGI test message, is logged in and responds with an acknowledgement (ac_test_ack see clause 5.3.3.20).
	3	AGGW receives AIGI test message acknowledgement from AAGW.
	4	AGGW waits a configurable time gw_t3 (see clause 5.3.3.11.1) before returning to (1).
	5	Use case ends when AIGI test message is disabled by the operator.
Extensions	**Step**	**Branching action**
	2a.1	AAGW does not receive AIGI test message from AGGW. Proceed to (4).
	2b.1	AAGW is not logged in. AAGW does not respond to AGGW. Proceed to (4).
	3a.1	AGGW does not receive acknowledgement from AAGW. Log event and proceed to (4).

A.23 Ground to Air Configuration Message

23 Title		Ground to Air Configuration Message
Goal in context	The message is sent by the AGGW after an AES has successfully logged on to provide the AIGI protocol parameters.	
Preconditions	The AAGW is logged in to Aeronautical Safety services.	
Success end condition	The AGGW receives a configuration ACK message from the AAGW.	
Failed End condition	The AGGW does not receive a response to the configuration message.	
Primary Actors	AGGW AAGW	
Trigger	AAGW has logged on to the AGGW for service.	
Description	**Step**	**Action**
	1	AGGW sends configuration message (gw_conf see clause 5.3.3.11) to the AAGW.
	2	AAGW receives configuration message.
	3	If the configuration message has values that are not the default (see clause 5.3.3.11 for default values) then the AAGW shall take on board the new value.
	4	AAGW sends a configuration ACK message (ac_conf_ack see clause 5.3.3.12) to the AGGW.
Extensions	**Step**	**Branching action**
	2a.1	AAGW does not receive configuration message, AGGW times out on receiving a configuration ACK. Proceed to 4a.1.
	3a.1	The configuration message contains values out with the specified range, proceed to use case [AAGW receives invalid message].
	4a.1	AGGW does not receive configuration ACK from AAGW. AGGW may resend the configuration message gw_r2 (see clause 5.3.3.11.1) times, Proceed to (1).
	4b.2	AGGW has retried sending the configuration message gw_r2 times. No further action.

A.24 AGGW receives message from aircraft when not serving an ocean region

24	Title	AGGW receives message from aircraft when not serving an ocean region	
Goal in context		AGGW ignores message from an aircraft if it is not currently servicing ACARS traffic for an ocean region. Note: this should eventually cause the AAGW to try and logon again or regain alternative service e.g. in the case where a site switch has occurred.	
Preconditions		AGGW receives a message from an AAGW while the AGGW is not serving an ocean region. Aircraft has established PDP context to allow connection to AGGW.	
Success end condition		Aircraft starts use case [AAGW detects forward link inactivity].	
Failed End condition		Aircraft does not detect forward link inactivity.	
Primary Actors		AGGW AAGW	
Trigger		AGGW receives message from aircraft while it is not serving an ocean region.	
Description		**Step**	**Action**
		1	AGGW logs the received message but does not send a reply.
Extensions		**Step**	**Branching action**
		1a.1	AAGW does not receive message from AGGW.
		1a.2	Eventually the AAGW will start the use case [AAGW detects forward link inactivity].

A.25 AGGW receives invalid message from AAGW

25	Title	AGGW receives invalid message from AAGW	
Goal in context		AGGW ignores message from an AAGW if it is an unknown message type or a malformed message.	
Preconditions		AGGW receives a message from an AAGW that is invalid. AAGW has established PDP context to allow connection to AGGW.	
Success end condition		Message is logged and ignored.	
Failed End condition		AAGW continually sends malformed messages.	
Primary Actors		AGGW AAGW	
Trigger		AGGW receives message from AAGW.	
Description		**Step**	**Action**
		1	AGGW logs the received message but does not send a reply.
Extensions		**Step**	**Branching action**
		1a.1	If all AAGW messages are malformed then the AAGW will eventually start the use case [AAGW detects forward link inactivity].

A.26 AAGW Receives Uplink while Awaiting Response to a Downlink

26 Title		AAGW Receives Uplink while Awaiting Response to a Downlink
Goal in context	Simultaneous ACARS transfers are handled correctly.	
Preconditions	Aircraft is logged into the Family SL ACARS service.	
Success end condition	ACARSs messages initiated by the air and ground are both received and acknowledged correctly.	
Failed End condition	Either one of the ACARS messages are not acknowledged.	
Primary Actors	CMU AAGW AGGW CSP	
Trigger	Step1: ACARS message arrives at AAGW from CMU. Step 3: ACARS message arrives at AGGW from CSP.	
Description	**Step**	**Action**
	1	AAGW timestamps (see clause A.5.1) message (m1) arrival from CMU and wraps the ACARS message into an inter-gateway message (ac_acars_msg see clause 5.3.3.7).
	2	AAGW sends message (m1) to AGGW and increments count of number of ACARS messages sent.
	3	AGGW timestamps (see clause A.5.1) message (m2) arrival from CSP and wraps the ACARS message into an inter-gateway message (gw_acars_msg see clause 5.3.3.9).
	4	AGGW sends message to AAGW (m2).
	5	AGGW receives message (m1) and checks that the AIGI message sequence number to ensure that it is not duplicated.
	6	AGGW sends ACARS message (m1) to CSP. AGGW records time at which message was sent to CSP, calculating delivery time. AGGW increments count of number of ACARS messages received.
	7	AGGW sends acknowledgement (a1) (gw_acars_ack see clause 5.3.3.8) to AAGW.
	8	AAGW receives message (m2) from AGGW. AAGW checks message sequence number to ensure that it is not a duplicated message.
	9	AAGW extracts the ACARS message (m2) from the inter-gateway message and sends the message to CMU, recording time of delivery (see clause A.5.1) and increments the count of received ACARS messages.
	10	AAGW sends ACARS acknowledgement receipt (a2) (ac_acars_ack see clause 5.3.3.10) (including time of delivery to CMU and message sequence number) to AGGW.
	11	AAGW receives acknowledgment (a1) from AGGW.
	12	AGGW receives acknowledgment (a2) of message delivery and logs time message was sent to CMU, calculating associated latency.
Extensions	**Step**	**Branching action**
Message not delivered to AGGW	5a.1	AGGW does not receive message. Proceed to 11a.1.
	5b.1	AGGW identifies the message as a duplicate from message sequence number. Resume from (7).
Message not delivered to CSP	6a.1	CSP does not receive message. No ACARS message will be sent in response. (Note: CMU will try to re-send message following timeout in receiving ACARS ACK, Multiple timeouts may produce a NOCOMM.) No further action.
Message not received by aircraft	8a.1	Message is not received at AAGW. No message is delivered to CMU and no ACARS acknowledgement is generated.
Duplicated message	8b.1	Message is identified as duplicate. AAGW sends ACARS acknowledgement receipt (including original timestamp of delivery and message sequence number. The Transaction ID in the ACARS acknowledgement shall be copied from the identified duplicate message.). Resume from (12).
AAGW does not receive acknowledgement	11a.1	If an acknowledgement is not received in ac_t2 (see clause 5.3.3.11) seconds the AAGW times out the response. AAGW re-tries sending the message ac_r3 (see clause 5.3.3.11) times. Message is re-sent with original message sequence number and timestamp. AAGW increments count of number of ACARS retransmissions.

26	Title	AAGW Receives Uplink while Awaiting Response to a Downlink	
		11b.1	AAGW has retried sending the ACARS message ac_r3 times (see note).
		11c.1	AGGW responds to AAGW with a negative acknowledgement message (gw_msg_nak see clause 5.3.3.22) indicating that the AAGW is not logged on to this AGGW (site switch has occurred that was not transparent).
		11c.2	AAGW follows the behaviour from step (2) in use case [AGGW receives message from aircraft in logged off state].
Message acknowledgement not received at ground gateway		12a.1	AGGW does not receive message acknowledgement. AGGW re-tries sending message gw_r2 (see clause 5.3.3.11.1) times after timeout. Message is re-sent with original message sequence number. Resume from (8).
		12b.1	AGGW does not receive message acknowledgement and has already retried gw_r2 times. Message is logged as undelivered.
NOTE: CMU will re-try sending the message after no ACARS ACK is received. Multiple re-tries will result in NOCOMM indication from CMU.) No further action.			

History

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