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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.

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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.

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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.

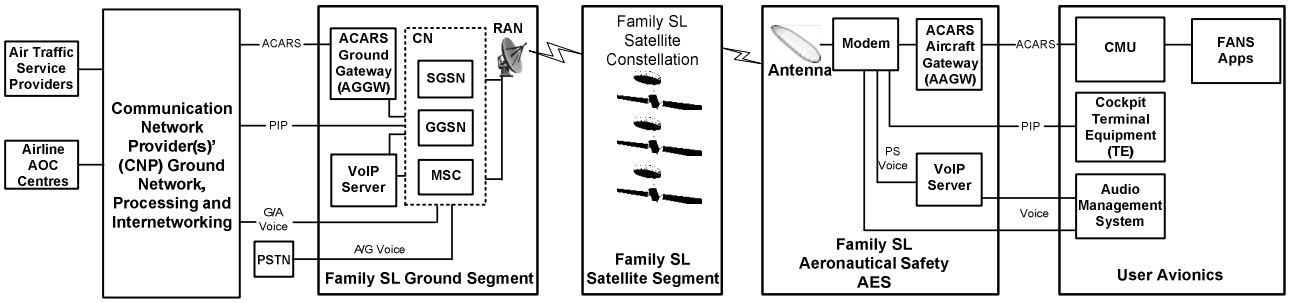

Figure 4.1: Aeronautical Safety Service Architecture

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.

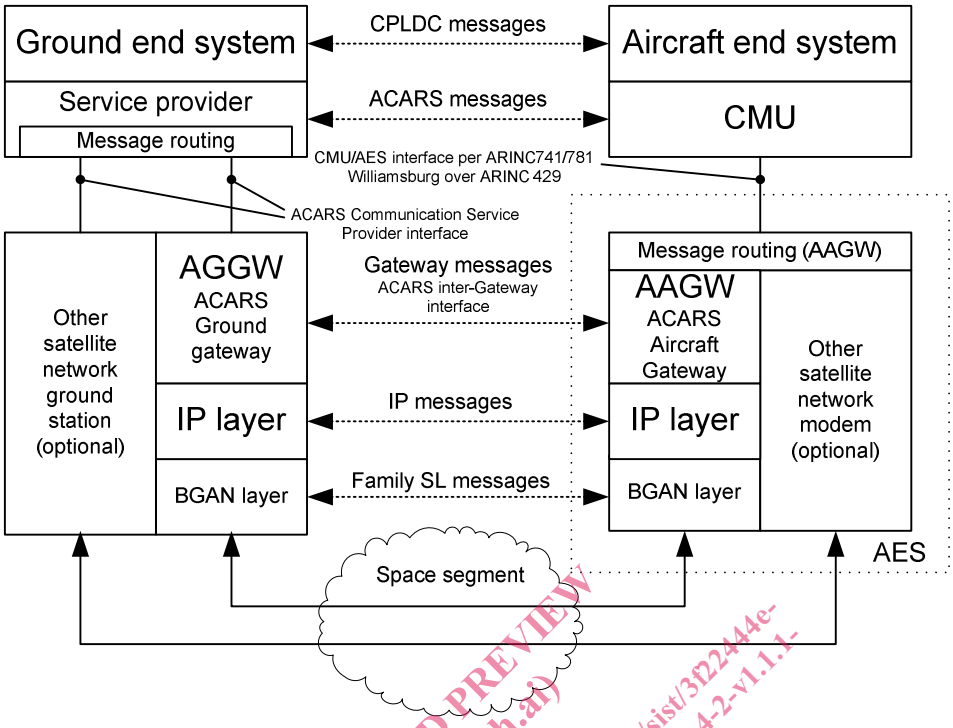

Figure 5.1: ACARS Air and Ground Stacks

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

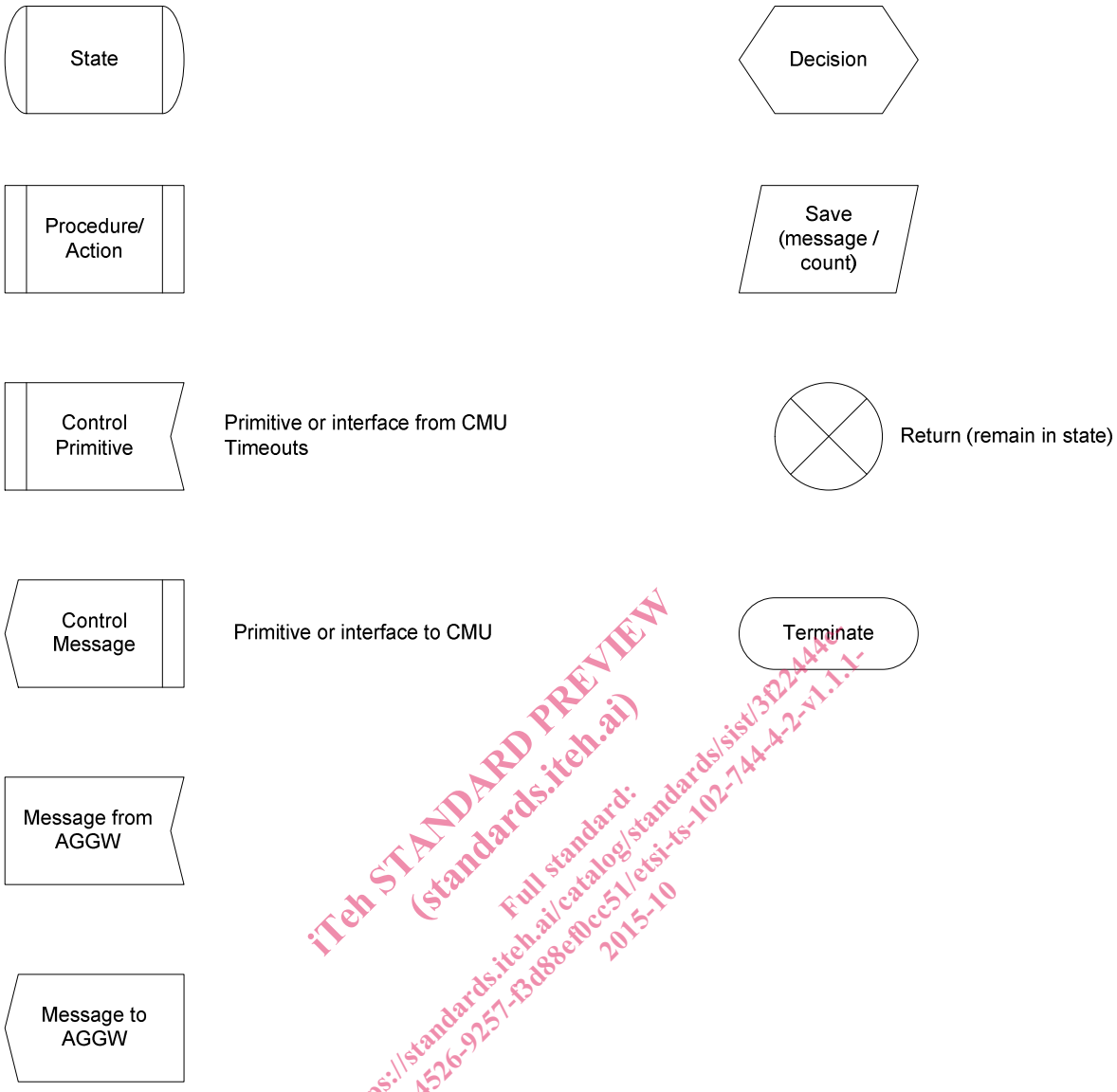

Figure 5.2: SDL Legend