Iridium GMDSS LRIT

Amendments to legacy Iridium LRIT

Revision history

Rev.	Date	Section	Description / Remarks	Initials
1.03	2022-02-25	3.1.2 3.4.1 3.4.2 3.4.2	LRIT SMS header identifier changed to 0xCC Limit Timer field maximum value Added missing fields (SN, N) from table Correct ASP encoding of V field (use 0xFF)	KK
1.02	2022-01-14	1.6 3.3, 3.4 3.4.1 3.4.1 3.5 3.5.2 3.6	Reference to IEC 62729 added Assignment of responsible ASP (activation) method changed, and deactivation introduced Config Command format updated with new fields: SN, N Clarification of ASP encoding of version field Allow longitude of 180 degrees New event codes 'IMO Invalid' Clarify GNSS Failure event code use Uses deactivation and activation during change of flag	KK
1.01	2021-12-10	1.2 3.1.3 3.3 3.4 3.4.1 3.5	Clarify that administrative processes are partly described Fixed spelling and added reference Fixed reference Added note explaining how an ASP can determine whether it is the responsible ASP without making any changes Clarify message field encoding Clarify event code use. Reduced / Disabled events are now only triggered by actions of the vessel Master	KK
1.00	2021-11-17	all	Initial version	KK

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1 Introduction

As a Communications Service Provider (CSP) the Iridium network currently facilitates LRIT communication between shipborne equipment and Application Service Providers (ASPs) through a proprietary Iridium protocol utilizing the Iridium Short Burst Data (SBD) packet data service.

This document amends the Iridium LRIT Protocol Standards Definition [10], enabling the Iridium LRIT protocol to utilize the Iridium SMS service in place of the Iridium SBD service, without any fundamental changes to the protocol. The amendment seeks to minimize the complexity of changes required in the Iridium network, Application Service Providers, and shipborne equipment.

This amendment cannot stand alone and shall be read together with Iridium LRIT Protocol Standards Definition [10].

1.1 Purpose

This document is intended for Application Service Providers and shipborne equipment manufacturers who wish to support Iridium LRIT in the Iridium GMDSS system.

1.2 Scope

How the Application Service Provider interfaces to the Iridium network for sending and receiving SMSs is out of scope of this document.

The current administrative processes of activating, deactivating or transfer of ownership of shipborne equipment is strongly tied to the SBD service. These processes need to be redefined for Iridium GMDSS LRIT utilizing SMS. This is only partly covered by 3.6.

1.3 Precedence

This document amends the Iridium LRIT Protocol Standards Definition [10]. In case of contradiction between the Iridium LRIT Protocol Standards Definition [10] and this document, this document takes precedence.

1.4 Terms and Definitions

Flag Administration

A Contracting Party operating a ship registry. Flag Administrations are responsible for ensuring ships flying their flag comply with IMO regulations pertaining to LRIT.

Responsible ASP

The one ASP the shipborne equipment is configured to send interval position reports to and respond to LRIT Configuration Command messages.

Shipborne Equipment

Equipment carried by a ship to participate in LRIT. Such equipment must comply with the Performance Standard and be "Type Approved" by the relevant flag administration.

1.5 Acronyms and Abbreviations

ASP	Application Service Provider
CSP	Communications Service Provider
IMO	International Maritime Organization
MO	Mobile Originated
MT	Mobile Terminated

1.6 References

[1] 3GPP 23.038
Alphabets and language-specific information

[2] IMO Resolution MSC.202(81), May 2006
Adoption of amendments to the international convention for the safety of life at sea, 1974

[3] IMO Resolution MSC.263(84), May 2008
Revised performance standards and functional requirements for the long-range identification and tracking of ships

[4] IMO Resolution MSC.330(90), May 2012
Adoption of amendments to the revised performance standards and functional requirements for the long-range identification and tracking of ships

[5] IMO Resolution MSC.400(95), June 2015
Adoption of amendments to the revised performance standards and functional requirements for the long-range identification and tracking of ships

[6] IMO MSC.1/Circ.1259, Rev.8, April 2020
Long-range identification and tracking system
Technical documentation (part I)

[7] IMO MSC.1/Circ.1294, Rev.6, April 2020
Long-range identification and tracking system
Technical documentation (part II)

[8] IMO MSC.1/Circ.1307
Guidance on the survey and certification of compliance of ships with the requirement to transmit LRIT information

[9] IEC 62729, Edition 1.0, 2012-06
Maritime navigation and radiocommunication equipment and systems
Shipborne equipment for long-range identification and tracking (LRIT)
Performance requirements

[10] Iridium LRIT Messaging Protocol Standards Definition, v1.1

[11] Iridium Short Burst Data Service
Developers Guide, Release 3.1

[12] RFC 4648
The Base16, Base32, and Base64 Data Encodings

2 Iridium LRIT overview

This chapter gives a very brief introduction to the Iridium LRIT design. Please see [10] for further details.

2.1 Iridium LRIT protocol

The Iridium LRIT protocol [10] is a binary and bidirectional protocol. It defines two messages: LRIT Position Report and LRIT Configuration Command.

The LRIT Position Report is sent periodically by the shipborne equipment and can also be requested by the ASP using the LRIT Configuration Command.

The LRIT Configuration Command can also be used by the ASP to retrieve or modify the LRIT configuration in the shipborne equipment. The shipborne equipment responds with an LRIT Configuration Command.

2.2 Iridium SBD service

The SBD service [11] is a binary packet data service. The service does not allow the shipborne equipment to specify a destination for MO data and does not reveal the source of MT data. The peer, with whom the SBD packets are exchanged, is statically configured in SPNET and it is implicitly expected the two agree on the protocol carried on top of SBD. This means the shipborne equipment can only communicate with one peer (e.g. an ASP) and one function (e.g. LRIT).

The ASP has two available options for interfacing the Iridium network for the purpose of exchanging SBD packets with the shipborne equipment:

- Email
- DirectIP

The specifics and differences of these two methods are out of scope of this document. What is of interest is that both methods transfer the IMEI of the shipborne equipment together with each SBD packet (in both directions) for unique identification of the shipborne equipment. This enables the ASP of communicating with many shipborne equipment.

3 Iridium GMDSS LRIT

The primary difference between Iridium GMDSS LRIT and legacy Iridium LRIT is the replacement of the SBD service with the SMS service for transport of the LRIT message between the shipborne equipment and the ASP.

Another notable difference between legacy Iridium LRIT and Iridium GMDSS LRIT is the introduction of a list of known ASPs and one responsible ASP in the shipborne equipment.

3.1 SMS service

3.1.1 Provisioning

The SMS service is not included in all Iridium GMDSS subscriptions. Iridium GMDSS LRIT terminals are required to have a subscription with Iridium that includes the SMS service.

An ASP will not receive an error notification from the Iridium network if attempting to send an SMS to shipborne equipment without a valid SMS subscription. The ASP will simply not get a reply.

3.1.2 Encapsulation

The Iridium SMS service can carry 140 bytes of binary data (or 160 characters from the GSM 7-bit default alphabet) in one SMS. One or more LRIT messages may be encapsulated in one SMS.

Each message is prefixed by a 2-byte SMS header containing an identifier and length:

7	6	5	4	3	2	1	0	
Identifier								0
Length								1
LRIT Message (2 or 10 bytes)								2 … N

Table 1 SMS header

The SMS header *identifier* field must be encoded 0xCC. The *length* field specifies the length of the LRIT message following the SMS header (e.g., the decimal value 10 for an LRIT Position Report).

If the ASP sends an LRIT Configuration Command with both the P (Poll) and A (Ack) flags set, the shipborne equipment may respond with just one SMS containing both the LRIT Position Report and LRIT Configuration Command.

SMS Header (2 bytes)
LRIT Configuration Command (10 bytes)
SMS Header (2 bytes)
LRIT Position Report (10 bytes)

Figure 1 SMS encapsulating two LRIT messages

3.1.3 Shipborne equipment

In contrast to the SBD service, the shipborne equipment specifies a destination when sending an SMS. Likewise, when receiving an SMS, the shipborne equipment can extract the peer from the SMS. The SMS peer is (typically) identified by a phone number.

As the shipborne equipment is also using the SMS service for other functions than LRIT, the shipborne equipment must be able to identify an MT SMS as destined for the LRIT function. This is done by looking up the SMS peer phone number in a list of known LRIT ASPs and verify the SMS LRIT header *identifier* field.

The list of LRIT APSs and their phone number is received in the GMDSS configuration (see 3.2).

3.1.4 Application Service Provider

When using SBD, the shipborne equipment is identified by the IMEI. In the Iridium GMDSS LRIT system, the ASP shall identify the shipborne equipment by its MSISDN. The MSISDN must be used as destination when sending an SMS and is included when receiving an SMS.

The procedure for how the ASP obtains the MSISDN of the shipborne equipment of a given vessel is out of scope of this document.

3.2 Known ASPs

The shipborne equipment has a list of known ASPs. The list of known ASPs is obtained by the shipborne equipment dynamically from the Iridium GMDSS Configuration or by other means.

The shipborne equipment must ignore LRIT messages received from an entity not in the list of known ASPs.

3.3 Responsible ASP

The ASP to which the shipborne equipment sends interval position reports is the *responsible ASP* and must be a member of the list of known ASPs. If the responsible ASP is removed from the list of known ASPs, it is no longer the responsible ASP.

Before the shipborne equipment can send interval position reports to the responsible ASP, the shipborne equipment must be configured to send to that specific ASP. Assignment of a responsible ASP to the shipborne equipment is called *activation* and can be done by any ASP in the list of known ASPs at any time by sending an LRIT Configuration Command (see 3.3.1). Likewise, an ASP can perform a *deactivation* at any time with the LRIT Configuration Command (see 3.3.2).

If the shipborne equipment has a user interface, the operator shall be able to see the responsible ASP.

3.3.1 Activation

An ASP assigns itself as the responsible ASP using the LRIT Configuration Command. As a minimum, both SN and SI flags must be set (SO, ST and SD are optional) and the 'Responsible' field must be set to 1 (decimal).

When the shipborne equipment receives an LRIT Configuration Command with the SN flag set and N=1, it must validate the IMO number before accepting the activation.
If the SI flag is not set or if the IMO number from the LRIT Configuration Command does not match the IMO number from the GMDSS configuration, activation fails, and the shipborne equipment shall respond as if none of 'set' flags have been set (see 3.4). If the P flag is set, the Event Code 'IMO Invalid' shall be used in the LRIT Position Report.

If the SI flag is set and the IMO numbers match, the shipborne equipment shall:

1. send an LRIT Position Report with the event code 'Responsibility Lost' (see 3.5) to the current responsible ASP (if any)
2. change the responsible ASP to the ASP from which it received the LRIT Configuration Command
3. process and respond to the LRIT Configuration Command in accordance with [10] and with 'Responsible' set to 1 (decimal).

3.3.2 Deactivation

An ASP removes itself as the responsible ASP using the LRIT Configuration Command. The SN flag must be set, and the 'Responsible' field must be set to 0 (decimal). The other 'set' flags (SI, SO, ST, SD) shall not be set.

When the shipborne equipment receives an LRIT Configuration Command with the SN flag set and N=0 from the responsible ASP, it shall:

1. remove its responsible ASP
2. set its LRIT configuration to default (interval reporting disabled)

Whether the ASP was the responsible or not, the shipborne equipment shall:

1. if any of the SI, SO, ST, or SD flags are set they shall be ignored
2. if the A flag is set, it shall send a Null Configuration (see 3.4.2) to the ASP
3. if the P flag is set, it shall send an LRIT Position Report with Event Code 'Responsibility Lost' (instead of 'Polled Position')

3.4 LRIT Configuration Command

When the shipborne equipment receives an LRIT Configuration Command from the responsible ASP and the SN flag is not set, it shall process and respond in accordance with [10].

When the shipborne equipment receives an LRIT Configuration Command **with** the SN flag is set, it shall process and respond to it in accordance with 3.3.1 and 3.3.2.

When the shipborne equipment receives an LRIT Configuration Command from a known, but non-responsible ASP, and **without** the SN flag set, it shall process and respond as follows:

- if any of the SI, SO, ST, or SD flags are set they shall be ignored

- if the A flag is set, it shall send a Null Configuration (see 3.4.2) to the ASP
- if the P flag is set, it shall send an LRIT Position Report with Event Code 'Responsibility Lost' or 'IMO Invalid' (instead of 'Polled Position')

3.4.1 Packet structure

Minor changes have been made to the LRIT Configuration Command packet structure:

- The *Offset* field is reduced from 13 bits to 11 bits and the maximum valid value is 1439 (23 hours and 59 minutes). The former two most significant bits are now reserved.
- Introducing the SN and N fields

7	6	5	4	3	2	1	0	
H								0
M		P	SI	SO	ST	SD	A	1
I [23-16]								2
I [15-8]								3
I [7-0]								4
R		O [10-5]						5
O [4-0]					T [12-10]			6
T [9-2]								7
T [1-0]		D	R			SN	N	8
V								9

Table 2 Configuration Command packet structure

Below are the updated field definitions.

Field	Name	Description
H	Header	See [10]
M	Message	See [10]. The value 3 is used in both MO and MT messages.
P	Poll Position	See [10]
SI	Set IMO	See [10]
SO	Set Offset	See [10]
ST	Set Timer	See [10]
SD	Set Reduced	See [10]
A	Ack	See [10]
I	IMO number	See [10]
O	Offset	Same as [10], except the maximum value is limited to 1439 (23 hours and 59 minutes).
T	Timer	Same as [10], except the maximum value is limited to 1439 (23 hours and 59 minutes).
D	Reduced	See [10]

R	Reserved	Must be encoded with zero bits and ignored by receiver.
SN	Set Responsible	0: Leave unchanged 1: Set Responsible
N	Responsible	0: ASP is not the responsible ASP 1: ASP is the responsible ASP
V	Version	Same as [10], but ASP shall always encode field with 0xFF.

Table 3 LRIT Configuration Command field description

3.4.2 Null Configuration

The Null Configuration is an LRIT Configuration Command message with the fields encoded as follows:

Field	Name	Value
H	Header	0xF0
M	Message	3
P	Poll Position	0
SI	Set IMO	0
SO	Set Offset	0
ST	Set Timer	0
SD	Set Reduced	0
A	Ack	0
I	IMO number	0
O	Offset	0
T	Timer	0
D	Reduced	0
R	Reserved	0x00
SN	Set Responsible	0
N	Responsible	0
V	Version	Manufacturer and Firmware Version of Device in accordance with [10].

Table 4 Null Configuration

3.5 LRIT Position Report

3.5.1 Packet structure

The 'LgD' field (longitude degrees) has a valid range of 0-180 (decimal). If taking the decimal value 180, the LgM and LgS fields shall be zero.

3.5.2 Event codes

Value	Name	Description
88 (0x58)	Polled Position	Sent in response to an LRIT Configuration Message received from the responsible ASP with the P flag set – except if • the requesting ASP is a non-responsible ASP, in which case 'Responsibility Lost' is used instead, or • the LRIT IMO number does not match the GMDSS IMO number, in which case 'IMO Invalid' is used instead
11 (0x0B	Interval Position	Used when sending interval position reports - except if GNSS navigation solution is unavailable and has been for more than one hour, in which case 'GNSS Failure' is used instead.
15 (0x0F)	IMO Invalid	Used in place of Polled Position or Interval Position in case the LRIT IMO number does not match the GMDSS IMO number.
64 (0x40)	Power On	See [10]
65 (0x41	Power Off	See [10]
68 (0x44)	Antenna Disconnect	See [10]
69 (0x45)	Iridium Signal Loss	See [10]
91 (0x5B)	GNSS Failure	Used in place of Interval Position if GNSS navigation solution has been unavailable for more than 1 hour.
82 (0x52)	Reduced Enter	See [10]. Sent to the responsible ASP when reduced mode is activated by the Master.
87 (0x57)	Reduced Exit	See [10]. Sent to the responsible ASP when reduced mode is exited by the Master unless disabled mode is activated (in which case Disabled Enter is sent).
84 (0x54)	Disabled Enter	Sent to the responsible ASP when interval reporting is disabled by the Master.
85 (0x55)	Disabled Exit	Sent to the responsible ASP when interval reporting is enabled by the Master, unless reduced mode is entered (in which case Reduced Enter is sent).
89 (0x59)	Responsibility Lost	Sent to an ASP when it losses responsibility or if a non-responsible ASP polls a position report.

Table 5 Event Codes

3.6 Change of Flag

No shipborne equipment LRIT configuration / registration at Iridium exists for Iridium GMDSS LRIT. Hence, the ASP shall coordinate a deactivation / activation without Iridium.

Note:

- There is no guard in place to prevent an ASP from taking over shipborne equipment that has not yet been deactivated or disabled by its current responsible ASP.
- There is no method for the ASP to query Iridium nor the shipborne equipment who is the current responsible ASP of a particular shipborne equipment. To find out, an ASP can either
    a. make a voice call to the shipborne equipment and have them lookup the responsible ASP using the user interface of the terminal; or
    b. contact the other Iridium GMDSS LRIT ASP(s) and have them lookup the shipborne equipment in their database.

When a ship requests Transfer from one Flag Administration to another, the following steps shall be followed by the involved ASPs:

1. The ASP of the current Flag Administration confirms the information from the ship and deactivates the shipborne equipment (see 3.3.2).
2. The ASP of the current Flag Administration then forwards the ship information to the ASP for the new Flag Administration
3. The ASP of the new Flag Administration verifies the ship information and performs an activation of the shipborne equipment (see 3.3.1).