Input paper: [[1]](#footnote-1) ENAV26-5.1.10.1

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**□** ARM **□** ENG **□** PAP **X** Input

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Agenda item [[2]](#footnote-2) 5.1.10

Technical Domain / Task Number 2 ENAV technical domain1

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Preliminary Draft Revision of Recommendation G1139 Technical Characteristics for a VHF data exchange system in the VHF maritime mobile band

# Summary

This document is to make revisions for VDE-SAT based on Recommendation G1139 4th edition. We hope these changes will be adopted.

## Purpose of the document

This document is intended to improve the content in VDE-SAT part, with the following proposals:

Modify some specification description to achieve full-text consistency;

Simplify SBB message structure to improve utilization of time slots;

Modify MAC message structure to control the slotmap dynamically;

Add downlink DSCH in function of logical channel;

Modify EDN to ship and EDN from ship message structures;

Modify uplink and downlink acknowledgement message structures;

Modify uplink and downlink short message structures;

The parameters of Link-ID 20 should be modified;

Add two types of Gold Sequences.

Add the field of message size in resource request.

9 items of supplemental descriptions, 20 items of technical proposals and 6 items of corrections are summarized in Table 1. All revisions proposed in this document improve the content of VDE-SAT part compared with G1139 2020. The new slot map method is more flexible to deal with dynamic users loads. Some message structures are modified to make the definitions of link layer clearer.

Summary of the whole revisions

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | Type | Number | Content | Chapter |
|  | Supplemental Description | 9 | Advise to add detailed description of Enhanced Random Access | 3.1 SBB frag1 [2] |
|  | Advise to add detailed description of SBB backup frequency | 3.1 SBB frag1 [3] |
|  | Advise to add detailed description of SBB overflow LC | 3.1 SBB frag1 [4] |
|  | Advise to add detailed description of Primary Network ID | 3.2 MAC [2] |
|  | Advise to add detailed description of Roaming Network ID | 3.2 MAC [3] |
|  | Advise to add detailed description of “Session ID ship ” set to 0 | 3.3 EDN to Ship [3] |
|  | Advise to add detailed description of "Set Session ID to 0 for short message ACK" | 3.4 EDN from Ship [3] |
|  | Advise to add detailed expression of EDN to Ship | 3.3 EDN to Ship [1] |
|  | Advise to add detailed expression of EDN from ship | 3.4 EDN from Ship [1] |
|  | Technical Proposals | 20 | Delete the field of Network status in SBB frag1 | 3.1 SBB frag1 [1] |
|  | Add the field of logical channel cycle in SBB | 3.1 SBB frag1 [5] |
|  | Change "Total message size of all..." to "fragments including overflow" and shorten its size to 1Byte. | 3.1 SBB frag1 [6] |
|  | Renumber the communication frequency | 3.1 SBB frag2~4 [1] |
|  | Delete the field of logical channel slot sizes | 3.1 SBB frag2~4 [2] |
|  | Delete logical channel function, and place the slotmap into MAC to realize dynamic resource allocation. | 3.1 SBB frag2~4 [3] |
|  | Add DSCH for downlink ACK of uplink addressed message. | 3.1 SBB frag2~4 [3] |
|  | Add logical channel index A~F. | 3.2 MAC [4] |
|  | Add the field of Satellite ID | 3.3 EDN to Ship [2] |
|  | Change Destination Station ID to Satellite ID | 3.4 EDN from Ship [2] |
|  | Add the field of Ship Station ID | 3.5 Downlink ACK [2] |
|  | Shortened the NACK mask to 2Bytes | 3.5 Downlink ACK [3] |
|  | The value of Payload size should be variable | 3.6 Uplink ACK [2] |
|  | Source Station ID should be changed to Ship Station ID | 3.6 Uplink ACK [3] |
|  | Add the description of Max slots of Uplink DC | 3.6 Uplink ACK [4] |
|  | Source ID should be changed to Satellite ID | 3.7 Downlink Short Message [1] |
|  | Reserve only one type of uplink short message without ACK | 3.7 Uplink Short Message [2] |
|  | Parameters of Link-ID 20 should be modified | 3.9 Link ID 20 |
|  | Two new Gold sequences named SS2 and SS3 are added | 3.10 Gold Sequence |
|  | The field of message size should be added | 3.11 Resource request[1] |
|  | Corrections | 6 | Frame type #18 should be changed to #22 | 3.3 EDN to Ship [4] |
|  | Downlink should be changed to uplink | 3.5 Downlink ACK [1] |
|  | Change the description of “data and short messages” | 3.5 Downlink ACK [4] |
|  | Uplink should be changed to downlink | 3.6 Uplink ACK [1] |
|  | Change the description of “Uplink data” | 3.6 Uplink ACK [5] |
|  | The title of D 3.10.17 is the same with that of D 3.10.18. | 3.8 Uplink Short Message [1] |

## Related documents

[1] IALA. G1139 The Technical Specification of VDES 4th edition, 2020.02.06.

[2] ITU. Word Radiocommunication Conference 2019 (WRC-19) Provisional Final Acts, 2019.11.22

# Background

The technical specification of VDES (hereinafter referred to as G1139 2020) has been prepared to provide technical information required in the development of VDES equipment, which integrates the functions of VDE, ASM and AIS in the VHF maritime mobile band (156.025-162.025 MHz). VDE-SAT provides an efficient satellite data transfer link enabling a wide variety of applications for the maritime community. Almost all the design work of physical layer and link layer has been completed. However, there are also some revision works to refine G1139 2020. Therefore, this document presents some suggestions for G1139 2020, so as to make a contribution to the improvement of VDES technical specification.

# Discussion

## 3.1 Satellite Bulletin Board

The summary of SBB and MAC revision are listed as follows:

1. When SBB and MAC are considered, SBB contains the basic information of terminal access and VDE-SAT system (such as communication frequency, communication bandwidth, etc.) in a short time, while the MAC transmits the dynamic information (such as network status, random selection interval, etc.).

In G1139 2020, SBB transmits the information of slotmap every one minute, which is inflexible to deal with different user loads; If MAC can transmit the information every cycle, the throughput of communication system will be improved.

SBB defines the slotmap by two fields of "logical channel sizes" and "logical channel functions". There are two methods to realize slop mapping. One is to calculate logical channel sizes based on user loads in real time. The other is to store logical channel configurations in advance. The latter is more efficient than former one. Hence, each configuration can be replaced by an index from the slotmap table (cited in Figure 1).

SBB occupies 90 slots in G1139 2020, and it can be simplified based on the above ideas.

Downlink ACK of uplink addressed message and uplink short message, Resource Allocation, Downlink Short Messages, MAC, Paging and EDN are transmitted in ASC, fixed slot size of ASC could not guarantee the necessary signaling to be sent in time especially for Resource Allocation and downlink ACK of uplink addressed message, although the satellite can allocate appropriate time to send these types of signalling. For example, if there are 5 users sending uplink address messages, 2 packets of resource allocation occupied 30 slots and 5 packets of downlink ACK occupied 75 slots need to transmit in ASC. Obviously, it is not enough for ASC with the size of 90 slots. Therefore, DSCH for downlink ACK should be added because both resource allocation and downlink ACK are important for data transmission.

Referring to D 3.10.1 Satellite Bulletin Board, detailed revisions are shown below：

Table 2 Satellite Bulletin Board (up to 6 fragments)

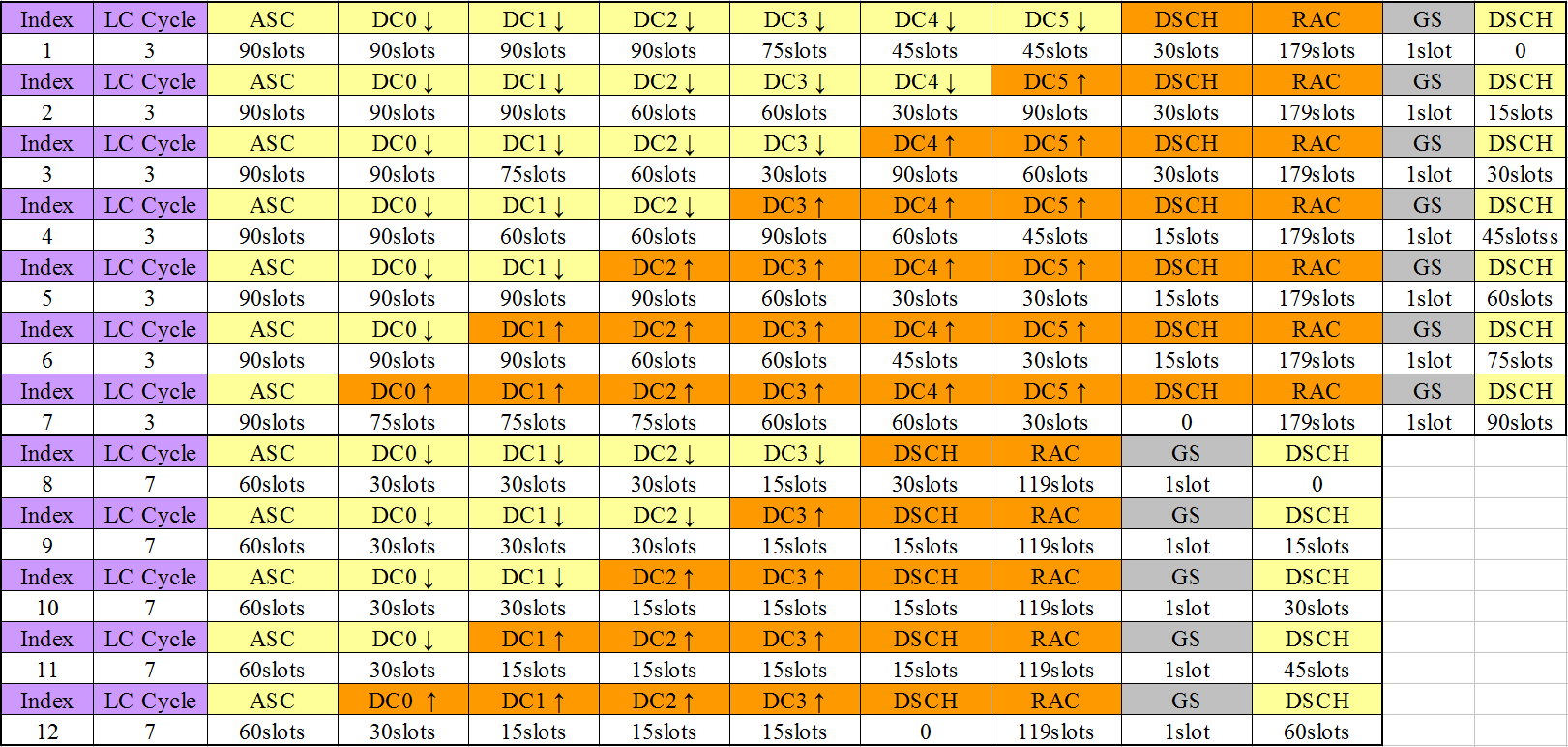
|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Field no | Value (Dec) | Size (Bytes) | Function | Content |
| 1 | 1 | 1 | Type | Bulletin Board start fragment 1, network info |
| 2 |  | 1 | Satellite ID | 0-255 |
| 3 |  | 1 | Primary Network ID | 0-255 |
| 4 |  | 1 | Roaming Network ID | 0-255 |
| 5 |  | 2 | SBB Version | Version number of this Bulletin Board  All valid versions are stored in the ship terminal ~~.~~ |
| 6 |  | 4 | Start time | UTC start time for this version of the Bulletin Board in number of seconds since 1. January 2000 00:00:00 UTC |
| 7 |  | 2 | Validity duration | Lifetime of this version in number of 1 minute frames  Up to 45 days |
| 8 | 0 | 0 | Network status[1] | 0: Operational  1: Reduced availability  2: Network down |
| 9 | 1 | 1 | Service capabilities | 4 MSB Bitmap  2092 version compatibility  4 LSB service capabilities bitmap  Bit3: Reserved for future use. Default = 0.  Bit2: Reserved for future use. Default = 0.  Bit1: Reserved for future use. Default = 0.  Bit0: Reserved for future use. Default = 0; Set to 1 for Enhanced Random Access[2] Supported. |
| 10 |  | 1 | SBB backup frequency[3] | As defined in ITU-R M.1084 |
| 11 |  | 2 | Max Uplink Msg Size | Maximum message uplink size allowed in kilo Bytes [kB]. |
| 12 |  | 1 | SBB overflow LC[4] | Default 0. |
| 13 | 3 | 1 | Logical channel cycle[5] | Logical channel cycle in one minutes, default 3. |
| 14 |  | 1 | fragments including overflow[6] | Bitmapp:  Bit0~bit5: SBB Fragment 1~6;  Bit6~bit7: Reserved for overflow.  Set to 1 when SBB fragments are sent. |

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| Issues for SBB Fragment 1 |
| [1] This field is already included in MAC frame. MAC is more efficient because it transmits in each cycle. Thus, it could be removed in this fragment. |
| [2] Detailed description of Enhanced Random Access should be added. |
| [3] There is no detail about SBB backup frequency. If this field is necessary, it can be shortened to 1Byte according to fragment 2~4 of SBB in G1139 2020 Table 65 . |
| [4] Detailed description of SBB overflow LC should be added. |
| [5] Add the field of logical channel cycle, which is the number of logical channel cycle in one minute, for the synchronization of baseband signal in every logical channel cycle. |
| [6] Suggest to shorten the size of this field to one byte. As all SBB fragments are in fixed length, one byte is enough due to one bit corresponding to one fragment.  Bitmap :  Bit0~bit5: SBB fragment 1~6;  Bit6~bit7: Reserved for overflow.  Set to 1 when SBB fragments are sent. |

Satellite Bulletin Board (Fragment 2~4)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Field no | Value (Dec) | Size (Bytes) | Function | Content |
| 1 | 2 | 1 | Type | Logical Channels 0-23 definition, frequency pairs A and B. |
| 2 | As defined in ITU-R M.1084 | 1 | Downlink frequency A[1] | Channel number as defined in ITU-R M.1084  Default:  2226: 161.9125MHz (for 50kHz bandwidth) |
| 3 | As defined in ITU-R M.1084 | 1 | Uplink frequency A[1] | Channel number as defined in ITU-R M.1084  Default:  1226: 157.3125 MHz (50kHz bandwidth) |
| 4 |  | 1 | Downlink and uplink bandwidth | First 4 bits defines downlink bandwidth.  1: 50 kHz (default)  2: 100 kHz  3: 150 kHz  Last 4 bits define uplink bandwidth  1: 50 kHz (default)  2: 100 kHz  3: 150 kHz |
| 5 |  | 0 | Logical channel slot sizes[2] | Up to 12 LCs on a frequency pair 1, multiple of 15 slots, 4 bits per LC (max size 15x15=225 slots)  Default SBB slot sizes. 90, 90, 30, 90, 90, 90, 90, 30, 30, 180, 0, 0. The slot sizes except SBB are repeated until frame is full (2250 slots) |
| 6 |  | 0 | Logical Channel function[3] | 4 bits per LCs  0: BBSC  1: ASC  2: DSCH  3: RAC  4: DC, Data up or down (Dynamic, given in Resource Allocation message)  5: Empty  Default: 0, 1, 4, 4, 4, 4, 4, 4, 2, 3, 5, 5 |
| 7 | As defined in ITU-R M.1084 | 1 | Downlink frequency B[1] | Channel number as defined in ITU-R M.1084  Default:  1226: 157.3125 MHz (50kHz bandwidth) |
| 8 | As defined in ITU-R M.1084 | 1 | Uplink frequency B[1] | Channel number as defined in ITU-R M.1084  Default:  2226: 161.9125 MHz (50kHz bandwidth) |
| 9 |  | 1 | Downlink and uplink bandwidth | First 4 bits defines downlink bandwidth.  1: 50 kHz (default)  2: 100 kHz  3: 150 kHz  Last 4 bits define uplink bandwidth  1: 50 kHz (default)  2: 100 kHz  3: 150 kHz |
| 10 |  | 0 | Logical channel slot sizes[2] | Up to 12 LCs on a frequency pair 1, multiple of 15 slots, 4 bits per LC (max size 15x15=225 slots)  Default SBB slot sizes. 90, 90, 30, 90, 90, 90, 90, 30, 30, 180, 0, 0. The slot sizes except SBB are repeated until frame is full (2250 slots) |
| 11 |  | 0 | Logical Channel function[3] | 4 bits per LCs  Default: 0, 1, 4, 4, 4, 4, 4, 4, 2, 3, 5, 5  See “SBB Fragment 2” for more details. |

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| **Issues for SBB Fragment 2~4** |
| [1] According to final acts in WRC-19, the VDE-SAT communication band from 157.2MHz to 161.925MHz can be numbered at intervals of 25kHz, and the channel number is from 0 to 189 shown in following table. Thus, One Byte is enough even for the whole VDE communication band from 156.025MHz to 162.025MHz (channel number is from 0~240). |
| [2] [3] Two fields of logical channel size and logical channel function should be removed, and slotmap can be transmitted in MAC. Two reasons are expressed as follows:   1. Because the resource allocation and paging are from the satellite, the channel functions are determinate for that. Thus the slotmap of logical channels can be configured by the index of slotmap table. 2. Slotmap configurations for 6 channel pairs are placed into MAC due to dynamic slot configuration for satisfying different user loads. |
| [3] Downlink DSCH for ACK should be added in the logical channel functions. Uplink ACK is transmitted in DSCH, while downlink ACK is placed in ASC. Because it takes at least one minute for the slotmap to switch, it is difficult to adapt to the user load in time. Thus, the following problems will be caused if all DCs are allocated for uplink addressed message:   1. Lower slot usage rate: uplink DSCH is not used; 2. Conflict of signalling transmitted in ASC: due to the limited slot size of ASC, resource allocation and downlink ACK could not be transmitted in ASC at the same time in some situations, which will cause signalling transmission conflict.   Therefore, downlink DSCH for ACK should be added in the logical channel functions. Combining with dynamic configuration for slotmap, the usage rate of slots could be improved and conflict of important signaling could be solved. In the following figure, "yellow" is for downlink, "blue" is for either downlink or uplink, "orange" is for uplink, and "gray" is for no transmission.   |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | BBSC | ASC | DC0 | DC1 | DC2 | DC3 | DC4 | DC5 | DSCH | RAC | GS | DSCH |   According to the above revisions, SBB can be shortened to 3 fragments occupied 45slots based on the current design of physic layer.  In Figure 1, 12 types of slotmap (two types of logical channel cycle, 3 & 7) are shown. In DC0 ~ DC5, it is better to choose small DC number for downlink transmission, and to choose big DC number for uplink transmission, because switching from uplink to downlink will cause data collision from ships. MAC consists of the index in slotmap table at the beginning of every cycle. |



Slotmap Table with LC cycle 3 and LC cycle 7

## 3.2 Media Access Control

Referring to D 3.10.2 Media Access Control, detailed revisions are shown below：

Media Access Control [1]

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Field no | Value (Dec) | Size (Bytes) | Function | Content |
| 1 | 10 | 1 | Type |  |
| 2 | 10 | 2 | Payload size | Fixed of fields 3 to 17. |
| 3 |  | 1 | Satellite ID | 0-255 |
| 4 |  | 1 | Primary Network ID[2] | 0-255 |
| 5 |  | 1 | Roaming Network ID[3] | 0-255 |
| 6 | 0 | 1 | Media Access Priority | 0: All accesses allowed  1: All accesses except Short Data Message Allowed  2: Only Resource Request/Response allowed  255: No accesses allowed; system busy |
| 7 | 12 | 1 | Random selection interval | In multiple of 15 slots  Default set to 12 (12 x 15 = 180 slots)  The ship terminal generates a uniformly distributed random number between 0 and this number. This number multiplied by 15 determines RAC slot number, and is rounded up to next slot on a grid given by the Link ID. For the default Link ID 20, the RAC transmissions starts on a 5 slot grid. |
| 8 | 3 | 1 | Short Uplink Data Message access limit | Maximum number of short messages allowed during a 15 minute interval.  Default: 2 |
| 9 | 0 | 1 | Network status | 0: Operational  1: Reduced availability  2: Network down |
| 10 | 3 | 1 | ARQ/timeout limits | 4 MSB Number of fragment retries  Default: 3 retries for a fragment.  4 LSB: Timeout timer setting  Reserved for future use. Default = 0. |
| 11 |  | 2 | Bulletin Version number | Maps to SBB version number. |
| 12 |  | 1 | Logical channel index A [4] | Index of slotmap table |
| 13 |  | 1 | Logical channel index B [4] | Index of slotmap table |
| 14 |  | 1 | Logical channel index C [4] | Index of slotmap table |
| 15 |  | 1 | Logical channel config D [4] | Index of slotmap table |
| 16 |  | 1 | Logical channel index E [4] | Index of slotmap table |
| 17 |  | 1 | Logical channel index F [4] | Index of slotmap table |

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| **Issues for Media Access Control** |
| [1] LEO satellites move fast and make communications with ships for several minutes each time. Besides, the effective coverage area of the satellite is relatively wide, which can normally reach thousands of kilometers. Due to the large ocean area, the ship activity area is not fixed and not evenly distributed, which leads to great differences in access ships at different times and in different places. According to the current standard, the configuration cycle of slotmap is 1 minute, which is too long and cannot meet the current ship access characteristics. Therefore, that dynamic configuration of slotmap is required for each logical channel cycle. |
| [2] Detailed description of Primary Network ID also shown in SBB should be added. |
| [3] Detailed description of Roaming Network ID also shown in SBB should be added. |
| [4] Add six fields of “logical channel index A~F” with size of 1 Bytes. Two fields of "logical channel sizes" and "logical channel functions in SBB Fragment 2~4 are removed, and replaced by the new fields of “logical channel index A~F” accordingly. |

## 3.3 End Delivery Notification to ship

Referring to D 3.10.10 End Delivery Notification to ship, detailed revisions are shown below：

End Delivery Notification to ship[1]

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Field no | Value (Dec) | Size (Bytes) | Function | Content |
| 1 | 18 | 1 | Type |  |
| 2 | 5-30 | 2 | Payload size | Size of fields 3 to 14. |
| 3 |  | 1 | Satellite ID[2] | 0-255 |
| 4 |  | 4 | Ship 1 Station ID | The Unique Identifier of the ship station. |
| 5 |  | 1 | Session ID ship 1 | Set to 0 for short uplink messages.[3] |
| 6 |  | 4 | Ship 2 Station ID | The Unique Identifier of the ship station  Set to 0 when empty. |
| 7 |  | 1 | Session ID ship 2 | Set to 0 for short uplink messages.[3] |
| 8 |  | 4 | Ship 3 Station ID | The Unique Identifier of the ship station  Set to 0 when empty. |
| 9 |  | 1 | Session ID ship 3 | Set to 0 for short uplink messages.[3] |
| 10 |  | 4 | Ship 4 Station ID | The Unique Identifier of the ship station  Set to 0 when empty. |
| 11 |  | 1 | Session ID ship 4 | Set to 0 for short uplink messages.[3] |
| 12 |  | 4 | Ship 5 Station ID | The Unique Identifier of the ship station  Set to 0 when empty. |
| 13 |  | 1 | Session ID ship 5 | Set to 0 for short uplink messages.[3] |
| 14 |  | 4 | Ship 6 Station ID | The Unique Identifier of the ship station.  Set to 0 when empty. |
| 15 |  | 1 | Session ID ship 6 | Set to 0 for short uplink messages.[3] |

Referring to D 3.12.5 Satellite to ship addressed message with EDN,



Satellite to ship addressed message with EDN[4]

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| **Issues for EDN to ship** |
| [1] The function of "EDN to ship" should be added in detail. From the expression of EDN and data transfer protocol in D 3.12, the function of EDN to ship is ambiguous. EDN is used to end the session and only for addressed message according to data transfer protocol. However, it is also used in short message according to the field content. These descriptions are misleading and the detail should be added. |
| [2] Add the field of satellite ID, in order to complete the frame structure. |
| [3] It should be expressed in detail. Firstly, the name "short uplink messages" is not uniform in the whole text and could be replaced by "uplink short messages"; Secondly, from the point of data transfer protocol, END is not for short messages, and the description of "set 0..." is not clear. |
| [4] In Figure 2，the frame type of EDN from a ship is 18，but "#18" is END to a ship. Thus, "#18" should be"#22" in the figure. |

## 3.4 End Delivery Notification from ship

Referring to D 3.10.11 End Delivery Notification from ship, detailed revisions are shown below：

End Delivery Notification from ship[1]

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Field no | Value (Dec) | Size (Bytes) | Function | Content |
| 1 | 22 | 1 | Type |  |
| 2 |  | 4 | Ship Station ID | The Unique Identifier of the ship station |
| 3 |  | 1 | Satellite ID[2] | 0-255 |
| 4 |  | 1 | Session ID | Set to 0 for Short Message ACK.[3] |

This message may be used by the application on a vessel to confirm reception a downlink message. [4]

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| --- |
| **Issues for EDN from ship** |
| [1] The function of "EDN from ship" should be added in detail. From the expression of EDN and data transfer protocol in D 3.12, the function of EDN from ship is ambiguous. EDN is used to end the session and only for addressed message according to data transfer protocol. However, it is also used in short message according to the field content. These descriptions are misleading and the detail should be added. |
| [2] The field of "Destination Station ID" should be replaced to "Satellite ID", which is necessary for link layer communication. In addition, the frame including two ship IDs is a hybrid of the link layer and the application layer. |
| [3] That session ID set to 0 is for short message ACK in EDN from ship is ambiguous. Because uplink ACK for downlink short message is already defined in frame type #13. |
| [4] This sentence should be deleted. Because the function of each layer should be clear. |

## 3.5 Downlink Acknowledgement

Referring to D 3.10.12 Downlink Acknowledgement, detailed revisions are shown below：

Downlink Acknowledgement[1]

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Field no | Value (Dec) | Size (Bytes) | Function | Content |
| 1 | 29 | 1 | Type |  |
| 2 |  | 1 | Satellite ID |  |
| 3 |  | 4 | Ship Station ID[2] |  |
| 4 |  | 1 | Downlink CQI |  |
| 5 |  | 2 | NACK mask[3] | Lost fragments/packets set to 1. All fields are set to 0 for short messages.  Oldest packet is LSB |

Note:

Used for the uplink ACK of downlink data and short messages [4] .

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| **Issues for Downlink Acknowledgement** |
| [1] The title of Table 7 is not consistent with the Note below the table. "Downlink Acknowledgement" should be replaced by "Uplink Acknowledgement", according to the transmission link. |
| [2] The field of "Ship station ID" should be added, because the satellite can't recognize the source of this ACK. |
| [3] Because the max size of one LC is 225 slots (cited in Table 65), there are 15 fragments in one period with Link-ID = 33/34 (15 slots/burst size), i.e. two bytes are enough for uplink ACK. |
| [4] In Annex D3.12, "short message" is written as "short data message". They should be written uniformly and the name of "short message" is recommended. |

## 3.6 Uplink Acknowledgement

Referring to D 3.10.13 Uplink Acknowledgement, detailed revisions are shown below：

Uplink Acknowledgement [1]

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Field no | Value (Dec) | Size (Bytes) | Function | Content |
| 1 | 13 | 1 | Type |  |
| 2 | 32[2] | 2 | Payload size | Size of fields 3 to 8. |
| 3 |  | 1 | Satellite ID[3] | 0-225 |
| 4 |  | 4 | ship Station ID[3] | The Unique Identifier of the ship station |
| 5 |  | 1 | Session ID | 1-255 |
| 6 |  | 1 | Resource re-allocation | Number of future packets the Logical Channel may be used for. |
| 7 |  | 1 | Uplink CQI |  |
| 8 |  | 1 | Adaptive  Coding and  Modulation  Control | 4 MSB  0: Maintain Link ID  1: Select Link ID with next higher CQI  2: Select Link ID with next lower CQI  4 LSB  0: Use default power level for current Link ID  1: Reduce Power level 10 dB  2: Reduce power level 3 dB  3: Increase power level 3 dB |
| 9 |  | 23 | NACK mask[4] | Lost fragments/packets set to 1.  Oldest packet is LSB |

Note:

Used for the downlink ACK of uplink data[5].

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| --- |
| **Issues for Uplink Acknowledgement** |
| [1] The title of Table 8 is not consistent with the Note below the table. "Uplink Acknowledgement" should be replaced by "Downlink Acknowledgement", according to the transmission link. In addition, two types of downlink ACK are necessary, one is for short messages transmitted in ASC, and the other is for addressed message transmitted in downlink DSCH. For downlink ACK of uplink short message, the fields of Session ID and Resource re-allocation are unnecessary and the size of NACK mask can be one byte. |
| [2] The value of Payload Size should be variable according to the size of NACK mask. |
| [3]   1. "Source Station ID" is ambiguous, and it should be replaced by "Ship Station ID". Because the communication of link layer is between one ship and one satellite. The communication of ship-to-ship is a combination of ship-to-satellite and satellite-to-ship, which is two communication flows. 2. Correspondingly, the field of Satellite ID should be added in this frame. |
| [4] The max size of one LC is 225 slots (cited in Table 65), then there are 225 fragments with Link-ID = 21 (1slots/burst size), i.e. The size of NACK mask should be 29 Bytes which exceeds the max size of one burst with Link-ID = 32. Thus, the max slot size of one DC should be specially expressed in Table 65. |
| [5] "data" should be replace by "addressed messages and short messages". Only messages have ACK. |

## 3.7 Downlink Short Message

Referring to D 3.10.14 Downlink Short message (with and without Ack) , detailed revisions are shown below：

Downlink Short Message (with Ack)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Field no | Value (Dec) | Size (Bytes) | Function | Content |
| 1 | 14/16 | 1 | Type |  |
| 2 |  | 2 | Payload size | Size of fields 3 to 6. |
| 3 |  | 1 | Satellite ID [1] |  |
| 4 |  | 4 | Ship Station ID | The Unique Identifier of the destination station |
| 5 |  | Variable | Payload | Binary data. |

|  |
| --- |
| **Issues for Uplink Acknowledgement** |
| [1] "Source ID" should be replaced by "Satellite ID". Both "Source ID" and "Ship Station ID" are 4 Bytes, which means that the short messages can be transmitted from one ship to another ship by one satellite at the same time. In Figure 63 (satellite to ship short data message with ACK) and Figure 64 (ship to satellite short data message with ACK) in G1139 2020 which show the protocol of data transferring in the link layer, the protocol is between one satellite and one ship, and the frame structure should be consistent with the data transfer protocol. So, it should be replaced by "Satellite ID". Moreover, if the application of ship-to-ship is considered, the application layer in the satellite can realize the function. |

## 3.8 Uplink Short Message (without Ack)

Referring to D 3.10.18 Uplink Short Message (without Ack)[1], detailed revisions are shown below：

Uplink Short Message (without Ack)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Field no | Value (Dec) | Size (Bytes) | Function | Content |
| 1 | 24-28[2] | 1 | Type |  |
| 2 |  | 4 | Ship Station ID | The Unique Identifier of the source station |
| 3 |  | 5 | Data | Binary data. |

|  |
| --- |
| **Issues for Uplink Short Message without ACK** |
| [1] D 3.10.18 has the same title with D 3.10.17. The title of D 3.10.18 should be changed to "Other Types of Uplink Short Message (without ACK)". |
| [2] There are five types of uplink short message, but the differences between them are not shown. |

## 3.9 Link ID 20

The following table shows C/(N0+I0) threshold of different Link ID referring Table 10 VDE-SAT Uplink ID parameters in G1139 2020 A1.2.7.

C/(N0+I0) of Link ID 20, 21, 22, 23, 24

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Link ID | 20 | 21 | 22 | 23 | 24 |  |
| Burst size | 5 | 1 | 3 | | | slots |
| FEC output bytes | 12 | 92 | 390 | 568 | 947 | bytes |
| C/(N0+I0) threshold | 32.3 | 49.2 | 49.2 | 53.3 | 57.5 | dBHz |

The following table shows C/(N0+I0) threshold of different Link ID referring Table 12 VDE-SAT Downlink ID Parameters in G1139 2020 A1.2.7.

C/(N0+I0) of Link ID 32, 33, 34

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Link ID | 32 | 33 | 34 |  |
| Burst size | 15 | | | slots |
| FEC output bytes | 39 | 535 | 1040 | bytes |
| C/(N0+I0) threshold | 31.6 | 41.7 | 44.7 | dBHz |

According to the downlink budget in G1139 2020 D2.2.3,

VDE-SAT downlink budget as function of elevation angle

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Ship elevation angle  (degrees) | Satellite EIRP in circular polarization  (dBW) | Satellite range  (km) | Path loss  (dB) | Polarization loss  (dB) | Ship antenna gain  (dBi) | Carrier level at LNA  (dBm in 50 kHz) | C/N0  (dBHz) | | C/(N0+I0) (dBHz) |
| 0 | −2.2 | 2 829 | 145.7 | 3 | 3 | -117.8 | 50.5 | 43.2 | |
| 10 | −2.2 | 1 932 | 142.4 | 3 | 3 | -114.5 | 53.8 | 46.5 | |
| 20 | −2.2 | 1 392 | 139.5 | 3 | 2.5 | -112.2 | 56.2 | 48.8 | |
| 30 | −2.4 | 1 075 | 137.3 | 3 | 1 | -111.6 | 56.7 | 49.4 | |
| 40 | −3.3 | 882 | 135.5 | 3 | 0 | -111.8 | 56.5 | 49.2 | |
| 50 | −4.7 | 761 | 134.3 | 3 | −1.5 | -113.4 | 54.9 | 47.6 | |
| 60 | −6.6 | 683 | 133.3 | 3 | −3 | -115.9 | 52.5 | 45.1 | |
| 70 | −9.5 | 635 | 132.7 | 3 | −4 | -119.1 | 49.2 | 41.8 | |
| 80 | −12.4 | 608 | 132.3 | 3 | −10 | -127.7 | 40.7 | 33.3 | |
| 90 | −15.7 | 600 | 132.2 | 3 | −20 | -140.9 | 27.5 | 20.1 | |

According to the uplink budget in G1139 2020 D2.3.3,

VDE-SAT uplink budget as function of elevation angle

| Ship elevation angle (degree) | Ship antenna gain  (dBi) | Ship e.i.r.p. (dBW) | Polarization loss (dB) | Path length (km) | Path loss  (dB) | Satellite antenna gain (dBi) | Carrier level at LNA, including feed loss  (dBW) | C/N0  (dBHz) |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| deg | dBi | dBW | dB | km | dB | dBi | dBW | dB |
| 0.0 | 3.0 | 10.8 | 3.0 | 2 829 | 145.7 | 8.0 | –130.9 | 72.0 |
| 10.0 | 3.0 | 10.8 | 3.0 | 1 932 | 142.4 | 8.0 | –127.6 | 75.3 |
| 20.0 | 2.5 | 10.3 | 3.0 | 1 392 | 139.5 | 8.0 | –125.2 | 77.6 |
| 30.0 | 1.0 | 8.8 | 3.0 | 1 075 | 137.3 | 7.8 | –124.7 | 78.2 |
| 40.0 | 0.0 | 7.8 | 3.0 | 882 | 135.5 | 6.9 | –124.9 | 78.0 |
| 50.0 | –1.5 | 6.3 | 3.0 | 761 | 134.3 | 5.5 | –126.5 | 76.4 |
| 60.0 | –3.0 | 4.8 | 3.0 | 683 | 133.3 | 3.6 | –128.9 | 73.9 |
| 70.0 | –4.0 | 3.8 | 3.0 | 635 | 132.7 | 0.7 | –132.2 | 70.7 |
| 80.0 | –10.0 | –2.2 | 3.0 | 608 | 132.3 | –2.2 | –140.7 | 62.1 |
| 90.0 | –20.0 | –12.2 | 3.0 | 600 | 132.2 | –5.5 | –153.9 | 48.9 |

Because Link-ID 32 (15slots/burst size, 39Bytes) is for transmitting downlink signaling (SBB, MAC, Downlink ACK, Paging, Resource Allocation) and Link-ID 20 (5slots/burst size, 12Bytes) is for transmitting uplink signaling (Uplink ACK, Resource Request, Paging Response ), maximum communication elevation angle is determined by reception power and threshold of downlink and uplink under the situation of different elevation angles.

The following table is the comparison of C/(N0+I0) of different Link IDs under the situation of minimum and maximum elevation angle. From the table, three conclusions are derived:

1. The link margin of uplink signalling is too much , 48.9 - 32.3 = 16.6dBHz at elevation angles 90°, while the link margin of downlink signalling is at 80+ degree.

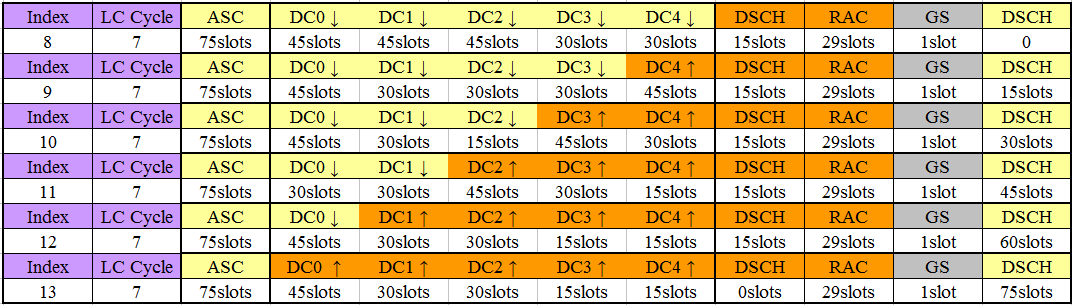
One burst size of Link-ID 20 is 5slot where only 12bytes are transmitted, and the RACH occupies 180 slots which is an example of slotmap in G1139 2020, in order to support 6 DCs accessed by ships.

Based the above points, the burst size of Link-ID 20 can be decreased to 1slot, due to the fact of enough link margin used Link-ID 21 (1slot/burst size) at 80+degree.

Comparison of C/(N0+I0) of different Link IDs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Link ID | 32 | 20 | 21 |  |
| Minimum Elevation Angle (Min EA) | 0 | 0 | 0 | degree |
| Maximum Elevation Angle (Max EA) | 80+ | 90 | 80+ | degree |
| C/(N0+I0) Threshold | 31.6 | 32.3 | 49.2 | dBHz |
| C/(N0+I0) @ Min EA | 43.2 | 72.0 | | dBHz |
| C/(N0+I0) @ Max EA | >33.3 | 48.9 | | dBHz |

From the following figure, if Link-ID 20 is replaced by Link-ID 21, RACH slot size (120) can be decreased to 30, and the uplink DSCH can occupy 15 slots divided into 5 sub-channels due to 5 DCs. Therefore, the utilization rate of DCs is from 42% to 60.67% almost twice than that of Link-ID 20 from 23.33% to 32.67%.



Slotmap with LC cycle 7 based on Link-ID 21

In conclusion, the parameters of Link-ID 20 causes too much link margin and power waste, and these parameters need to be modified to decrease the RACH slot size and improve the slot utilization rate.

## 3.10 Gold Sequence

In order to enable terminals to demodulate the quadruple overlapping signals within the overlapping coverage of the VDE satellite beams, two new Gold sequences named SS2 and SS3 are added.

The comparisons of auto-correlation and cross-correlation of SS2 and SS3, and the cross-correlation between SS0, SS1 and SS2 and SS3 in the G1139 standard are shown in the figures below. Result shows that the four Gold sequences have good cross-correlation performance and can be used in VDE spread spectrum.

Two new Gold sequences

| **Name** | **Spreading Sequence** |
| --- | --- |
| SS2 ||
| SS3 ||

The auto-correlation and cross-correlation of SS2 and SS3 are shown as follows:



Auto-correlation and cross-correlation of SS2 and SS3



cross-correlation of SS0 with SS2 and SS0 with SS3



Cross-correlation of SS1 with SS2 and SS1 with SS3

## 3.11 Resource Request

Referring to D 3.10.5 Resource Request, detailed revisions are shown below：

Resource Request

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Field no | Value (Dec) | Size (Bytes) | Function | Content |
| 1 | 20 | 1 | Type |  |
| 2 |  | 4 | Ship Station ID | The Unique Identifier of station where the message originated from, as described in section 1 |
| 3 |  | 1 | Satellite ID | Destination satellite ID. |
| 4 | 0 | 1 | Priority | 0: Normal  255: Pan-pan |
| 5 | 1 | 1 | Terminal capabilities | See field 3 in Paging Response Message. |
| 6 |  | 1 | Downlink ASC CQI |  |
| 7 |  | 1 | Message size[1] | the size of message transmitted in this session . |

Note:

The message will be transmitted on the RAC by ships during a resource request.

|  |
| --- |
| **Issue for Resource Request** |
| [1] The field of Message size should be added. If the satellite knows the size of message transmitted in this session, it is more efficient to allocate channel resource according to the user data size and it is easier for storage management from the view of engineering application. |

# Action requested of the Committee

We sincerely hope the committee adopts our proposals.

1. Input document number, to be assigned by the Committee Secretary [↑](#footnote-ref-1)
2. Leave open if uncertain [↑](#footnote-ref-2)