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Agenda item [[2]](#footnote-2) 5.1

Technical Domain / Task Number 2 …………………………………

Author(s) / Submitter(s) China MSA

Maritime Safety Information Broadcast by VDES in Bohai Sea

# Background

VHF data exchange system (VDES) is an enhanced and upgraded version of the automatic identification system (AIS) for ships in maritime mobile services. The concept of VDES was proposed by IALA/ITU in 2013. In 2014, the IMO and ITU took VDES as an important part of the implementation of e-navigation strategy. The WRC-15 approved Recommendation ITU-R M.2092-0. The WRC-19 assigned frequencies for the application of VDES satellite component. In February, 2022, Recommendation ITU-R M.2092-1 was released. The G1117 on VDES application scenarios is experiencing revision. China has been actively carrying out the development and application of VDES. Currently VDES is being used to broadcast maritime safety information (MSI) in the Bohai Sea area.

# Brief introduction

The structure of MSI broadcast system is shown in Figure 1. After acquisition of MSI by the data platform the MSI is transferred to the VDES control system immediately. The VDES control system transfers MSI to the base stations of Laotieshan, Beihuangcheng, Beichangshan and Qimudao through wired communication links at appropriate time according to defined rules, and then MSI is broadcast to the ship through VHF link immediately.



1. System structure

The MSI includes weather forecast, meteorological warning, navigational warning and other types, and is broadcast through ASM channel in Chinese which is coded using utf-8.

Four VDES base stations are deployed in LaoTieShan, Beichangshan, Beihuangcheng and Qimudao on the Yantai-Dalian route in the Bohai Sea.



1. Distribution of VDES base station

## Selection of ASM message type

According to Recommendation ITU-R M.2092-1, ASM uses seven types of messages to realize the data transmission. The 7 types are listed as follows in Table 1:

1. ASM message type

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Message ID | Name | Description | Access scheme | Communication state |
| 0 | Broadcast AIS ASM Message | Encapsulated AIS ASM messages. | RATDMA | None |
| 1 | Scheduled Broadcast Message | Broadcast data using communication state. | FATDMA RATDMA MITDMA | MITDMA |
| 2 | Broadcast Message | Broadcast data with no communication state. | FATDMA RATDMA | None |
| 3 | Scheduled Individual Addressed Message | Individual addressed data with communication state. Requires acknowledgement. | FATDMA RATDMA MITDMA | MITDMA |
| 4 | Individual Addressed Message | Individual addressed data with no communication state. Requires acknowledgement. | FATDMA RATDMA | None |
| 5 | Acknowledgment Message | This message is used to provide and acknowledgment for one or more addressed messages. | FATMDA RATDMA MITDMA | None |
| 6 | Geographical Multicast Message | Addressed to a group of stations defined by their geographical location with no communication state. No acknowledgment required. | FATDMA RATDMA | None |

Scheduled broadcast message is selected for the promulgation of MSI. With MITDMA, a chain of scheduled broadcast ASM messages can accommodate 2242 bytes data at most, which is sufficient for one piece of MSI generally.

(1) MSI promulgation using single ASM message

When one piece of MSI can be transmitted using 1-3 time slots, only the RATDMA time slot access algorithm is used. In this case, 1 ASM message is sent, and the maximum effective data length is 158 bytes;

(2) MSI promulgation using multiple ASM messages

When one piece of MSI can be transmitted using 4-43 time slots, the RATDMA and MITDMA time slot access algorithms are used to send the message. The RATDMA slot access algorithm selects the initial available slot, and the MITDMA slot access algorithm selects the subsequent available slots. In this case, 15 ASM messages are sent at most, and the maximum effective data length is 30+158\*14=2242 bytes. Considering the busiest case (the first slot and subsequent 3-slot groups are in different Selection Intervals), the time from the beginning to the end of the transmission is 235\*15/2250=1.6 minutes in which 1+3\*14=43 slots are all used;

(3) Rejection of MSI promulgation

When one piece of MSI can’t be transmitted within 43 time slots, the promulgation is rejected and a negative response is fed back.

## Message definition

Each piece of MSI includes 7 fields which are serial number, type, source, level, time, valid days, and content.

1. MSI definition

|  |  |  |
| --- | --- | --- |
| Field | Type | Description |
| Number | Integer | Serial number of the MSI |
| Type | integer | typhoon warning, gale warning, fog warning, weather forecast, navigational warning |
| Source | string | Source of the MSI |
| Level | string | Vital, important or routine |
| Content | string | Content for the MSI |
| time | string | Reception time by the Data platform |
| Valid days | integer | Valid days for the MSI |

## Broadcast schedule

1) Broadcast time(UTC+8)；

Weather forecast in Chinese: 0800,2000；

Meteorological warning in Chinese, navigational warning in Chinese: 0000,0600,1200,1800.

2) For the important or vital navigational warning, it shall be broadcast immediately after acquisition by the data platform, and then broadcast according to the schedule.

3) For routine navigational warning, it is broadcast according to the schedule; If the information is valid for more than 3 days, it is broadcast according to the schedule in first 3 days, and in the remaining days, it is broadcast at 0600 merely.

4) For the meteorological warning, it shall be broadcast immediately and then broadcast according to the schedule.

## Priority

Based on revised NAVTEX manual and MSI broadcast practice when there are multiple pieces of MSI information to be broadcast at the scheduled broadcast time, the broadcast is arranged according to the following principles:

1) For MSI with different types, vital navigational warning > meteorological warning > important navigational warning > routine navigational warning > weather forecast, in which “>” means “having priority over”.

2) For MSI with the same type, the later it is received by the data platform, the earlier it is broadcast.

## Strategy for mitigating interference

To mitigate interference, the following strategies are used:

For neighbouring base stations, MSI is broadcast using the same ASM channel at different time.

For non-neighbouring base stations, MSI is broadcast using different ASM channels at the same time.

The detailed arrangement is displayed in Table 3：

1. Broadcast arrangement

| Base station | Channel | Time | Contents (in Chinese) |
| --- | --- | --- | --- |
| Laotieshan | ASM1(2027)  161.950 | 0800 2000 | Weather forecast |
| 0000 0600 1200 1800 | Meteorological warning, navigational warning |
| Beihuangcheng | ASM1(2027)  161.950 | 0810 2010 | Weather forecast |
| 0010 0610 1210 1810 | Meteorological warning, navigational warning |
| Beichangshan | ASM2(2028)  162.000 | 0800 2000 | Weather forecast |
| 0000 0600 1200 1800 | Meteorological warning, navigational warning |
| Qimudao | ASM2(2028)  162.000 | 0810 2010 | Weather forecast |
| 0010 0610 1210 1810 | Meteorological warning, navigational warning |

## Effect evaluation

We have installed VDES equipment on three ships. However, due to the Covid-19 pandemic situation, the shipborne VDES station cannot be used to test the reception effect. Considering the VDES base station conforms to the same standard as the shipborne VDES equipment in ASM message reception, the VDES base station is used to test the reception effect. According to the geographical location, LaoTieShan and Beihuangcheng are paired to receive ASM messages mutually, and Beichangshan and Qimudao are paired to receive ASM messages mutually. The following table shows the reception results from June 7, 2022 to June 28, 2022.

1. MSI reception result

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Broadcast station | Laotieshan | Beihuangcheng | Beichangshan | Qimudao |
| MSI number transmitted correctly | 1079 | 1065 | 1079 | 914 |
| Reception station | Beihuangcheng | Laotieshan | Qimudao | Beichangshan |
| MSI number received correctly | 762 | 857 | 675 | 654 |
| Correct reception rate of MSI | 70.62% | 80.47% | 62.56% | 71.55% |
| Distance between transmission station and reception station (n mile) | 22.62 | 22.62 | 28.78 | 28.78 |

The correct reception rate of MSI for Beihuangcheng is 70.62% which is 22.62 nautical miles away from Laotieshan. The correct reception rate of MSI for Laotieshan is 80.47% for Laotieshan which is 22.62 nautical miles away from Beihuangcheng.

The correct reception rate of MSI for Qimudao is 62.56% which is 28.78 nautical miles away from Beichangshan. The correct reception rate of MSI for Beichangshan is 71.55% which is 28.78 nautical miles away from Qimudao.

The overall correct reception rate of MSI is 71.26%. Considering that each piece of MSI such as navigational warning or meteorological warning is broadcast at least four times a day, the correct reception probability of MSI in one day is not less than 99.32%, which indicates a high reliability. Based on statistics, a single piece of MSI requires an average of 5 ASM messages. According to the overall correct reception rate of MSI 71.26%, it can be estimated that the average correct reception rate of ASM message is 93.4%.

# References

1. Recommendation ITU-R M 2092-1
2. G1117 VHF DATA EXCHANGE SYSTEM (VDES) OVERVIEW

# Action requested of the Committee

The Committee and interested parties are invited to consider the information provided in this paper and carry out multi-party cooperation on the application of VDES system.

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