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Expert Working Group for Mutual Exchange and Deliveries
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AIS EWG 30-2019

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|------------------------|---|
| Document title | EMSA document on AIS data buffering and retransmission by Member States |
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| Submitted by | Poland |
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Background

The attached EMSA document (SSN/LRIT 4.5.4) related to AIS data buffering and retransmission by Member States is submitted for information and discussion at AIS EWG 30-2019.

Action requested

The Meeting is invited to take note of and discuss the document, e.g.:

- how HELCOM countries are dealing (or planning to arrange solution) with this issue;
- whether Norway might be interested in changing of C-Scope proxy software to meet EMSA expectations and requirements.

Meeting: 4th SSN / LRIT Group Meeting

Place and date: Lisbon, 23 October 2018

Agenda item: AIS data quality report

Document number: SSN/LRIT 4.5.4

Submitted by EMSA

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|---------------------------|--|
| Summary | This document presents the issues related to AIS data buffering and retransmission by Member States, and proposes the execution of verification tests. |
| Action to be taken | As per paragraph 3. |
| Related documents | SSN Interface and Functionalities Control Document (IFCD). |

1. Background

This paper illustrates the importance of AIS data buffering and retransmission in the event of technical or communications malfunction in the data flow chain between national AIS servers and the central SSN system, and proposes the execution of certain tests to verify that these functionalities are properly implemented.

AIS data is mainly used for tracking of vessel positions in real time (although historical AIS data is also valuable), and the buffering of AIS data is directly linked to the quality of SSN services. EMSA receives regular requests from the Member States for historical AIS data, such as: from the German Waterways Police related to ship recycling; from the Spanish administration related to 2 fishing vessels, and; from the Greek SSN NCA and the Spanish PoC of IMS for a set of 4 vessels.

In order to reduce the risk of losing AIS data when there is a technical or communications malfunction, AIS buffering is an important functionality that allows the storage of data during the time of malfunction, and its re-transmission as soon as the connection resumes. However, AIS buffering can only succeed if it is applied to all of the elements in the information flow, as shown in Figure 1.



Figure 1: AIS information flows

AIS buffering measures have already been applied as follows:

- a. EMSA developed the SSN streaming interface (SSN SI), which is installed at Regional Server sites in order to store AIS data for up to 12 hours (with or without down sampling). EMSA signed SLAs with Italy and Norway (countries hosting the AIS Regional Servers) for the hosting, monitoring, updating and testing of the SSN SI. In the event of a failure of the SSN SI, the regional AIS server buffers the received messages for up to 12 hours, and then re-transmits them once the connection to SSN SI resumes.

- b. The technical solution implemented by AIS regional servers ensures that the national proxies (NPRs) installed at Member States sites begin storing the AIS information in a local database (or the RS disk cach) when the connection with the regional AIS server is down, and then send both the real time and the stored information to the AIS regional server when the connection is restored.

In cooperation with Norway and Italy, EMSA carried out an analysis of the data buffering and re-transmission functionalities following incidents that took place between June and August 2018 (when the AIS data flow was discontinued e.g. due to maintenance). The methodology used and the results are presented in Annex I.

The EMSA analysis showed that many MSs already apply buffering/re-transmission at national level. However, the situation was not conclusive for all cases, so further analysis and testing will be necessary.

The analysis also demonstrated that a critical element in the data exchange architecture is the communication link between the national AIS system and the NPR. The functionalities for buffering and re-transmission of the stored information need also to be ensured by national AIS systems. Thus, national AIS servers should be capable of recognising that the connection with the NPR is unavailable, and of buffering the data and retransmitting it to the NPR when the connection is restored.

2. EMSA proposal

EMSA considers that it is necessary to conduct systematic tests in order to verify whether data buffering and re-transmission is being carried out properly at all stages in the data exchange information chain shown in Figure 1 (i.e. national AIS servers, NPRs, regional AIS servers and the SSN SI).

These tests would be conducted by involving individual Member States and the relevant AIS Regional Servers in specific test scenarios. The detailed test scenarios should be agreed at a later stage, but a first draft is shown in Annex 2.

If Member States agree on the proposed way forward, the tests will be scheduled at agreed times, and the results will be presented at the SSN group meetings, thus allowing Member States to assess any possible improvements which may be required.

Furthermore, the procedure for the buffering and re-transmission of AIS data by Member States needs to be drafted and included in the Common Operational Procedures (COP) document.

3. Actions required

Member States are invited to provide their comments on the proposals in section 2.

ANNEX 1

AIS data buffering analysis

1. Introduction

AIS data buffering is directly linked to data quality. Section 4.4 of the IFCD requires Member States to ensure that SSN messages are stored and transmitted to the central SSN system when communications and/or systems have recovered. Considering the importance of data buffering and re-transmission, EMSA has analysed the AIS data provision incidents spotted during June – August 2018. The results of analyses by Member State are presented in section 4 of this Annex.

2. Methodology

The data re-transmission capabilities were analysed using the QLIK¹ monitoring tool, by comparing the values “Create_DT” (presents the number of messages recorded in SSN by their reception time stamp) and “Contact_DT” (presents the number of messages recorded in SSN by their creation time stamp). Under normal conditions, both sensors should show a positive value (i.e. incoming messages recorded by their reception time stamp and creation time stamp).

In the event of a failure, the “Create_DT” value becomes “0”, confirming that the messages have not been received by the central SSN system (i.e. the message reception time stamp is not recorded). In case the data is re-transmitted following the incident, the “Contact_DT” shows positive values for the incident period, confirming that messages were received (i.e. the message creation time stamp was recorded) (see Fig. 1):

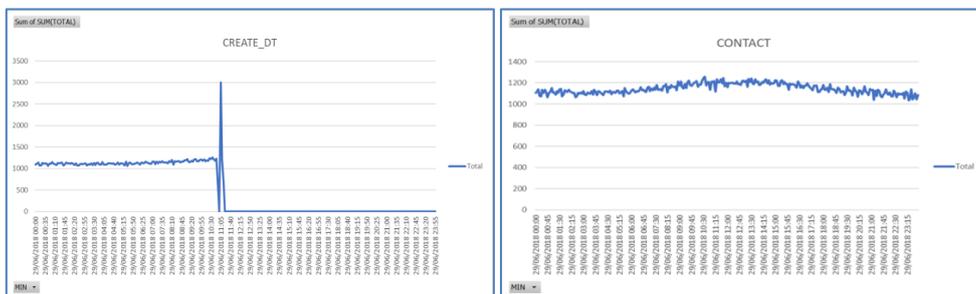


Fig. 1: Data retransmission

The “Contact_DT” value “0” for the incident period confirms that the data were not retransmitted (i.e. the message creation time stamp was not recorded). Figure 2 demonstrates the data transmission failure:

¹ Qlik is a software for data visualization, executive dashboards and self-service business intelligence. QlikView supports visual data discovery, self-service reporting, and the development and sharing of data dashboards.

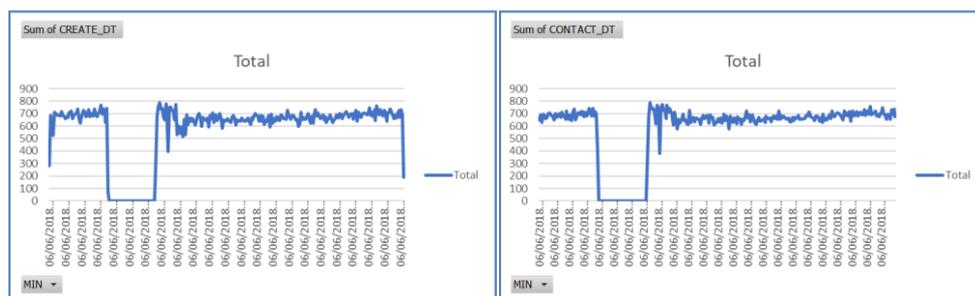


Fig 2: Data retransmission failure

The SEG application was also used to filter ships movements since the analysis of the AIS tracks visualizes whether data has been re-transmitted (i.e. if the vessel track is complete or not).

3. Summary of findings

EMSA carried out analysis of the data buffering and re-transmission functionalities following incidents that occurred in the AIS systems of 14 Member States (when the data flow was discontinued e.g. due to maintenance) between June and August 2018. A summary of the findings can be seen in Table 1:

| Member State | Date | Retransmission | Comments |
|--------------|---|----------------|---|
| Belgium | 09.02.2018 | Y | EMSA/RS/Belgium exercise |
| Croatia | 23-24.06.2018 | Y | |
| Estonia | 02-03.07.2018 | N | |
| Finland | 02.08.2018 | N | |
| France | 02.-04.06.2018 19.06.2018 | N N | |
| Iceland | 29.06.-02.07.2018 | Y | |
| Italy | 27.07.2018 | Y | A specific condition causing the incident was reported. |
| Latvia | 26-27.07.2018 01.08.2018 07.08.2018 | N Y N | Unstable behaviour. Additional test is needed. |
| Lithuania | 28-29.07.2018 | N | |
| Malta | 07-08.07.2018 11-12.07.2018 15-16.07.2018 | N N N | |
| Poland | 03. 06. 2018 04. 06. 2018 06. 06. 2018 | N N N | |
| Portugal | 03.08.2018 | N | A specific condition causing the incident was reported. |
| Slovenia | 29.01.2018 09.03.2018 | Y | EMSA/RS/Slovenia exercise |
| Sweden | 06.06.2018 | N | |

Table 1: Summary of findings

4. Data buffering analysis per Member State

CROATIA

SSN Croatia provided T-AIS data intermittently from 23 Jun 18:33 to 24 Jun 13:24 [MSS Status Report 25.06.2018 // ticket = MSS-207938]. The analysis showed that buffered data was provided following the incident (the "Contact_DT" sensor had a positive value for the incident period). However, the recovery period and the data rate for that period was too long. The issue will be further monitored by both, the regional server and EMSA.

Conclusion: SSN Croatia re-sent T-AIS data when the communication and/or system were re-established. Additional testing is required.

ESTONIA

SSN Estonia did not provide T-AIS data from 2 July 21:46 to 03 July 07:13 [MSS Status report 03/07/2018 / Ticket=MSS-208433]. The incident was analysed using the QLIK queries. The "Contact_DT" sensor showed "0" values for the incident period indicated by sensor "Create_DT". This confirms that the buffered data were not re-transmitted.

Conclusion: SSN Estonia did not re-send the information when the communication and/or system were re-established.

FINLAND

SSN Finland did not provide T-AIS data to HELCOM on 2 August from 03:46 to 05:54 [MSS Status Report 01/08/2018 // ticket=MSS-210326]. The incident was analysed using the QLIK queries. The "Contact_DT" sensor showed "0" values for the incident period indicated by the "Create_DT" sensor. This confirms that the buffered data were not re-transmitted.

Conclusion: SSN Finland did not re-send the information when the communication and/or system were re-established.

FRANCE

SSN France did not provide AIS data to North-Sea RS from 02.06.2018 23:37 to 04.06.2018 07:49 [Status Report 05/06/2018 // ticket=MSS-206684]. The incident was analysed using the QLIK queries. The "Contact_DT" sensor shows "0" values for the incident period, which is indicated by the "Create_DT" sensor. This confirms that the buffered data were not re-transmitted.

Furthermore, SSN France did not provide T-AIS data to North-Sea RS on 19 June from 07:47 to 09:49 and from 19:25 to 20:54 [MSS Status Report 20.06.2018 // ticket = MSS-207620]. The incident was analysed using the QLIK queries. The "Contact_DT" sensor shows "0" values for the incident period. This confirms that the buffered data were not re-transmitted (the messages creation time stamps were not recorded). The same results were observed also for several other incidents occurred during July 2018.

Conclusion: SSN France did not re-send the information when the communication and/or system were re-established.

ICELAND

SSN Iceland did not provide AIS data between 29 June 2018 17:38 and 02 July 2018 10:28 [MSS Status report 03/07/2018 / Ticket=MSS-208433]. The incident was analysed using the QLIK queries. The “Contact_DT” sensor shows positive values for the incident period. This confirms that the buffered data were re-transmitted (the messages creation time stamps were recorded). The analysis also confirmed that SSN received all the data for the incident period.

Conclusion: SSN Iceland re-sent the AIS data when the communication and/or system were re-established.

ITALY

Data stream of SSN Italy was analysed following the incident of 27 July, when MARES Proxy was not sending T-AIS data between 07:18 and 15:02 [MSS Status Report 30.07.2018 // ticket = MSS-210157]. The analysis showed that the “Contact_DT” sensor had a positive value for the incident period. This confirms that the buffered data were re-transmitted (the messages creation time stamps were recorded).

Conclusion: SSN Italy re-sent the T-AIS data when the RS communication with SSN SI was re-established. However, the presented example was not related to the downtime of the national AIS system. Additional test should be conducted.

LATVIA

SSN Latvia did not provide T-AIS data from 26 July 16:18 to 27 July 12:29 [MSS Status Report 30.07.2018 // ticket = MSS-210157]. The incident was analysed using the QLIK queries. The “Contact_DT” sensor showed “0” value for the incident period presented in “Create_DT”. This confirmed that the buffered data were not re-transmitted (the messages creation time stamps were not recorded).

On 01.08.2017, Latvia was not providing AIS data to the HELCOM RS between 21:02 – 23:19 [MSS Status Report 01/08/2018 // ticket=MSS-210326]. The incident was analysed using the QLIK queries. The analyses showed positive values for the “Contact_DT” sensor (i.e. the messages creation time stamps were recorded).

On 7 August 2018, SSN Latvia was not providing T-AIS data from 00:07 to 02:14 [MSS Daily status report of 07/08/2018 / ticket=MSS-210694]. The incident was analysed using the QLIK queries. The analyses showed “0” values of the “Contact_DT” sensor for the incident period (i.e. the messages creation time stamps were not recorded). This confirms that the buffered data were not re-transmitted (the messages creation time stamps were not recorded).

Conclusion: Latvia is capable to re-send the information when the communication with regional AIS server is re-established. However, due to an unstable behaviour of the system (two tests out of three were negative) additional test should be conducted.

LITHUANIA

SSN Lithuania did not provide T-AIS from 28 July 14:46 to 29 July 06:33 [MSS Status Report 30.07.2018 // ticket = MSS-210157]. The incident was analysed using the QLIK queries. The analyses showed “0” values of the “Contact_DT” sensor (i.e. the messages creation time stamps were not recorded for the incident period).

This confirms that the buffered data were not re-transmitted (i.e. the messages creation time stamps were not recorded).

Conclusion: SSN Lithuania did not re-send the information when the communication and/or system were re-established.

MALTA

SSN Malta did not provide T-AIS data to MARES from 07.07.2018 21:54 to 08. 07.2018 04:49 UTC [MSS Status report 09/07/2018 // ticket = MSS-208769]. The incident analyses showed “0” values of the “Contact_DT” sensor (i.e. the messages creation time stamps were not recorded for the incident period). This confirms that the buffered data were not re-transmitted.

SSN Malta did not provide T-AIS data from 11 July 2018 05:32 to 12 July 2018, 12:49 [MSS Daily status 13/07/2018 / ticket=MSS-209052]. The incident analyses showed “0” values of the “Contact_DT” sensor (i.e. the messages creation time stamps were not recorded for the incident period). This confirms that the buffered data were not re-transmitted.

SSN Malta did not provide T-AIS data also from 15 - 16 July [MSS Status Report 17.07.2018 // ticket = MSS-209342]. The incident analyses showed “0” values of the “Contact_DT” sensor (i.e. the messages creation time stamps were not recorded for the incident period). This confirms that the buffered data were not re-transmitted following the incident.

Conclusion: SSN Malta did not re-send the information when the communication and/or system were re-established.

POLAND

SSN Poland did not provide AIS data to HELCOM on 3 Jun from 18:03 to 21:49 [MSS Status Report 04.06.2018 // ticket = MSS-206608]. The incident was analysed using SEG application. The analysis performed after the incident showed that the dedicated ship’s position remains unchanged during the incident period, meaning that AIS data was not buffered and re-sent. The same conclusion was confirmed by analysis based on the QLIK queries, where the “Contact_DT” sensor showed “0” values for the incident period (i.e. the messages creation time stamps were not recorded)

SSN Poland did not provide AIS data to HELCOM on 4 June from 18:03 to 21:49 [MSS Status report 04.06.2018 // ticket = MSS-206608]. The incident was analysed using the QLIK queries. The “Contact_DT” sensor showed “0” values for the incident period, which is indicated by the “Create_DT” sensor. This confirms that the buffered data were not re-transmitted.

SSN Poland did not provide T-AIS data to HELCOM on 6 June from 04:00 to 07:24 [MSS Status Report 06/06/2018 // ticket=MSS-206762]. The incident analyses confirmed that the buffered data were not re-transmitted - the “Contact_DT” sensor showed “0” values for the incident period (i.e. the messages creation time stamps were not recorded).

Conclusion: SSN Poland did not re-send the information when the communication and/or system were re-established.

PORTUGAL

SSN Portugal did not provide T-AIS data from 3 August 19:04 to 6 August 09:54 [MSS Daily status 07/08/2018 / ticket=MSS-210694]. The power outage was reported as the reason for the incident, i.e. the AIS data were not received and stored during the incident period. Also the incident analyses showed “0” values of the “Contact_DT” sensor (i.e. the messages creation time stamps were not recorded for the incident period).

Conclusion: SSN Portugal did not re-send the information when the communication and/or system were re-established. However, the observed case related to the back-up and recovery capabilities, and not the data buffering and retransmission.

SWEDEN

SSN Sweden did not provide T-AIS data on 06 June from 07:30 to 08:43 [MSS Status Report 07/06/2018 // ticket=MSS-206817]. The incident analysis showed “0” values of the “Contact_DT” sensor (i.e. the messages creation time stamps were not recorded for the incident period). This confirms that the data was not resent following the incident.

Conclusion: SSN Sweden did not re-send the information when the communication and/or system were re-established.

BELGIUM

In the framework of EMSA/RS exercises foreseen in the SLA (Art. 5 of Annex 4), the data buffering test was made by EMSA in cooperation with the NCA (North Sea/Atlantic RS) and Belgium, on 09.02.2018.

The test scenario included simulation of the communication problem and testing the offline storage (data buffering) functionality. To simulate the communication problem, the NPR was disconnected by the NCA (regional AIS server), expecting that during the test downtime the national server will buffer the historical data locally, and will send historical data together with online data, in the same feed, when the test is over.

The results were analysed by the NCA and EMSA and confirmed the reception of data from Belgium for the testing period. EMSA also confirmed that it has recorded a normal rate of positions from Belgium for timestamps within the test period.

Conclusion: SSN Belgium re-sent the T-AIS data when the communication with regional AIS server was re-established.

SLOVENIA

In the framework of EMSA/RS exercises foreseen in the SLA (Art. 5 of Annex 4), the data buffering tests were made by EMSA in cooperation with regional AIS server (MARES) and Slovenia, on 29.01.2018. Due to the programming issues, the test was repeated on 09.03.2018.

The test scenario included simulation of the communication problem and testing the offline storage (data buffering) functionality. Slovenian NPR was disconnected from the regional server for 30 minutes, expecting that the proxy will send the buffered data to the regional server at the end of disconnection. The connection from MARES to Slovenia was not affected, and Slovenia continues receiving AIS data from other member states.

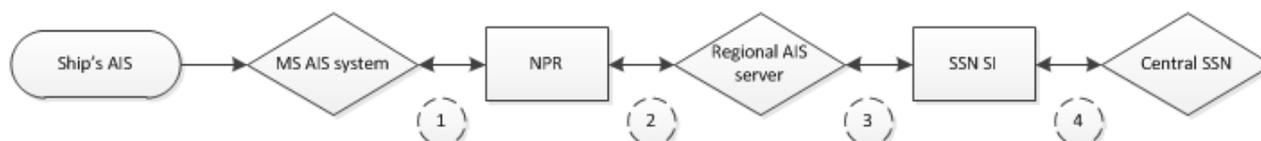
The results were analysed by the ICG and EMSA and confirmed that the test was successful for both, the pre-production and production environments (running different versions of SSN SI software). The buffered data were received at EMSA. The test should be conducted again, after the new version of SSN SI was installed at the SSN production environment.

Conclusion: SSN Slovenia re-sent the data when the connection was re-established.

ANNEX 2

Data retransmission test scenarios

The main components of the AIS data information flow are presented in the schema below:



The stages of the information flow to be tested are marked as links No 1, 2, 3 and 4.

Test scenario 1: data buffering by SSN SI

Requirement: SSN streaming interface (SSN SI) installed at the regional server site shall be capable of storing AIS data for up to 12 hours (with or without down sampling).

Test execution: The link **No 4** will be disconnected (or disabled) by the SSN administrator for a specified period of time. Following the re-connection, the participants will compare the amount of messages delivered/received before and after the disconnection. In case of the buffering/retransmission failure, the RS administrator will provide EMSA the data of the testing period.

Participants: EMSA and RS.

Number of tests: 1-2 per RS.

Test scenario 2: data buffering by the regional AIS server

Requirement: In the event of a failure of SSN SI the regional AIS server shall buffer the received messages (up to 12 hours) and then retransmit them once the connection to SSN SI has resumed.

Test execution: The link **No 3** will be disconnected (or disabled) by the RS (or SSN) administrator for a specified period of time. Following the re-connection, the participants will compare the amount of messages delivered/received before and after the disconnection. In case of the buffering/retransmission failure, the RS administrator will provide EMSA the data of the testing period.

Participants: EMSA and RS.

Number of tests: 1-2 per RS connection to SSN SI.

Test scenario 3: data buffering by NPR

Requirement: The technical solution implemented by regional AIS servers ensures that the national proxies (NPRs) installed at the Member States sites begin storing the AIS information in a local data base (or the RS disk cach) when the connection with the regional AIS server is down, and sending to the regional AIS server both the real time and the stored information when the connection is restored.

Test execution: The link **No 2** will be disconnected (or disabled) by the RS administrator for a specified period of time. Following the re-connection, the participants will compare the amount of messages delivered/received before and after the disconnection. In case of the buffering/retransmission failure, the MS administrator will provide RS the data of the testing period.

Participants: EMSA, RS and MS.

Number of tests: 1-2 per NPR connection to RS.

Test scenario 4: Data buffering by national AIS server

Requirement: In the event of a failure or a scheduled interruption, NCAs shall ensure that SSN messages are stored and then transmitted to the central SSN system when communications and/or systems have recovered. The national system should be able to re-send messages for up to 2 weeks (ship position information may be down-sampled for this purpose).

Test execution: The link **No 1** will be disconnected (or disabled) by the MS administrator² for a specified period of time. Following the re-connection, the participants will compare the amount of messages delivered/received before and after the disconnection. In case of the buffering/retransmission failure, the MS administrator will provide RS the data of the testing period.

Participants: EMSA, RS and MS.

Number of tests: 1-2 per national AIS system.

The tests will be conducted by involving each individual Member States and regional AIS servers, and will impact only the data stream connected to SSN pre-production.

² The technical capabilities to perform the test will be assessed prior the testing.