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DISTRIBUTION OF ENCS BY MEANS OF SENC DISTRIBUTION

(*Proposal to CHRIS by Germany, supported by Australia, Canada and USA (NOAA)*)

1. Introduction

The issue of SENC distribution has been discussed at the CHRIS-11 as well at the subsequent WEND-5 meeting. The CHRIS meeting noted that an IHO specification in S-52, in its present wording, would require the SENC to be generated from the ENC by the ECDIS onboard ship, and any amendment to it should be based on careful considerations. The WEND meeting, in discussing the viability of ENCs being distributed directly through SENCs, felt unsure about the potential technical implications, particularly regarding security, and referred this issue back to CHRIS for advise. The purpose of this paper is to clearly define the issue, to examine its implications and to propose further action.

2. The Proposal for SENC Distribution

The ECDIS PS clearly require the ECDIS to have the capability of processing ENCs so as to transform it into the System ENC. Thus, there must always be a distribution mechanism for ENCs, as a minimum requirement.

It is proposed ***to additionally allow, upon a voluntary arrangement between user and service provider, for distribution of ENCs through SENCs which have already been generated from the ENCs by a service provider before reaching the ECDIS onboard. The official (SOLAS-compliant) status of the ENCs will be retained in the advance transformation when used on a type-approved ECDIS.***

The SENC is the ready-to-use display file for ECDIS. Official raster data for the ECDIS raster mode, e.g. ARCS data are distributed already today as SENCs.

The benefits from the SENC distribution path would be:

- Integration of ENCs with data from other sources will be possible under one single service and one single security mechanism. This is a considerable benefit to the mariners.
- Integration of ENCs with data from other sources for both SOLAS-compliant ECDIS as well as for ECS use will become an attractive business for data suppliers who have the largest market shares today. It will considerably foster replacement of non-official data by official ENCs, wherever they exist, and therefore enhance marketing of HO´s ENCs. It will benefit HOs as well, hence.

3. Outline of the Issue

The mechanism for distributing the official data for ECDIS from the originating HOs to the end user for the purpose of SOLAS compliant use have nowhere been completely described beforehand. Most has been left to HOs to organize the data distribution under the WEND concept. The current specifications are partly contradicting, and do not reflect security aspects which seem to have gained considerable importance.

Attention is drawn to the following facts:

- The ECDIS Performance Standards (PS) do require an ECDIS to have the capability to read ENCs and to generate SENCs from the ENCs and updates to it. However, the ECDIS PS do nowhere explicitly state that this is to be the only mechanism to generate the SENC.
- The ECDIS PS state that it is the SENC which "is actually accessed by ECDIS for display generation and other navigational functions, and is the equivalent to the paper chart".
- Consequently, throughout the ECDIS PS generally refer to the SENC for all the functions to be performed by an ECDIS.
- By contrast, the IHO specification in IHO S-52 explicitly states that "the conversion process (from SENC to ENC) should be accomplished in the ECDIS", and that the "official copy of the HO supplied ENC is to be kept onboard. From this, the ECDIS generates the "System ENC", which is used for actually operating the ECDIS Through the same conversion process, official updates are added to the System ENC".
- Likewise, the more recent introduction of the ECDIS raster mode of operation is only reflected in the Appendix 7 added later to the ECDIS PS, but not at all in IHO S-52 or any of its Appendices.
- The only RENC operational so far, PRIMAR, has made the implementation of a sophisticated security mechanism using data encryption, involving data compression, mandatory for all SOLAS compliant ENC applications. Encryption (and the need for decryption by the ECDIS) is nowhere mentioned in the ECDIS PS and in IHO S-52 and its Appendices, and it is only mentioned in S-57 as an optional possibility but is not defined there (rather, S-57 explicitly *forbids* use of data compression involved with the PRIMAR encryption method). So far, no IHO security standard has been defined.

It must be concluded from these facts that particularly the IHO specifications do need some updating anyway to take into account some more recent developments not considered at the time of writing IHO S-52 and S-57.

4. Discussion

4.1 Compliance of SENC distribution with ECDIS PS

- **Can the ENC retain its official status inside the SENC when transformed outside the ECDIS?**
  Yes. The SENC stands for *System **ENC*** and contains therefore the same ENC, but in a different encapsulation (format). It is widely accepted that a change of encapsulation, which happens also e.g. on encrypting and compressing S-57 in the PRIMAR security system, does not alter the contents and will not impair the character of an ENC and its compliance with S-57. It is not the encapsulation which is the core of S-57. This is illustrated by the fact that ISO 8211 has been chosen as format for S-57, which is not developed as a part of S-57, but is just one of various different other formats. The format can easily be changed for another one without affecting S-57 in substance.

  Both, transforming the ENC into SENC and decrypting an ENC back to plain S-57 is subject to official type approval for ECDIS. Since the software performing these functions inside an ECDIS can be applied also outside an ECDIS, it can be (and has been) type-approved separately from the ECDIS. Hence, there is guarantee that the transformation (or decryption) will not degrade the ENCs. In addition, technically it is the same software rendering the ENC in the SENC official data when operating inside the ECDIS and it will do the same when applied externally. Thus, there is no point for changing the ENC status to non-official if it is distributed through the SENC.

- **The SENC allows the ENC to be mixed with non-official data. How does the ECDIS identify the source of the data, and how does it respond to data from non-official origin?**
  The S-57 structure of ENCs remains unaltered within an SENC. S-57 contains a flag for each cell whether the data is official or not. Any data supplemented by a service provider will be flagged "unofficial" in the SENC, no matter where the conversion process from ENC to SENC has taken place, inside or outside the ECDIS. The ECDIS, according to the ECDIS PS

must process this flag, and put the ECDIS into ECS mode when operating on non-official chart data. This is subject to type approval. Thus, there is no danger that by virtue of the SENC distribution non-official data suppliers illegally reach "official" status.
In principle, it does not matter where the ENC-to-SENC conversion takes place.

- **Is there anything else in the ECDIS PS relevant to distribution?**
  No. The ENC-to-SENC conversion capability of an ECDIS required by the ECDIS PS is a minimum requirement and will be satisfied by any ECDIS and be tested on type approval. The ECDIS PS otherwise do not regulate on distribution matters. This is the task for IHO.

4.2 Compliance with IHO Specifications

- **Does any IHO Specification regulate on the ENC-to-SENC conversion?**
  The only place in the IHO specifications dealing with ENC-to-SENC conversion is S-52, paragraph 3.3. Whilst 3.3(b) only requires the capability of ECDIS to perform the conversion from ENC to SENC, 3.3(c) states: "This conversion process should be accomplished in the ECDIS but does not imply real-time processing of HO supplied data". The next subparagraph 3.3(d) requires: "The official copy of the HO supplied ENC is to be kept onboard. From this, the ECDIS generates the "System ENC" ….". This Specification would need amendment to reflect the option for SENC distribution. It should be borne in mind that the IMO ECDIS PS are the lead document for ECDIS and that this S-52 requirement appears to be an interpretation of the ECDIS PS, but cannot be considered a regulation. Data distribution itself is not covered by IHO S-52 or any other IHO specification specifically for ENCs and SENCs, resp.. Thus, an amendment to S-52 will not have an impact on any other specifications or regulations.

- **Will SENC distribution drive S-57 out of use?**
  No. Plain S-57 including the present ISO 8211 encapsulation (format) will continue to be the encapsulation used by HOs for delivering their data to a RENC. If this RENC encrypts the data before supplying it to the end user (as PRIMAR does), the encapsulation changes anyway. The content, i.e. the data and its logical structure is not affected at all, though. The same happens on transforming an ENC into SENC. Data content of the ENC and its logical structure must remain unaltered and correspond to S-57 because otherwise the SENC wouldn't be a SENC any more. The transformation software is subject to type-approval for ECDIS, or separately for external applications. In this regard, there is no principle difference with respect to S-57 compliance between SENC distribution and e.g. PRIMAR's present practice of supplying encrypted data. It should be born in mind, though, that SENC distribution is only an additional, optional distribution mechanism, and ENC distribution will remain.

4.3 Impact on security

- **Will security be affected by SENC distribution?**
  SENC distribution is a different path of distribution, compared to ENC distribution. The following explanation is given against the background of PRIMAR's security system.

  PRIMAR has established a uniform, uninterrupted secure data flow from the RENC (PRIMAR) across the distributor down to the end user. The data encrypted by PRIMAR pass the distributor (if any, the end user may get the data also directly from PRIMAR, if he wishes) without possibility of the distributor to decrypt the data, and reach the end user who will be the only one in the position to decrypt, and subsequently convert the data to the SENC.

  By comparison, in the SENC distribution scheme, the distributor must decrypt the data before it can be converted to the SENC. The SENC, then, will again be encrypted by the distributor.

Finally the data will be decrypted again automatically on reaching the ECDIS. The security scheme employed by the distributor may differ from the RENC's one.

From the user's point of view there is no difference, except if the user needs supplementary data for route coverage, he would get it integrated in a single security system. This is more convenient than with ENC distribution plus extra supplementary data.

From the HO's perspective, there is little difference either. The procedures the distributor has to follow in order to maintain security can be made subject of the terms of contract. The HOs necessarily must trust in the distributor's will to strictly adhere to the contract they have with the RENC. If the RENC wishes to maintain a record of end users and which ENCs they use (as PRIMAR does), this can be arranged through the contract with the distributors.

- **Will the variety of different SENC formats cause any problems?**
  No. HO's are not affected at all as they will have to continue using S-57 for supplying ENCs to the RENC/distributors. The user, if he prefers plain ENC delivery, can choose the ENC distribution scheme. The delivery of ENCs through SENCs is just an option for a customized service (probably at an additional service charge), taylored to be used in the particular ECDIS. Other SENC formats than the one supported by the target ECDIS are not relevant to that ECDIS. If the particular SENC service would fail for some reason, choosing the ENC distribution would be the fallback option.

4.4 Compliance with WEND

- **Does SENC distribution comply with the WEND system?**
  Yes. There is nothing in the WEND principles which touches on where the ENC-to-SENC conversion takes place, or which is inhibiting SENC distribution otherwise. Thus, SENC distribution is fully compatible with WEND.

4.5 Impact on ECDIS Type-approval

- **Does IEC 61174 require an amendment to allow for SENC distribution?**
  No. IEC 61174 is based on the IMO ECDIS P.S. which cover only the minimum requirements for ECDIS. This includes the internal ENC to SENC conversion as a mandatory capability, but neither includes the interface of an ECDIS to read externally generated SENCs, nor the external SENC generation itself. A direct processing capability for externally generated SENCs is an optional feature for an ECDIS (like the PRIMAR security interface, which also is not covered by IEC 61174) which on type-approval will be checked for proper function and any negative side affects on the primary ECDIS functionality, in accordance with IEC 60945.

5. Proposals to CHRIS for adoption

5.1 Amendment of S-52

The "Specifications for Chart Content and Display Aspects of ECDIS" (s-52), 5TH Edition will be amended as follows:

Paragraph 3.3 (d) – old version –

"The official copy of the HO supplied ENC is to be kept onboard. From this, the ECDIS generates the "System ENC", which is used for actually operating the ECDIS. Through the same conversion process, official updates are added to the System ENC.

The information content of the SENC should include all that of the ENC corrected by official updates (see Appendix 1)."

Paragraph 3.3 (d) – new wording –

"The official copy of the HO supplied ENC is to be kept onboard to allow the data to be reloaded in the event of corruption of the "System ENC". The SENC, which is generated from the official ENC, is used for actually operating the ECDIS. Official updates are added to the SENC through the same process.

The information content of the SENC should include all that of the ENC corrected by official updates (see Appendix 1)."

5.2 CHRIS Conclusion

The following Conclusion is proposed for adoption by CHRIS:

"SENC data, generated by a recognized ENC distributor from ENCs supplied by, or on the authority of government authorized hydrographic offices, may be used in an ECDIS satisfying the SOLAS carriage requirement, subject to the following limitations:

- The ECDIS must be type-approved by a recognized authority.
- The software used for transforming the HO-supplied ENCs into the SENC externally must be type-approved by a recognized authority.
- The SOLAS carriage requirement is only satisfied for those SENC contents generated from HO-supplied ENCs and official updates to it.
- An ECDIS operating on all other data not generated from HO-supplied data will automatically perform as an ECS only."