EGNOS implementation in maritime receivers

The MAREC project

Presented at EGNOS Workshop

25th of September 2019

KONGSBERG PROPRIETARY: This document contains KONGSBERG information which is proprietary and confidential. Any disclosure, copying, distribution or use is prohibited if not otherwise explicitly agreed with KONGSBERG in writing. Any authorised reproduction in whole or in part, must include this legend. © 2017 KONGSBERG – All rights reserved.

Background

- SBAS should be made available for maritime users
- Equipment standards are not yet available for using SBAS for navigation under SOLAS rules
- There already exists equipment standards for GPS, GLONASS, Galileo and Beidou, as well as for differential GPS and differential GLONASS.
- IMO has issued Recommendation MSC.401(95) Performance Standards For Multi-system Shipborne Radionavigation Receivers, under which SBAS is introduced.

There is a need for a test standard for maritime SBAS

SBAS – Space Based Augmentation System. Examples: EGNOS and WAAS

SOLAS - International Convention for the Safety of Life at Sea

IMO – International Maritime Organization

Background

KONGSBERG

- GSA, ESA and ESSP have prepared *Draft Guidelines for Manufacturers for the Implementation of SBAS in Shipborne Receivers*
- These guidelines could form the input to an IEC/EN equipment test standard
- To further evolve this work, GSA set up the **MAREC** project, which is managed by Kongsberg Seatex.

GSA – European GNSS Agency

ESA – European Space Agency

ESSP – European Satellite Services Provider

MAREC Highlights

KONGSBERG

- MAREC approach is SBAS, hence not only limited to EGNOS
- MAREC is focused on the legacy SBAS: GPS L1 augmentation
- The aim is to contribute to guidelines for the implementation of SBAS in the maritime, including test specifications
- The algorithms will be implemented and tested in laboratory and in real environment
- MAREC will test equipment in three product categories: SOLAS, non-SOLAS and AIS
- Duration: 24 months, until Q1-2020

SOLAS - International Convention for the Safety of Life at Sea

AIS – Automatic Identification System

MAREC - Draft Guidelines for Manufacturers for the Implementation of SBAS in Shipborne Receivers

KONGSBERG

- use the same SBAS SIS as aviation (MOPS DO229)
- not required to calculate a protection level
- need to calculate quality estimates like position error ellipses and 95% accuracy
- RAIM will be required in line with maritime GPS/DGPS receiver standards (IEC61108-1)
- it will be left to the equipment manufacturer to find suitable algorithms for position solution, accuracy estimates and RAIM
- compliance assessment is done via test
- benefits of this approach:
  - adaptation to the diversity of maritime environments
  - opens up for new innovations

RAIM - Receiver autonomous integrity monitoring

MAREC - Integration of SBAS and IALA DGNSS at User Level

KONGSBERG

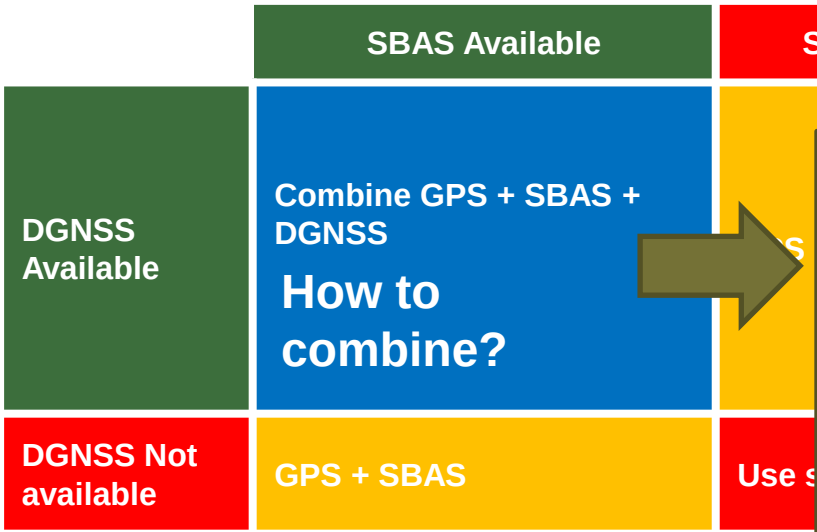
IMO rec. MSC.401(95) *Performance Standards for Multi-system Shipborne Radionavigation Receivers*

	SBAS Available	SBAS Not available
DGNSS Available	Combine GPS + SBAS + DGNSS **How to combine?**	GPS + DGNSS
DGNSS Not available	GPS + SBAS	Use standalone GPS

MAREC - Integration of SBAS and IALA DGNSS at User Level

KONGSBERG

IMO rec. MSC.401(95) *Performance Standards for Multi-system Shipborne Radionavigation Receivers*



Alternatives:

- select either SBAS or DGNSS
- Combine both systems into one position solution
- provide both position solutions, user to select which to trust

If selecting either DGNSS or SBAS, what are the selection criteria?

If combining, how to combine?

Combining DGNSS and SBAS into a single position

KONGSBERG

- Combination at position level:
  - Option 1: Use second position for integrity check
  - Option 2: Use a weighted average of the positions

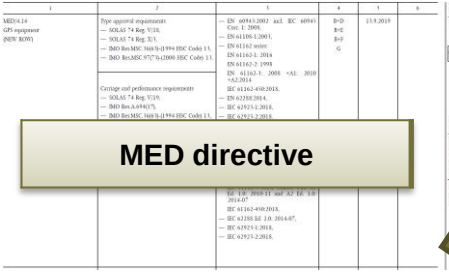
- Combination at pseudo-range level:
  - Requires harmonized error estimates for optimum weight matrix in position and RAIM algorithms

- Using integrity information from SBAS and corrections from DGNSS
  - Not recommended, as SBAS integrity is linked to SBAS corrections

Is there a need to standardize how to combine the systems?

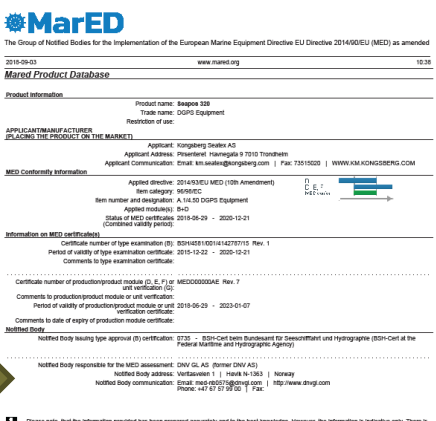
EU Marine Equipment Directive (MED)

KONGSBERG



MED directive

Conformity assessment by notified body



MarED

The Group of Notified Bodies for the Implementation of the European Marine Equipment Directive EU Directive 2014/90/EU (MED) as amended

2015-09-03 www.mared.org 10:36

Mared Product Database

Product Information

Product name: Seapos 320
Trade name: DGPS Equipment
Restriction of use:

APPLICANT/MANUFACTURER (PLACING THE PRODUCT ON THE MARKET)

Applicant: Kongsberg Seatex AS
Applicant Address: Pirsenteret Havnegata 9 7010 Trondheim
Applicant Communication: Email: km.seatex@kongsberg.com | Fax: 73515020 | WWW.KM.KONGSBERG.COM

MED Conformity Information

Applied directive: 2014/93/EU MED (10th Amendment)
Item category: 96/98/EC
Item number and designation: A 1/4.50 DGPS Equipment
Applied module(s): B+D
Status of MED certificates (Combined validity period): 2018-06-29 - 2020-12-21

Information on MED certificate(s)

Certificate number of type examination (B): BSH/4581/001/414278/715 Rev. 1
Period of validity of type examination certificate: 2015-12-22 - 2020-12-21
Comments to type examination certificate:

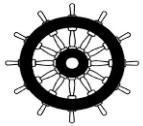
Certificate number of production/product module (D, E, F) or unit verification (G): MEDDE00000AE Rev. 7
Comments to production/product module or unit verification:
Period of validity of production/product module or unit verification certificate: 2018-06-29 - 2023-01-07
Comments to date of expiry of production module certificate:

Notified Body

Notified Body issuing type approval (B) certification: 0735 - BSH-Cert beim Bundesamt für Seeschiffahrt und Hydrographie (BSH-Cert at the Federal Maritime and Hydrographic Agency)

Notified Body responsible for the MED assessment: DNV GL AS (former DNV AS)
Notified Body address: Veritasveien 1 | Høvik N-1363 | Norway
Notified Body communication: Email: med-nb0575@dnvgl.com | http://www.dnvgl.com
Phone: +47 67 57 99 00 | Fax:

Please note, that the information provided has been prepared accurately and to the best knowledge. However, the information is indicative only. There is no guarantee for completeness, actuality or an absolute correctness. For further clarification, please contact the indicated Notified Bodies or the companies offering the products to the market directly.



Wheelmark

GILFAN [CC BY-SA 3.0 (https://creativecommons.org/licenses/by-sa/3.0)]

EU Marine Equipment Directive (MED)

KONGSBERG

1	2	3	4	5	6
MED/4.14 GPS equipment (NEW ROW)	Type approval requirements — SOLAS 74 Reg. V/18, — SOLAS 74 Reg. X/3, — IMO Res.MSC.36(63)-(1994 HSC Code) 13, — IMO Res.MSC.97(73)-(2000 HSC Code) 13. Carriage and performance requirements — SOLAS 74 Reg. V/19, — IMO Res.A.694(17), — IMO Res.MSC.36(63)-(1994 HSC Code) 13, — IMO Res.MSC.97(73)-(2000 HSC Code) 13. — IMO Res.MSC.112(73), — IMO Res.MSC.191(79), — IMO Res.MSC.302(87).	— EN 60945:2002 incl. IEC 60945 Corr. 1: 2008, — EN 61108-1:2003, — EN 61162 series: EN 61162-1: 2016 EN 61162-2: 1998 EN 61162-3: 2008 +A1: 2010 +A2:2014 IEC 61162-450:2018, — EN 62288:2014, — IEC 62923-1:2018, — IEC 62923-2:2018. Or: — IEC 60945:2002 incl. IEC 60945 Corr. 1: 2008, — IEC 61108-1 Ed. 2.0: 2003, — IEC 61162 series: IEC 61162-1:2016 IEC 61162-2 ed1.0: 1998-09 IEC 61162-3 ed1.2 Consol. with A1 Ed. 1.0: 2010-11 and A2 Ed. 1.0: 2014-07 IEC 61162-450:2018, — IEC 62288 Ed. 2.0: 2014-07, — IEC 62923-1:2018, — IEC 62923-2:2018.	B+D B+E B+F G	13.9.2019	

L 237/106 EN Official Journal of the European Union

What is required for type approval of SBAS receiver equipment within MED?

KONGSBERG

- IMO level, alternative approaches:
  - A new performance standard for SBAS receiver equipment
  - Or using as reference the existing MSC.401(95) *PERFORMANCE STANDARDS FOR MULTI-SYSTEM SHIPBORNE RADIONAVIGATION RECEIVERS*
  - Other approaches?

- IEC/EN level test standard:
  - Modify existing GPS/DGPS test standards (IEC61108-1 and -4)
  - Or prepare new test standard for a GPS receiver augmented with SBAS
  - Other approaches?

- In MAREC we use the DGPS test standard as model for the content of the SBAS test standard

MAREC – equipment testing

KONGSBERG

- Tests are developed on basis of the Draft Guidelines for Manufacturers for the Implementation of SBAS in Shipborne Receivers
- Testing to be done for the following equipment categories:
  - SOLAS
  - Non-SOLAS
  - AIS
- Testing to be done in laboratory and on sea using live EGNOS and GPS
- Equipment tests will provide feedback on the feasibility of the tests in the draft guidelines

SOLAS and non-SOLAS

- The SBAS Guidelines will be implemented and tested in a Kongsberg SeaPos 320 unit for SOLAS applications, and in a Kongsberg DPS 132 unit for non-SOLAS applications.

GPS + DGPS + SBAS

AIS – Automatic Identification System

KONGSBERG

- Additionally, a Kongsberg AIS 300 unit will be used in the Sea Trials. The navigation performance will be compared with SeaPos 320.

GPS + DGPS + SBAS

- Open question on AIS standard: Should position derived with SBAS be reported as a non-differential or as a differential position?

Next steps and beyond

KONGSBERG

- In MAREC project:
  - Equipment testing based on proposed test standard
  - provide feedback on guidelines and test standard
- Beyond MAREC:
  - finalization of test standard, possibly within IEC TC80
  - include SBAS equipment with relevant standards in MED
  - work should also be started for maritime standardization of the new DFMC SBAS.
- Ideally a DFMC SBAS test standard for maritime equipment should be available well in advance of the service becoming operational

MED – Marine Equipment Directive

DFMC - Dual Frequency Multiple Constellation

The MAREC project will test the equipment with simulator and in a real environment in the Trondheim Fjord test area for autonomous vessels.