

Input paper for the following Committee(s):

check as appropriate

Purpose of paper:

- ☐ ARM                      **X** ENG                      ☐ PAP  
☐ ENAV                      ☐ VTS

**X** Input☐ InformationAgenda item <sup>2</sup> (from agenda)

11

Workplan Task Number / Technical Domain <sup>2</sup>

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Working Group

WG3

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## Note by the IALA Deputy Secretary-General re Resilient Position Navigation and Timing (RPNT)

### 1. SUMMARY

This is a discussion paper from the Deputy Secretary-General, to the ENG Committee, with personal views, to stimulate thinking on RPNT.

### 2. IMO RESOLUTIONS RELATING TO PNT

Two IMO Resolutions are relevant.

- The IMO performance requirements for recognition of systems in the World Wide Radio Navigation System (Resolution A.1046, WWRNS)
- Requirements for future GNSS (Resolution A.915)

### 3. RESILIENCE IN POSITIONING

Annex A explains the meaning of redundant, back-up, and contingency when applied to RPNT.

If a terrestrial system is to be used to provide resilience to a satellite PNT system, there is no likelihood of a global system covering the whole surface of the earth. Regional or local systems will be needed, and these may not cover all coastal sea areas. Ideally regional systems should be harmonised, and be economical to implement for the service provider and the users.

#### ➤ DSG view

- **A positioning system independent of GNSS is needed to achieve true RPNT**

<sup>1</sup> Input document number, to be assigned by the Committee Secretary

<sup>2</sup> Input papers should be assigned to a work task as listed in the Committee work plan which is available in input papers. Leave open if uncertain but consider how the paper is to be processed if not relevant to a work task

- A redundant system is not needed for maritime RPNT, but a globally-harmonised set of back-up systems could be provided by coastal states, covering important coastal and harbour areas
- It is appropriate to have less stringent performance requirements for these backup systems than the IMO Resolutions, if these revised requirements will enable an acceptable back-up service to be provided at acceptable cost to AtoN authorities.
- The areas where RPNT is needed are in coastal and harbour areas, and generally only part thereof, and will be determined by the relevant authority in each state.

#### 4. DGNSS SERVICES

Please refer to the separate input paper from the IALA Secretariat to ENG-8 on this subject.

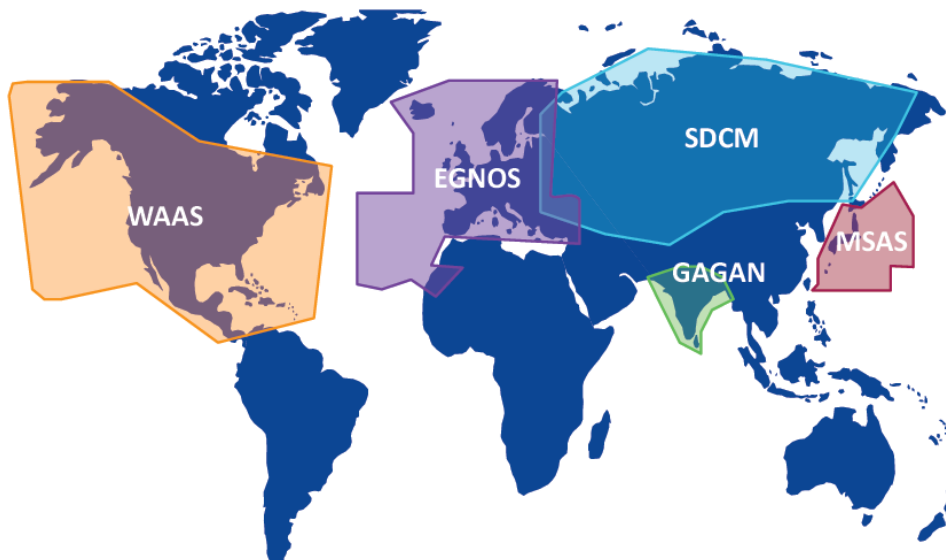
#### 5. SBAS

SBAS improves the accuracy and reliability of GNSS information by correcting signal measurement errors and by providing information about the accuracy, integrity, continuity and availability of its signals.

Originally developed for aviation users (see [https://gssc.esa.int/navipedia/index.php/SBAS\\_Fundamentals](https://gssc.esa.int/navipedia/index.php/SBAS_Fundamentals)), SBAS is increasingly used by the maritime sector.

Several countries have implemented their own Satellite-based Augmentation System. For example, in Europe EGNOS covers the majority of the European Union (EU), along with some neighbouring countries and regions. Other national SBASs include:

- **USA:** Wide Area Augmentation System (WAAS)
- **Japan:** Multi-functional Satellite Augmentation System (MSAS)
- **India:** GPS and GEO Augmented Navigation (GAGAN)
- **China:** Satellite Navigation Augmentation System (SNAS) (in development)
- **South Korea:** Wide Area Differential Global Positioning System (WADGPS) (in development)
- **Russia:** System for Differential Corrections and Monitoring (SDCM) (in development).



All of these systems comply with a common global standard and are therefore:

- **Compatible:** they do not interfere with each other;
- **Interoperable:** a user with a standard receiver can benefit from the same level of service and performance, regardless of what coverage area they are located in.

See <https://www.gsa.europa.eu/european-gnss/what-gnss/what-sbas> :-

A future Australian SBAS will augment Global Navigation Satellite System (GNSS) signals to deliver a satellite positioning capability across all of Australia and its maritime zones.

See <http://www.ga.gov.au/scientific-topics/positioning-navigation/positioning-for-the-future/satellite-based-augmentation-system>

➤ **DSG view**

- **GNSS supplemented by SBAS can provide accurate high-integrity positioning for coastal and harbour navigation**
- **SBAS services will become increasingly used in the maritime sector and will supersede DGNSS services**
- **Direct reception of the SBAS Signal in Space will be used by the maritime sector, and provision of SBAS information via AIS or MF beacons will not be done by shore authorities**

## **6. DEVELOPMENT OF R-MODE POSITIONING**

The R-Mode concept for MF beacons was developed in the ACCSEAS project. An R-Mode Roadmap was developed at an intersessional meeting of the ENAV Committee held in February 2016, and at that stage focused mainly on using existing DGNSS stations (MF) and AIS (VHF) stations.

R-Mode positioning using MF beacons (DGNSS stations) will have reduced accuracy at night, compared with daytime. Favourable geometry of shore stations and ship users is also important. These factors, plus the reducing interest globally in retaining DGNSS services, will limit the implementation of R-Mode at MF.

R-Mode is now being developed in the EU funded “Baltic R-Mode Project”.

Trials in China on R-Mode at VHF have shown great promise.

R-Mode at VHF, using AIS or VDES can provide accurate positioning with coverage limited by VHF propagation rules. Recent Committee work shows that use of AIS channels for VHF R-Mode will load the already congested AIS1 and AIS2 channels, which is not acceptable, and will not give as good accuracy as if VDES channels were used.

VDES R-Mode has the merits that:

- Conversion of existing AIS base stations will provide a basic service that can gradually be improved
- The cost to shore authorities is moderate
- Ships with AIS can use existing antennas, and upgrade or replace existing AIS receivers

## **7. eLORAN**

The Republic of Korea has a project to implement eLoran coverage of the country and its adjacent waters. We are not aware of any other eLoran implementation projects or plans to do so.

The DSG believes that eLoran is unlikely to be implemented in countries other than Korea, and that there is little or no interest in the shipping industry to equip ships with receiving and processing systems.

## **8. IALA POSITION ON RPNT TODAY**

IALA’s position today on RPNT lists the following as the likely back-up services.

- Racon absolute positioning
- eLoran
- R-mode at VHF, using VDES and/or AIS signals
- R-mode at MF.

This position is no longer tenable, as eLoran will not become a global system, nor even widely used, and R-Mode at MF now looks uncertain to be implemented.

## 9. REVISION OF POSITION ON RPNT

The DSG's view is that the shore-service technologies for providing [future] globally-harmonised resilient positioning services in the coastal and harbour phases should be:

- GNSS with SBAS
- R-mode at VHF, using VDES shore stations, to provide a back-up service

Both SBAS and VDES R-Mode can be introduced to existing and future vessels with little difficulty. VDES can be introduced ashore by replacing or upgrading existing AIS base stations. In some areas supplementary VDES shore stations may be needed.

Other presently available positioning systems are not likely to be implemented globally in a harmonised manner. Some future proposals for advanced radar positioning may not require shore services. Advanced racon positioning might develop but would require type approval and purchase of new radars, and so looks unlikely to be a success.

## 10. SUMMARY OF DSG VIEWS

1. Galileo and Beidou GNSS systems will become operational soon, bringing to four the number of independent GNSS systems in space
2. SBAS systems are in space, providing increased GNSS accuracy and integrity over wide coastal and sea areas
3. GNSS supplemented by SBAS can provide accurate high-integrity positioning for coastal and harbour navigation
4. It appears that DGNSS services will decline globally
5. SBAS services will become increasingly used in the maritime sector and will supersede DGNSS services for providing GNSS positioning integrity {and accuracy}
6. R-Mode VDES is the best, perhaps only, candidate for a globally-harmonised back-up positioning system for important coastal and harbour areas

## 11. THE COMMITTEE IS REQUESTED TO

Use the notes above to stimulate discussion in the Committee.

## 12. ANNEX A

What are redundant, backup and contingency services?

- A redundant system provides the same functionality as the primary system, allowing a seamless transition with no change in procedures.
- A backup system ensures continuation of the navigation application, but not necessarily with the full functionality of the primary system and may necessitate some change in procedures by the user.
- A contingency system allows safe completion of a manoeuvre, but may not be adequate for long-term use.