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ITU MARITIME RADIOCOMMUNICATION MATTERS

A satellite VDE segment as part of the future VHF Data Exchange (VDE)

Submitted by the European Space Agency (ESA)

SUMMARY	
Executive summary:	This document contains considerations regarding a possible satellite VDE downlink complement as part of the emerging VDE (VHF Data Exchange) that is discussed within Agenda Item 1.16 of the World Radio Conference 2015 (WRC-15)
Strategic direction:	1.1, 5.2
High-level action:	1.1.2, 5.2.5, 5.2.6
Planned output:	1.1.2.12, 5.2.5.5, 5.2.6.1
Action to be taken:	Paragraph 24
Related documents:	IMO/ITU EG 8/5/6 and NAV 56/8/2

Introduction

1 Resolution 360 (WRC-12): "Consideration of regulatory provisions and spectrum allocations for enhanced Automatic Identification System technology applications and for enhanced maritime radio communication", provides for two *resolves:*

- *1)* "… WRC-15 to consider modifications to the Radio Regulations to enable new AIS terrestrial and satellite applications …" and

- *2)* "… to consider, based on the results of ITU-R studies, additional or new applications for maritime radio communication within existing maritime mobile and mobile-satellite service allocations ..."

2 ITU-R WP 5B is elaborating upon the VDE (VHF Data Exchange) as a means to fulfil, in particular, *resolve 2)*.

Purpose

3 The purpose of this document is to inform the maritime community on considerations within WP 5B regarding a possible complementary satellite component within the VDE, from here on called "satellite VDE segment" or "satellite VDE downlink channel".

VDE concept

4 The VDE concept is addressed in IMO/ITU EG 8/5/6, NAV 56/8/2, ITU-R WP 5B document 5B/106 and in the recent IALA Maritime Radio Communications Plan (Edition 2, October 2012), and is here not further recalled. Within the VDE concept there is room for a complementary satellite segment.

VDE satellite segment

5 Satellite communications is an effective means to deliver information in a **broadcast** or **multicast** mode to a large number of ships, i.e. efficiently addressing many vessels using only minimal parts of the scarce maritime radio spectrum resource. A satellite downlink channel is able to address a single message to thousands of ships simultaneously within its footprint.

6 The frequencies which are currently under discussion for a satellite VDE downlink channel – as part of the VDE concept – will allow reception of the satellite channel with low-cost receive-only equipment, or can make extensive use of the existing VHF infrastructure on ships and require only minor modifications.

7 A satellite VDE downlink channel would allow to pass information to ships which is out of reach of the terrestrial VDE shore infrastructure, therefore extending the geographical reach of services which are carried over the VDE.

8 There is a large population of smaller-size ships – which do not carry satellite communication equipment on board – that could benefit from such a satellite VDE downlink channel. This would be of particular benefit for vessel populations in developing countries, small fishing boat fleets, recreational users and small leisure craft, and life rafts. Even individuals carrying a VHF receive-only device integrated in their life vest would be able to receive the VDE.

9 A satellite VDE downlink channel is well suited to support applications that typically address a large number of ships simultaneously or serve applications that address very remote ships. Document COMSAR 16/INF.2 "Report from the EfficienSea Project" provides examples of applications which are "push-addressed" or "push-multicast" ship-to-shore, and which could possibly be supported by a satellite VDE downlink channel such as MSI, METOC and SAR plan dissemination.

10 In general, a satellite VDE downlink channel could fulfil one-way information exchange requirements with characteristics as sketched above. Other examples of the possible applications are mentioned below:

.1 broadcast applications that will address the needs as coming out of the planned modernization of the GMDSS;

.2 "push-addressed", "push-multicast", or broadcast applications that will support future e-navigation developments, including regionally-targeted map updates;

.3 augment Maritime Safety Information (MSI) dissemination to Sea area A4 or severe weather warnings, complementing the maritime safety information service and WWNWS (World-Wide Navigational Warning Service) broadcasts via HF NBDP or SafetyNET;

.4 dissemination of satellite navigation correction messages towards the Polar regions: this will enable a satellite-based augmentation system (SBAS) such as EGNOS or WAAS at high latitude regions. It is expected that there are future applications that will benefit from the integration of GNSS and a VHF downlink;

.5 extend situational awareness by disseminating aggregated situational information to beyond-line-of-sight areas;

.6 improved situational awareness for other non-maritime platforms, such as aeronautical platforms receiving the satellite broadcast channel. This can be used for example to disseminate SAR plans;

.7 act as an alternative for acknowledgement of a distress alert, e.g. for AIS-SARTs or VHF-only equipped ships, or act as an alternative return/acknowledgement link. Intelligent combinations with SENDs (Satellite Emergency Notification Devices) or MOB (Man over Board) devices can be foreseen;

.8 allow management of AIS networks, allow for signalling to equipment such as AIS-SARTs, Aids to Navigation (AtoN) or AIS devices in general;

.9 act as an alternative NAVTEX channel, in particular for the Arctic and Antarctic NAVAREA's/METAREA's;

.10 possible integration with future use of long range AIS reception by satellite, as such implementing future two-way applications; and

.11 allow a broadcast overlay for current VHF data networks.

The examples above are far from exhaustive and will need to be thoroughly discussed and reviewed within the maritime community. All examples will need to be assessed for what concerns their intended users, vessel population, geographic area, the relation with (future) GMDSS, SOLAS or non-SOLAS users, e-navigation gap analysis, possible integration in the MSI service or WWNWS, etc.. Some examples may not be suited for satellite following such a review.

Spectrum requirements

11 As part of the various studies that will be performed in WP 5B, it will be determined where and how in the VHF frequency range a satellite VDE downlink channel can be accommodated. At this moment, there are currently only preliminary requirement in terms of bandwidth.

12 It will also be investigated whether the satellite VDE segment and the terrestrial VDE segment could partly share the same VHF spectrum, using signal processing technologies which are nowadays common in commercial hybrid satellite/terrestrial systems. This is very much in line with the current trends to use the scarce radio spectrum to the maximum extent possible.

13 An example architecture of the satellite VDE downlink is provided in the annex.

Deployment considerations

14 It is not likely that a satellite VDE segment will be deployed with full-fledged functionality and global coverage in "one go". However, advances in satellite and launcher technology allow to deploy an initial VDE satellite segment rather swiftly. A satellite VDE segment could then be gradually built up.

15 An initial satellite VDE segment could address specific geographical areas such as the Arctic (Sea area A4), or could serve a specific function such as METOC or MSI dissemination. In addition, a preliminary satellite VDE segment could be deployed quickly for experimental or validation purposes to gather experience with the concept, augment planned VDE terrestrial trials, and complement on-going e-navigation and other projects addressing maritime communication and navigation.

16 A preliminary satellite VDE segment would also allow reaching out to maritime communities in developing countries, for example with a maritime information dissemination demonstration to smaller fishing vessels in such countries.

17 The VDE transmit functionality on board a future satellite is expected to be relatively small in terms of size, power and weight. Therefore, a gradual deployment of the satellite VDE segment can be well addressed using the "hosted payload" concept, which has found broad acceptance in the space industry. This concept would allow to embark VDE transmitters as a relatively independent units on "host" satellites for which there are frequent launches.

18 For a full deployment of a VDE satellite segment, more extensive discussions are required with regards to functionality, synergy with the terrestrial VDE segment, radio frequency compatibility, intended users, required demonstration and validation campaigns, and last but not least the business model associated to such a service.

19 VDE transceivers will need to be available that can tune in on the satellite frequencies. It is expected that using software defined radio (SDR) technology this can be implemented at reasonable costs. Specifically a VDE receive-only version that would receive only the satellite VDE channel is expected to be low cost. No specific antenna developments are foreseen, as the VDE equipment can use existing VHF antenna infrastructure on the vessel.

20 The satellite VDE segment consists of an uplink facility that transmits information to the satellite.

21 The satellite will retransmit the information into the full footprint of the satellite downlink. The satellite will use in this downlink a number of 25 kHz VHF channels. Multiple channels could also be bundled to allow a higher information transfer data rate.

22 It is well possible that several maritime information providers deliver information to the vessel population, i.e. more ground stations or satellites would be used requiring also multiple VHF channels. There could also be uplink stations dedicated to regions or to specific kinds of information.

23 The information will be received by ships using low-cost VHF receive-only devices, or VDE transceivers. Within the ship, information could then be further be distributed (e.g. via NMEA or another marine electronic bus) to ECDIS plotters or other marine electronics.

Action requested of the Sub-Committee

24 The Sub-Committee is invited to note the information provided.

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ANNEX

Preliminary VDE reference architecture