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Input paper for the following Committee(s): check as appropriate Purpose of paper:

**□** ARM **□** ENG **□** PAP **x** Input

**x** ENAV **□** VTS **□** Information

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Technical Domain / Task Number 2 …………………………………

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EfficienSea 2 Progress Report on VDES Channel Modelling

# Summary

This paper reports progress on work being carried out as part of IALA’s contribution to the EU funded EfficienSea 2 Project. Results of previous VHF channel sounding trials have been reviewed and some initrial conclusions drawn.

## Purpose of the document

The Committee is invited to consider the contents of this paper when preparing documentation on VDES.

## Related documents

Recommendation ITU-R M.2092-0 (10/2015) Technical characteristics for a VHF data exchange system in the VHF maritime mobile band. ITU-R Report VHF data exchange system channel sounding campaign M.2317-0 (11/2014).

# Background

The channel sounding campaign examined radio propagation conditions for all channels intended for use in ship-to-shore and shore-to-ship VDES and ASM (Application Specific Message) communications. A comprehensive series of sea trials were conducted over five days during February/March of 2014, near Harwich in the United Kingdom. Five operational scenarios were examined, spanning four of the six IMO Maritime Service Portfolio area categories. System components and deployment were consistent with real world maritime use.

# Discussion

A progress report was given on the channel model at IALA ENAV WG3 inter-sessional meeting in Cape Town.

The work to date has consisted of a review of the previous channel sounding campaign by GLA R&RNAV, the test plans and reports, and a review of the analysis of the channel sounding data and model calculations. In this review, there has been no need to alter any of the results or conclusions.

New work has been performed using this data to assess the randomness and variability of the modelled taps in the tapped delay line model of the channel (TDL), and to evaluate the channel coherence time.

New analysis has shown the higher order taps do not vary in power or phase relative to the primary (1st tap), indicating that the statistics of the variation of these taps are driven by the same random process driving the strongest ‘direct’ signal component - and this has been shown for various trials conducted by GLA, both for static and moving vessel cases.

An analysis has been carried out of channel coherence time using Doppler (frequency) variation versus time data, as well as a channel gain rate of change versus time criteria. This is a substitute for actual waveform de-correlation over time on the channel, which is not possible to analyse due to the lack of waveform sample data in the ‘processed’ GLA datasets.

A further on-line literature review was conducted to see if any further maritime VHF channel measurements have been performed, or if any good channel models have been created. Consistent with the literature survey conducted by others (including Safar and Raulefs), no new sounding or model data emerged. However, some data was found from airborne channel measurements (for VHF voice and data communications), and some rudimentary channel model development. This latter information will be incorporated in the IALA channel airborne model.

Analysis has started on the exactEarth provided data for satellite signal power versus range/elevation with ship's MMSI and time of message reception.

The data is not sounding data per se, however, there appears to be a lot of good data on link fading characteristics. This should be sufficient to create a trend with elevation angle (or equivalently range), and also to assess if a Rician channel model will fit the signal power (amplitude) variation with time, or if some other distribution is required. Grouping by ship, or elevation angle may yield useful channel model results.

There are several analyses possible, such as overall link loss (power) versus elevation angle - as it does not appear to follow the free-space path loss very well. This is likely to be dominated by ship antenna radiation pattern leading to high gain near to the vessel horizon.

# ACTION

The IALA ENAV Committee is invited to note this information when considering the development of VDES.

1. Input document number, to be assigned by the Committee Secretary [↑](#footnote-ref-1)
2. 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 [↑](#footnote-ref-2)