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AMNAS project

Challenges and Opportunities for Satellite Communications and Navigation Augmentation Systems in Maritime VHF Bands

Executive Summary Report

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Executive Summary

The VHF Data Exchange System (VDES) is a future maritime communication system with a principal objective of enhancing maritime communication applications, based on robust and efficient digital transmission with wider bandwidth than Automatic Identification System (AIS), with a data rate up to 32 times the current AIS. As for AIS, VDES is mainly a ship-to-ship and ship-to-shore system. The ship-to-shore system will use the terrestrial VDES infrastructure that will extend the VDES coverage to only to around 60 km from the shore.

At World Radiocommunication Conference 2015, ITU-R Resolution 360 was included in the agenda for WRC-19 (agenda item 1.9.2), to consider modifications of the Radio Regulations, including new spectrum allocations for the satellite component of VDES. The aim is to enable a new VDES satellite component which will support long range communications between ships and shore and in areas where there is limited terrestrial infrastructure for VDES transmissions. Satellite VDES will make it possible to establish ship-to-shore communications for vessels throughout the Arctic region.

The satellite component is currently demonstrated by Space Norway AS using the VDE payload developed by Kongsberg Seatex AS for the Norwegian NORSAT-2 satellite launched in July 2017.

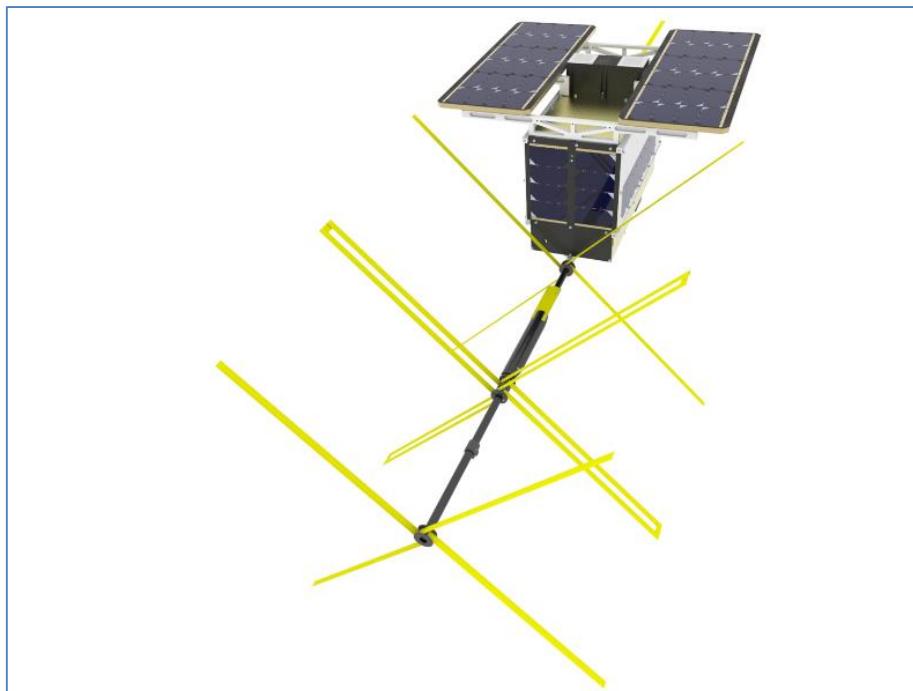


Figure 1: NORSAT-2 with VDE antenna

The AMNAS (Arctic Maritime Navigation Augmentation System) project has studied the broadcast of navigation augmentation data over the Arctic via VDES satellites. The aim is to improve maritime operational safety and efficiency, through the provision of data to improve navigational accuracy and to provide navigational integrity (both at system level and at user level).

Existing Satellite Based Augmentation Systems used to provide such data through geostationary satellites do not provide coverage for the maritime traffic of the Arctic. The maritime traffic in the Arctic is likely to increase as the polar ice recedes and new navigational routes become accessible.

Two alternative navigation augmentation system architectures using VDES have been proposed, each optimised for a different type of service:

- (i) an SBAS-type service providing near real-time integrity and correction data to maritime users in the Arctic;
- (ii) a store-and-forward type of service to deliver Integrity Support Messages (ISM) to users equipped with ARAIM (Advanced Receiver Autonomous Integrity Monitoring) enabled GNSS receivers.

The system could also allow other data or messages to be conveyed, such as Maritime Safety Information, Virtual Aids to Navigation or ice charts.

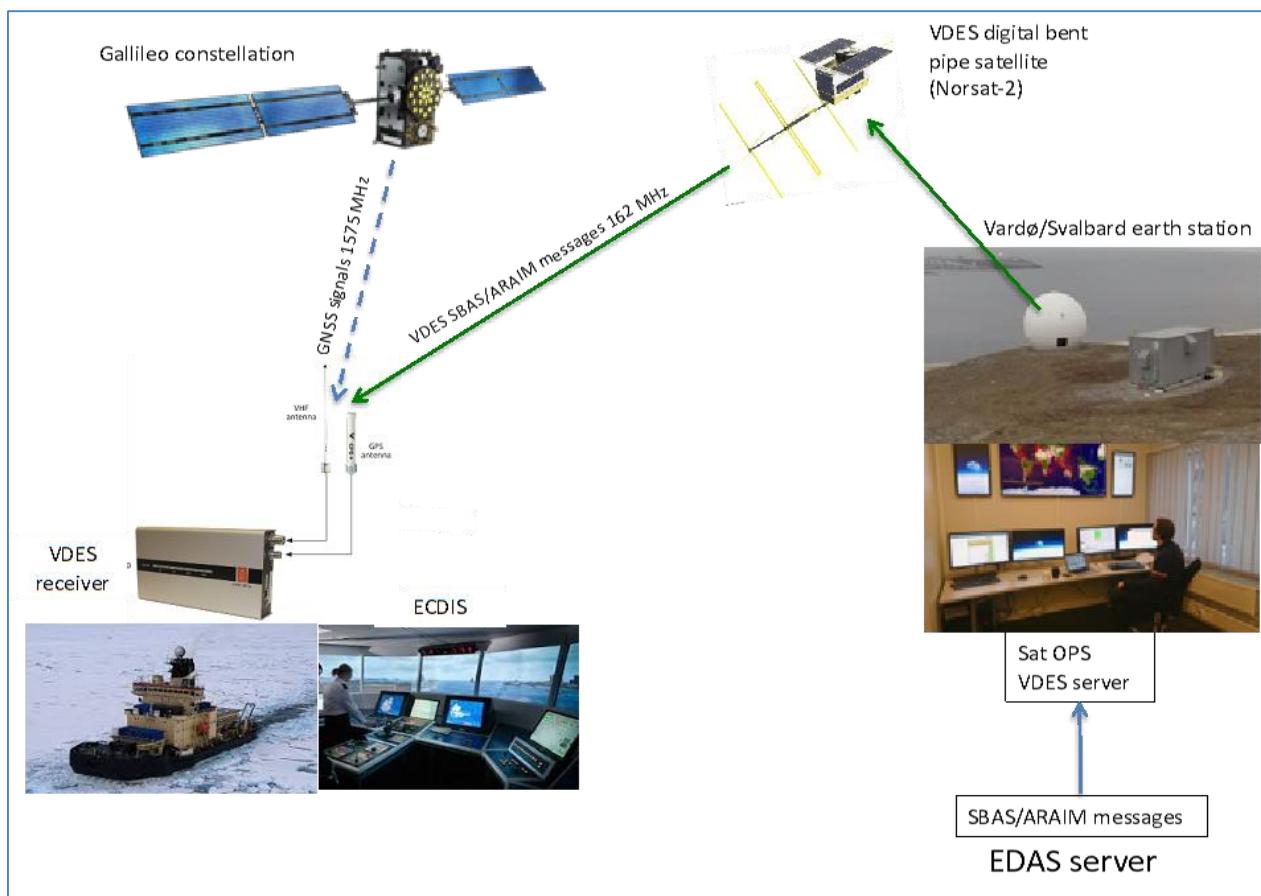


Figure 2: AMNAS System Concept using NORSAT-2

The AMNAS study shows that it is technically feasible to use low cost VDES satellites to deliver maritime SBAS in the Arctic beyond 70 degrees North with less than 10 s latency using 18 three to six U satellites in polar orbit. A throughput of around 300 bps is required. However, propagation measurements show fading intervals of 60 s and deep fades lasting more than 10 s making it challenging to ensure less than 1 s satellite link latency. In addition, the link budget at high elevation angles is reduced by 3 to 5 dB due to the low ship antenna gain at high elevation angles.

An ARAIM service is less demanding than SBAS, and the communication requirements for an ARAIM service can easily be met by VDES. Depending on the type of ARAIM service the number of VDES satellites required for an operational service might be as low as 1-2 satellites for the less stringent service and up to 6 satellites for a worst case latency of 15 minutes in areas between 70 and 90 degrees north.

As a result of the AMNAS study, a new downlink VDES waveform has been proposed by the consortium and approved by IALA at its October 2018 WG meeting. This waveform reduces latency from several seconds to less than 1 s and provides more robust time and phase synchronisation.

A service demonstration is proposed for both services.

For the SBAS service it is proposed to use SBAS messages from the EGNOS Data Access Service (EDAS) that offers ground-based access to EGNOS data through the Internet on a controlled access basis EDAS service.

Since no operational ARAIM service currently exist, it is proposed to use a synthetic message to demonstrate the service.

Some of the findings from AMNAS will be followed up by another ESA activity (VNADS). A VNADS demonstration using NorSat-2 and VDES for Navigation Augmentation services is scheduled for 2019.