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e-Navigation Committee
5th Session
Agenda Item 11

15-19 Sept 2008

Report on e-ANSI Trial

This document is submitted by the General Lighthouse Authorities and reports on the outcome of an e-ANSI trial demonstration held on 4th March 2008, at the Northern Lighthouse Board depot, in Oban, Scotland.
A trial system was demonstrated providing the mariner with (near) real time information on the status of local aids to navigation (AtoNs).
The demonstration involved an AtoN capable of relaying its status information to a shore side base station using radio telemetry. The base station then constructed and broadcast a message to shipping in the area using the AIS network. The AtoN status messages were then made available for graphical and textual display on the vessels' Electronic Chart System (ECS).
The demonstration proved the concept and benefits of (near) real-time information on AtoN status, which will allow the mariner an extra degree of confidence in AtoNs fitted with the requisite equipment.

The Committee is invited to note this information and consider the way forward on e-ANSI.

1. Introduction

Traditionally, physical Aids to Navigation (AtoNs) provide the mariner with spatial reference points using visual shapes, colours, lights and sometimes sounds. More recently AtoN remote monitoring gave the controlling authorities confidence that the service being provided, was as intended. That confidence could be shared with the mariner if there were automatic electronic updates of the AtoN status. The International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) ad-hoc working group on electronic Aids to Navigation Systems Information (e-ANSI) declared a wish to stage sea trials of a development system. The General Lighthouse Authorities (GLAs) proposed to stage a prototype demonstration.
The demonstration occurred on 4th March 2008, at the Northern Lighthouse Board depot at Oban in Scotland. It demonstrated the generation and transmission of defined e-ANSI events, and the display of the events on a proprietary Electronic Chart System (ECS).

2. The e-ANSI System

Figure 1 below shows a logical representation of the proposed IALA e-ANSI system.

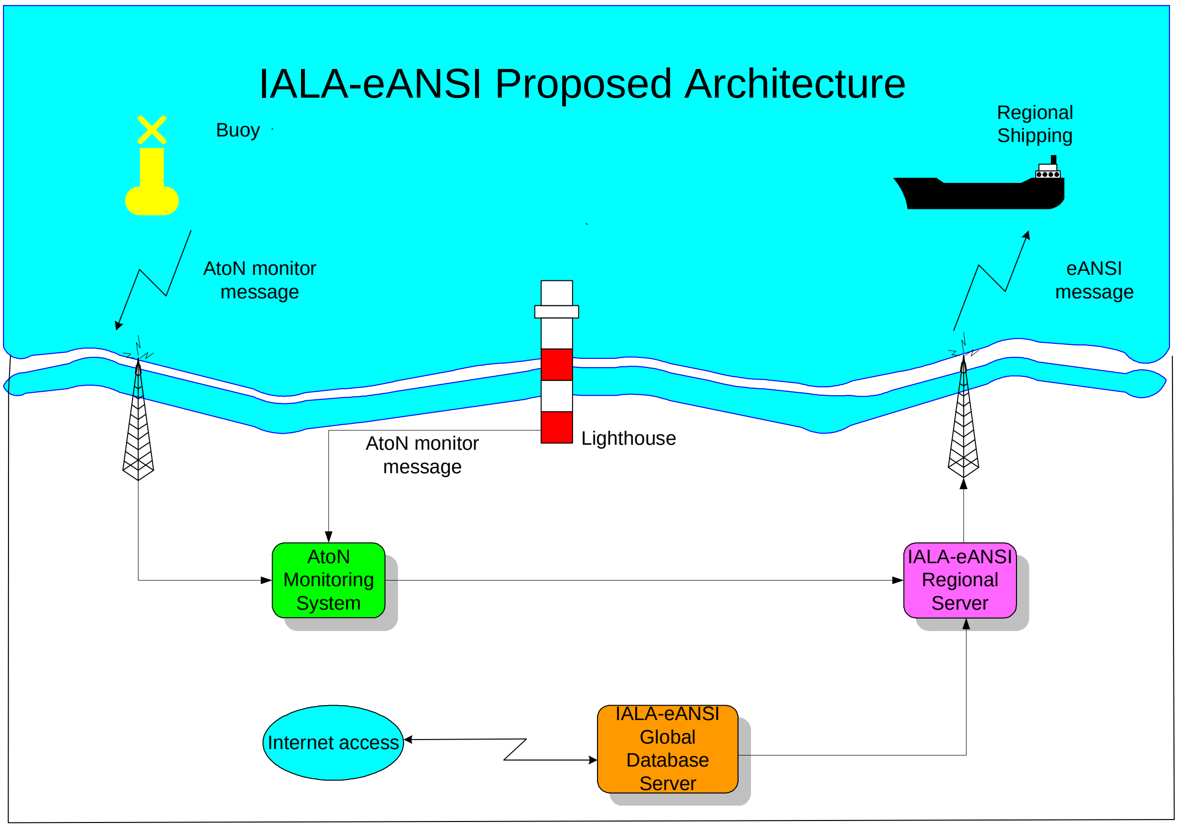

Figure 1: The proposed IALA e-ANSI system

Implementing e-ANSI required three components:

1. Monitored AtoN
2. Shore side base station for e-ANSI message generation
3. Ship based ECS for message display

It was also necessary to define the e-ANSI events, how they were to be created transported and displayed and how the demonstration was to be implemented.

3. Implementation Plan

Three work packages were defined as:

WP 1: Project Management and Demonstration - GLA R&RNAV, UK & Ireland
To supply a floating AtoN, ship, shore station, radio links as well as a site for the demonstration and to manage the project.

WP 2: e-ANSI Event Creation & Transmission - Tideland Signal Corporation, Texas, USA
Provide the AtoN monitoring equipment, define the e-ANSI message structure (Section 4) and provide the hardware/software required for the e-ANSI message generation.

WP 3: e-ANSI Event Display - Gatehouse A/S, Denmark
Supply a modified ECDIS, capable of interpreting and displaying the e-ANSI events.

4. e-ANSI Message Structure

Enabling the e-ANSI events to be correctly interpreted and displayed involved a clear message description being made available by Tideland. Five e-ANSI message types are defined in Table 1 below.

Message Type	Description	Contents includes
1	AtoN drifting off station	Identity of AtoN, Charted LAT/LNG as well as Current LAT/LNG, Time of last transmission, Drift Speed and Drift Bearing
2	A new or uncharted hazard	LAT/LNG, Nature of Hazard and Time of Occurrence
3	AtoN malfunction	Identity of AtoN, Charted LAT/LNG, Nature of Hazard and Time of Occurrence
4	Cancel a Message 1-3	Transmit time, Message Type
5	“Heartbeat” message	Transmit time, Message Type

Table 1: e-ANSI message type definition

In order to conserve bandwidth a numerical value is given to all the message parameters. Note that Message Types 2 and 3 contain a *Nature of Hazard*; this is a code number representing a Hazard as defined in the look-up Table 2 below.

Code Number (decimal)	Hazard	Description
1	Damaged	e.g. Top Mark Missing
2	Destroyed	
8	Buoy/ Light Vessel Off-Station	
16	Buoy/ Light Vessel Adrift	
24	Buoy/ Light Vessel Missing	
32	Light Extinguished	
64	Light Unreliable (Range)	
96	Light Unreliable (Sectors)	
128	Light Unreliable (Character)	
256	Fog Signal Inoperative	
512	Fog Signal Unreliable (Range)	
768	Fog Signal Unreliable (Character)	
1024	DGPS Inoperative	
2048	DGPS Unreliable (Range)	
4096	Racon Inoperative	
8192	Racon Unreliable (Range)	
12888	Racon Unreliable (Character)	
16384	Wrecked Vessel	
32768	Disabled Vessel	
49152	Miscellaneous Obstruction	

Table 2: Nature of Hazard Look-Up Table – code numbers and definitions

5. Equipment set up and demonstration

Instead of using a normal AtoN such as a buoy, there were several advantages in fitting the AtoN monitoring equipment to a small boat. The main advantage was manoeuvrability – the small boat could move on/off station when required and provide a more dynamic target on the ECDIS.

Similarly, instead of basing the ECS aboard a ship, to have the equipment next to the base station allowed the attendees to witness both the message creation prior to transmission and the received message as displayed on the ECDIS.

The Automatic Identification System (AIS) was chosen as the most convenient method, to transport the e-ANSI messages from the base station to receiving ECS equipment. To ensure that other mariners were not inconvenienced or confused by the e-ANSI messages, an *addressed* binary message format (AIS Message Type 6) was used, rather than the standard *broadcast* AtoN Message 21.

5.1 Equipment set up

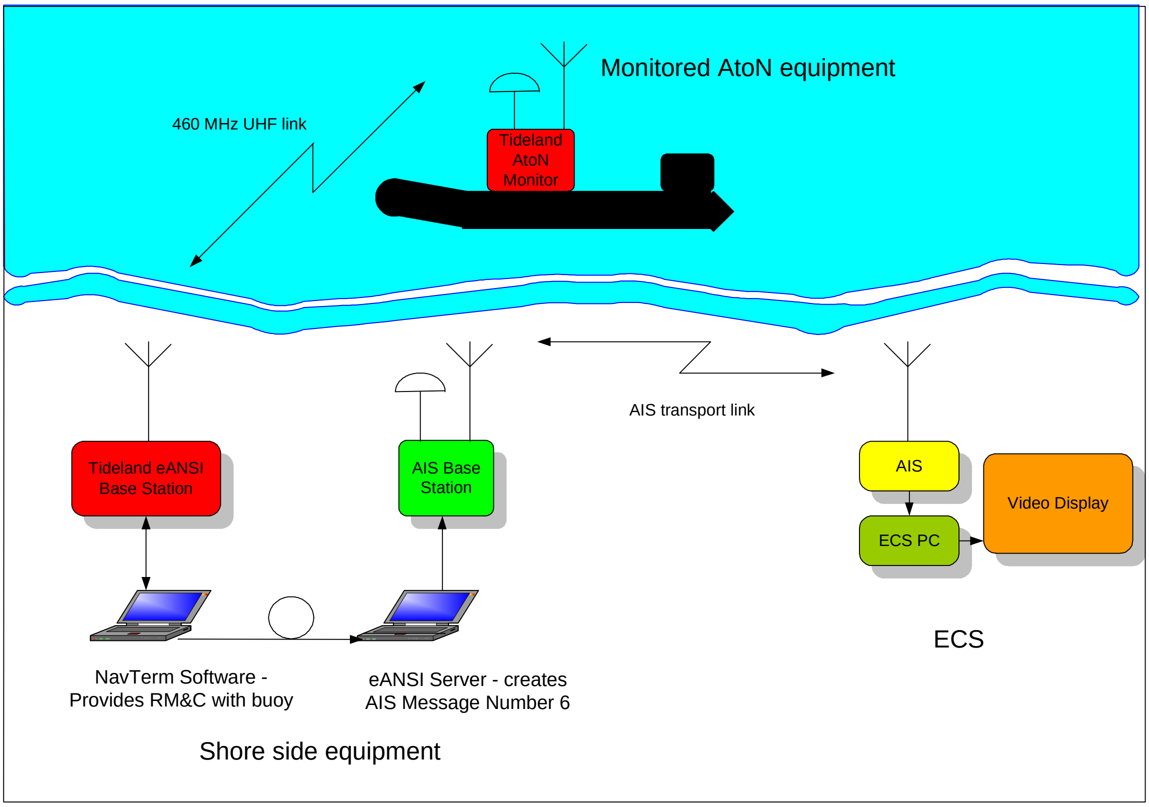

Figure 2: Demonstration set up system diagram

The AtoN equipment was connected via the UHF radio link to a laptop running Tideland's NavTerm™ software. This provided Remote Monitoring and Control (RM&C). In the event of an exception, for example AtoN *'Off-Position',* it generated an appropriate e-ANSI message (see Tables 1,2), which was sent via Ethernet to the e-ANSI Server laptop. The e-ANSI Server encapsulated the e-ANSI message, into the binary data area of an AIS Message 6. The message was addressed with the MMSI of the receiving station and sent to the AIS base station for transmission.

The addressed AIS unit passed the encapsulated e-ANSI message to the Gatehouse proprietary GAD™ ECS. The ECS PC decoded the e-ANSI message and used the position information to generate an AtoN icon at the appropriate location on the electronic chart. The ECS PC also decoded the message text fields, which reported the identity and status of the AtoN.

Figure 3: AtoN equipment mounted in the rear of an inflatable boat

Figure 4 illustrates the shore side set-up: The lower left-hand unit is the Tideland UHF radio base station; in the foreground is the NavTerm™ laptop. The laptop at the rear-left is the e-ANSI Server laptop; with the AIS base station (the blue faced unit) on the lower right hand side.

Figure 4: The shore side base station and equipment: AtoN monitoring, e-ANSI message generation and AIS base station

Figure 5 shows the ECS equipment set-up. The AIS unit can be seen above the GAD™ ECS PC, the main area of the display shows an electronic chart of Oban bay area, while the right hand text column lists various parameters of the selected AtoN, such as position and status.

Figure 5: ECS equipment set up, showing the AIS unit, ECS PC and display.

5.2 Demonstrating e-ANSI

5.2.1 Demonstrating Message Type1

A Message Type 1 occurs automatically when the AtoN is reported 'Off-Station'. To test the message, the inflatable boat shown in Figure 3 was located at the pre-defined charted position of the AtoN. The boat then motored slowly away from the charted position. When the AtoN guard ring was exceeded for a majority of samples, an alarm condition created a Message 1 (Table 1). The result can be seen in Figure 6, with AtoN called 'Boat' right of centre. Note the AtoN symbol is a green diamond shaped icon with crosshairs centred at its reported position.

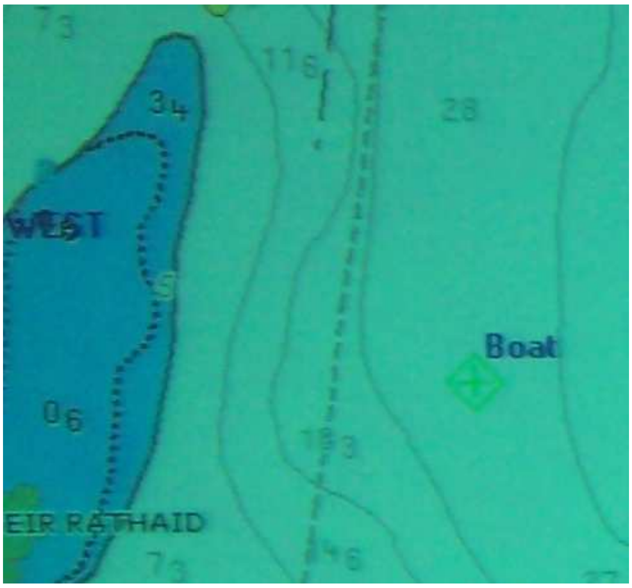

Figure 6: The AtoN icon – green diamond shape with crosshairs at the reported position of the AtoN named Boat.

Figure 7 gives a general view of the ECS when 'Boat' is selected with the cursor. Figure 7a gives a close-up view. Note that the selection process shows white corners of a square around the AtoN symbol, it also brings up a broken diamond symbol at the charted position. Figure 7b (also a close-up view of Figure 7) displays the AtoN status information; this correctly shows the *Identity, Current Position, Charted Position* and the e-ANSI *Message Type.* However the *Drift Speed*, *Drift Bearing* and the *Hazard Failure* are not reported.

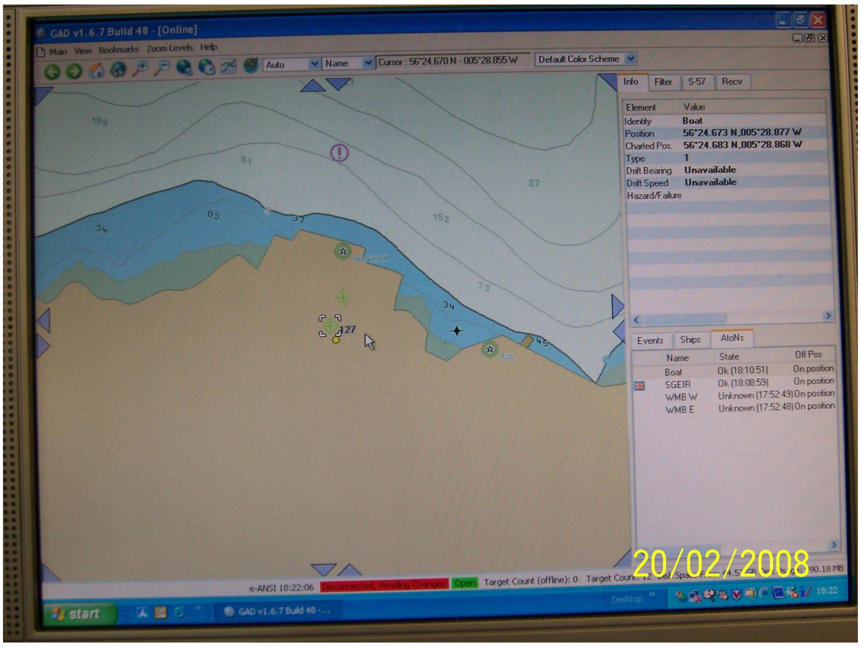

Figure 7: Electronic chart displaying the AtoN called Boat current position and charted position

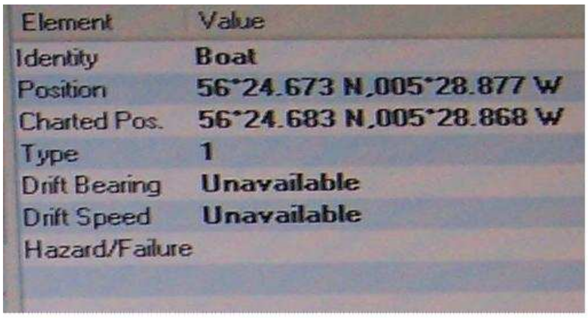

Figure 7a: Selecting AtoN Boat with cursor **Figure 7b:** Textual info from AtoN Boat

On investigation, the binary message length was too short to cater for the drift parameters. This was because an e-ANSI Message 1 spans two AIS time slots and will therefore, require two AIS Message Type 6 transmissions to complete. The e-ANSI Server only appeared to produce one.

Though Hazard/Failure is not part of the Message 1 structure, when encountering a Message 1 the Hazard/Failure field should state *'AtoN Drifting'*.

In principle, demonstrating Message 1 was successful, though there are still some areas for development with the message generation and display.

5.2.2 Demonstrating Messages Types 2-5

A Message 2 (New or Uncharted Hazard) is the same as a Message 3 (Malfunction of AtoN), except Message 2 does not have an Identity of AtoN. This denies Message 2 the ability to identify itself on the electronic chart and is consequently less useful. Therefore Message 3 is used to demonstrate both *New or Uncharted Hazard* and *Malfunction of AtoN.*

A New or Uncharted Hazard was demonstrated by creating two virtual AtoNs to mark an imaginary wreck; they were called WMB W, WMB E. The virtual AtoNs were constructed with the e-ANSI Server, using the application shown in Figure 8. Note that the code used for Nature of Malfunction - *16384* represent 'Wrecked Vessel' (Table 2). The sent messages from WMB W and WMB E result in AtoN icons with the identity WMB W and WMB E appearing in the chart area of the ECDIS, Figure 9 shows the corresponding information displayed in the text area for WMB E.

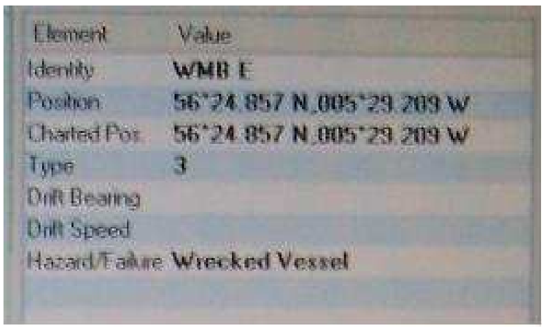

Figure 8: e-ANSI Server application **Figure 9:** Corresponding ECS information

Note that unlike Message 1 this message has the Hazard/Failure field set correctly with *'Wrecked Vessel'*.

The AtoN Malfunction was demonstrated successfully for some of the hazard codes (Table 2), though the interpretation is incorrect for others. For example the code 768 should report 'Fog signal Unreliable (Character), but instead it reports 'Fog Signal Inoperative', 'Fog Signal Unreliable (Range)' and 'Fog Signal Unreliable (Character)' all at the same time.

Because the observer could only see the end result, it was not possible to know whether the incorrect results witnessed were due to an encoding error with the message creation, or a decoding error with the message interpretation. The solution was to write a program to decode and check that the message had been set up correctly. Tests using the decode program showed that the messages tested appeared to be correct and therefore the problem lay with message interpretation. Gatehouse was aware of the few minor problems and that their software required modification, however, in principle, Message 3 was shown to work.

Message 4 (message to cancel Messages 1-3): The cancellation message worked successfully in both automatic, such as when the 'Off-Station' AtoN returned to the 'On-Station' mode, and manually, such as when cancelling a virtual AtoN.

Message 5 (Communication check or 'Heartbeat' message): Testing this message involved breaking the communication link between Laptops 1 and 2. This resulted in an alarm condition on the ECDIS, which cleared when the link was restored. Therefore Message 5 was demonstrated successfully.

6. Conclusions

The e-ANSI project successfully demonstrated the generation, transmission and display of the following e-ANSI events:

- AtoN drifting off station
- A new or uncharted hazard
- AtoN malfunction

It also demonstrated the generation (automatic and manual) of messages to cancel a current message, as well as communication link test messages. The events listed all appear at the ECS, with the AtoN symbol on the electronic chart area at the reported position. Similarly, AtoN status information was provided in a text area.

There are obvious benefits for the mariner to receive (near) real-time information on AtoN status, which will allow the mariner an extra degree of confidence in AtoNs fitted with the requisite equipment.