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A COMMERCIALLY BASED SERVICE FOR THE DISTRIBUTION OF ELECTRONIC CHART UPDATES

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. A new service to mariners is now available that can broadcast both electronic and paper chart updates directly to vessels at sea. This gives the mariner an affordable and future-proof path to immediate access to the latest data available from hydrographic offices, enhancing safety and easing the job of the mariner in keeping charts properly updated. The broadcast service also provides the mariner with other navigational data such as precision position fixing, weather and sea state forecasts.

INTRODUCTION

It has always been recognised that an important advantage of electronic charts is in the relative ease of getting up-to-date chart information directly to the mariner by telecommunications. Hence charts may be updated easily and accurately to the latest information supplied by hydrographic offices with minimum effort by the mariner.

In the more distant future we can envisage that when a mariner wishes to use a particular chart, either for planning or route monitoring purposes, then the latest (fully updated) copy available from the relevant hydrographic office will be immediately 'down-loaded' to the vessel. The vessel would not need to carry a local

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store of chart data, except for emergency use. For today this poses some unsolved problems, not the least being how to transmit such quantities of information to the mariner at an affordable price. Whilst this view of the future has to remain a vision for many years, the reality of today is that telecommunications can now provide a service that starts to approaches this ideal - and can be affordable.

The service to be described evolved out of a privately funded study on how to meet the distribution requirements that were inherently part of the United Kingdom Hydrographic Office's request for tenders for a 1997 UK Government Private Finance Initiative (PFI). In the end, for a variety of reasons, the PFI did not go ahead but the thinking on distribution continued, eventually leading in 1998 to the formation of ChartCo Ltd, jointly funded by Smiths Industries and Fugro.

DATA BROADCASTING

It is easy to envisage the basis of an electronic chart distribution system based on an Internet or e-mail service. Charts and their updates could be available on a secure site and the cost of access could be automatically billed to the shipping company. In practice such services become expensive because of the inherent cost in using point-to-point satellite communications for such data. Unfortunately the advent of global mobile phone services is not going to lower significantly the cost of point-to-point data delivery in the foreseeable future. For such cost reasons ChartCo designed their service around a broadcast method of data distribution. Because many vessels receive the same broadcasts the unit cost of delivering data to each vessel is much lower. The concept is applicable to a variety of 'common' data needed by vessels trading internationally. The cost effective ChartCo service supplements vessel specific point-to-point data transmissions, thus reducing the overall data communication costs of vessels

For a number of reasons ChartCo chose to use the Inmarsat Point-to-Multipoint (PMP) service for its broadcasts. These channels were already being used for the global broadcast of differential GPS (DGPS) corrections for both navigational and survey purposes. They had proved to be reliable for such exacting work and there was available, well-proven technology that needed little adaptation for the broadcast of electronic chart data and other navigational information. In particular Fugro, one of the shareholders of ChartCo, is a world leader in the supply of such DGPS services.

A major advantage of the Inmarsat PMP service is that it uses the same satellites as the normal point-to-point services, such as Inmarsat A, B and M, thus the vessel's existing Inmarsat terminal is 'unknowingly' already locked-on to the PMP broadcasts. On board, the PMP signal is extracted from the Inmarsat terminal by a special decoder box (receiver) supplied by ChartCo. The popularity of the DGPS services has meant that most Inmarsat terminals already have an approved method of connection to the decoder. An advantage of the PMP service is that it does not interfere in any way with the normal use of the Inmarsat terminal. In

particular it does not incur any call charges for the user, nor does it prevent simultaneous use of the normal functions of the terminal.

The PMP channels dedicated for ChartCo use are able to broadcast 24 hours a day and therefore have a large inherent capacity for data broadcasts. Even this capacity is insufficient to broadcast the original ENC database, but the service has more than adequate capacity to broadcast all updates to a future world series of ENCs. A considerable advantage to the mariner is that the broadcasts also include a complete service for paper chart corrections, including Notices to Mariners and tracings for all UKHO charts and for US coastal NOAA charts. Also included is a weather / sea-state forecast service supplied by the UK Meteorological Office and DGPS correction data originated by Fugro Starfix. The latter is particularly applicable to the use of ENCs and holds the potential for significant fuel savings when used with modern autopilots as it virtually eliminates vessel 'wandering' due to inaccurate GPS position fixes. ChartCo provides global DGPS corrections to enable such fuel saving to be achieved for the entire voyage and not just when the vessel is in coastal regions served by local DGPS stations. The resulting reduction in rudder movements can also lead to a significant increase in the length of time between expensive rudder-gear overhauls, providing additional cost benefits.

In the future other navigation services will be put on the ChartCo broadcasts and it is hoped to include RCDS updates as well as ENC updates.

THE CHARTCO BROADCAST INFRASTRUCTURE

A great deal of effort has gone into the integrity of the ChartCo service in order to render it accurate and reliable. An overview of the ChartCo broadcast system is given in Figure 1. The broadcast data is streamed by a dual redundant server system at ChartCo's Network Control Centre (NCC) in London. If one system develops a fault the other immediately takes over. A third system is continuously running at an auxiliary site 40 miles from the NCC. This takes over if there is a telecommunications blackout or a power failure at the NCC site.

Data is sent to Land Earth Stations (LES) at Goonhilly and Auckland New Zealand, for upwards transmission to the four Inmarsat satellites - Atlantic Ocean Region East (AORE), Atlantic Ocean Region West (AORW), Indian Ocean Region (IOR) and Pacific Ocean Region (POR). This gives round-the-world coverage to approximately +/-70 degrees from the equator. British Telecom are contracted to provide the uplinks and the network communications. They monitor the network continuously and provide a rapid response to any potential network failure.

ChartCo directly monitors the data broadcasts from all four satellites. Every data bit of received data is automatically compared to the data stream outputted by the ChartCo NCC. Any discrepancies, which are randomly possible in any communications system, cause the offending data packet to be immediately

rebroadcast. The receiving equipment on board the vessel automatically deals with the corrected data invisibly to the user.

A number of other methods are used to ensure that data is received uncorrupted. Forward Error Correction (FEC) is applied to the data to ensure that mildly corrupted data, perhaps due to local interference, is still received by the vessel.

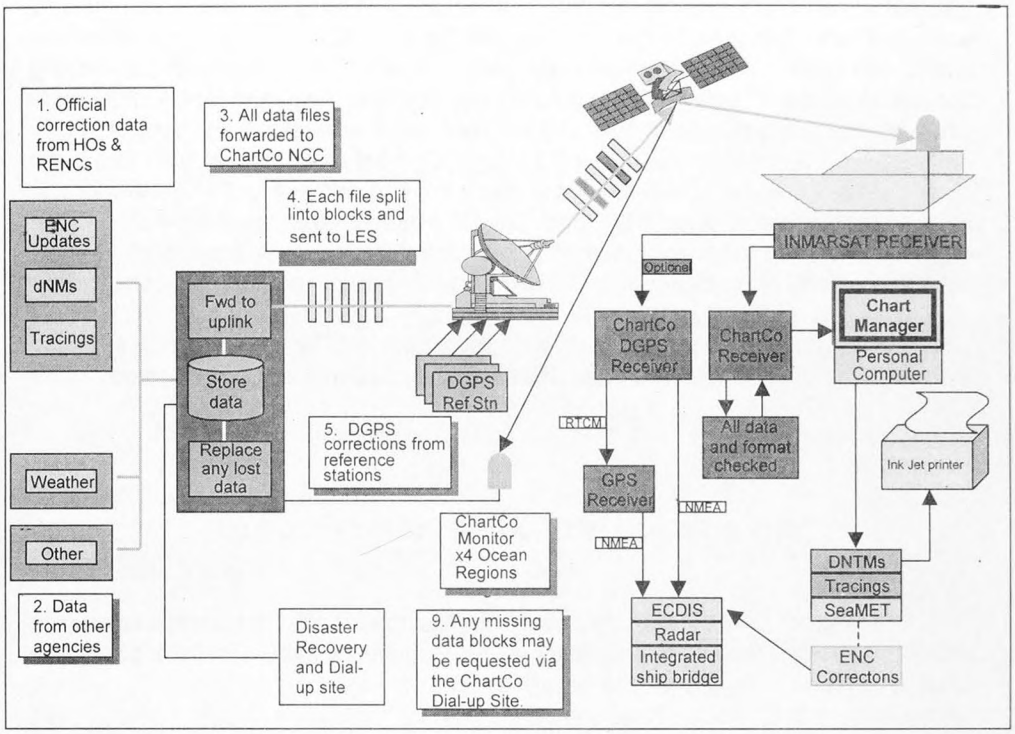

Fig 1. Overview of the ChartCo Broadcast System

The use of Cyclic Redundancy Codes (CRCs) allows the receiver to bar any residually corrupted data from being used by the mariner. Finally, complete data transmissions are repeated a number of times by the NCC allowing the shipboard system to automatically fill-in any lost data packets. These repeats are carried out over 48 hours, or so, in case there are local conditions on the vessel preventing the use of the Inmarsat equipment. For instance there are isolated areas in the world where Inmarsat reception is difficult due to interference, such as Tokyo Bay.

Occasionally the ChartCo system may flag to the mariner that essential data has not been received, despite all the above safeguards. This can occur, for example, when the vessel is in port for some time and the Inmarsat antenna has been obscured by dockside structures, or even turned off. In this case the system will ask whether this data should be automatically downloaded from ChartCo using any available point-to-point connection such as Inmarsat, GSM or normal phone, depending on the position of the vessel.

CHART UPDATES

Fortunately the mariner does not have to concern himself with the technical details and complexities that have been described above. The user's interface to the system is via a PC running ChartCo software, known as ChartManager, which has been designed to provide easy access to all of the ChartCo services. In particular ChartManager is designed to be able to look after the management of all official charts on the vessel, whether they be paper or electronic and form part of the ISM procedures of the ship. It is clear that it will be many years before ENC data has world coverage and that paper charts have a long life ahead of them, even if only being used in conjunction with RCDS data as the 'appropriate portfolio', as stated in the RCDS amendment to IMO's ECDIS resolution A.817.

One of the many advantages of the ChartCo system is that the service is sold by a global network of existing chart agents, as an enhancement to their individual paper chart management services. This ensures that the user receives a completely integrated service, covering all chart types, and does not have to go to different agents or services depending on whether paper, ENC or RCDS data is needed. This greatly reduces the inherent costs of dealing with multiple suppliers and allows the agent to cost effectively manage the ship's transition from paper to electronic data, however many years it takes. In particular it gives the user the advantage of 'instant' updates to paper charts, eliminating all the complications inherent in getting paper chart updates to vessels by conventional means.

It is emerging that the price model for ENC data is typically a cost per cell, or set of cells, for the base data and a related annual update charge. The base data will normally be distributed to the vessel on CD-ROM. The updates will get to the vessel by a variety of techniques including floppy disk, CD-ROM, broadcast and e-mail. Some data may be encrypted, similar to that used on the UKHO ARCS raster chart service. The ChartCo service is designed to utilise both encrypted and unencrypted data. Encrypted update data inherently deals with its own security and can typically only be loaded on an ECDIS that has been electronically authorised. For data that is unencrypted, but still requiring authorisation access, ChartCo uses its built-in service level feature, which also only gives access to authorised users of particular data. This is set up remotely and can be changed remotely, whilst the vessel is at sea.

ChartCo will receive ENC data from authorised sources only, usually direct from the relevant Hydrographic Office or RENC. As soon as new updates have been received they can be broadcast. ChartManager informs the user when updates relevant to the vessel's chart outfit have been received and the update database, which is embedded within ChartManager, is automatically updated. The user can then instruct ChartManager to create an update disk for one or more updates. This disk is created in IHO update format or in the required encrypted format of the particular HO. The disk is then loaded into the ECDIS.

In the future an international standard will be adopted for the direct interconnection of ECDIS equipment into a communication system, but until that occurs the disk exchange method will probably predominate. ChartCo are in discussion with some ECDIS suppliers and other relevant organisations to try to get early standardisation on such an interconnection.

STATUS OF SERVICE

Trials of the ChartCo service commenced in the summer of 1998, allowing the system to 'go live' in January 1999 in the four Inmarsat regions, giving world-wide coverage. It is currently providing a paper chart service, including Notices to Mariners and correction tracings, for all UKHO charts and for NOAA US coastal charts. The UKHO granted a full licence to ChartCo in January 1999, authorising the broadcast of their data. In addition the service provides global weather and sea-state forecasts from the UK Meteorological Office. This provides a forecast for every 6 hours over the succeeding 3 days, updated every 24 hours. A DGPS service is also available covering the whole Inmarsat coverage area.

The ENC service is currently confined to a trial programme because of the paucity of data of interest to vessels trading internationally. ChartCo is in discussion with a number of Hydrographic Offices and other official organisations in order to expand these trials. Providing data becomes available ChartCo will commence an ENC service during 1999. ChartCo is also in discussion with HOs to get a similar service for RCDS data.

Conclusions

A cost-effective service to mariners, suitable for the update of all types of official charts, is now available to the mariner. Although the service is currently only broadcasting data for the update of paper charts an ENC service will be available during 1999. Most mariners will need to use and maintain paper charts for many years to come, even when they have an IMO approved ECDIS onboard the vessel. Use of the broadcast chart update service provided by ChartCo enables the vessel to obtain updates to both paper and electronic charts promptly, accurately and affordably, giving a number of benefits to the vessel, including:

- Enhanced safety, since charts may be updated at sea soon after HOs release data.
- Improved time management:
  - charts do not have to be hastily updated during loading/unloading operations in port and may be updated to a sensible schedule, reducing probability of error,

  - easy to use chart management database, always updated with the latest information, eases task and further reduces probability of error.
- Easy compliance and audit to ISM procedures, reducing possibility of vessel arrest due to negligence of staff.
- Eliminates problems and cost in obtaining Notices to Mariners and corrections by post or courier.
- Forms part of an integrated service from established chart agents covering the supply and update of paper, ENC and RNC charts.