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# CONCEPTUAL MODEL OF A REGIONALLY INTEGRATED DATA BASE FOR ECDIS

by Adam J. KERR [1]

## INTRODUCTION

The Special Committee on a Worldwide Electronic Navigational Chart Data Base (WEND) was created as a result of Decision 3 of the XIVth International Hydrographic Conference [1]. The Special Committee was created following recommendations made at a Seminar to Discuss the Norwegian Electronic Chart Data Base Proposal, which was held at Monaco, 1-4 October 1991 [2]. Inter alia its tasks were to examine thoroughly the necessity of establishing a WEND suitable to the needs of international shipping and to examine the options for the administration, financial and legal and, as appropriate, technical organization, under the auspices of the IHO. The Special Committee, recently completed its third and final meeting, under the chairmanship of Dr Peter Ehlers, the President of the German Federal Maritime and Hydrographic Agency and has produced its final report [3].

The Special Committee on WEND concluded that there is a necessity for an international system of data base development for the production and distribution of ENCs (Electronic Navigational Charts) that must be influenced by the IHO, to satisfy the data needs for ECDIS. The Committee developed a Definition of WEND; a list of Principles; and a conceptual Model of a Regionally integrated Database Service. This paper explains the details and goals of the last of these, the conceptual model, making reference to the Definition and Principles that were proposed by the Special Committee.

## THE NEED FOR INTEGRATION OF NATIONAL SERVICES

Another major programme of the IHO, the INTernational (paper) chart programme has been designed to provide a wideworld service of paper charts [4]

[1] Director, International Hydrographic Bureau, 7 av. président Kennedy, 98000 Monaco.

in which all the IHO Member States can participate. In a paper written 25 years ago, Rear Admiral LANGERAAR observed that in some parts of the world there were up to eight different hydrographic offices compiling charts of the same area at the same scale or close to the same scale. The charts all served the same purpose and except for language differences, included essentially the same data. He considered that very many man-years were being wasted on this non-facsimile copying and, as a consequence, all world and regional chart coverages then used by mariners were less detailed and less up to date than the national coverages on which they were based. RAdm LANGERAAR also observed that four countries, the UK, the USA, France and the USSR had each established and were keeping keep up to date a world coverage of nautical charts which were not identical. Consequently the effort needed to maintain these four major chart folios, which numbered together some ten to twelve thousand charts was very great. From these observations, RAdm LANGERAAR proposed and the IHO subsequently endorsed, that considerable economies could be made by the IHO Member States jointly contributing to one unique International set of charts. A unique chart scheme would be produced at small, medium and large scales. Member States would then volunteer themselves to produce specific charts which would be compiled and drafted to an international (IHO) standard. Eventually, a uniform set of international charts in an agreed scheme are produced to provide a World series of charts. Member States which then have need to provide a set of charts, either on a regional or worldwide basis may then avoid duplicate compilation by arranging to reproduce the basic chart information adding only such items as their own crest and language, if they wish. The basic chart design and data would stay the same [5].

The INTernational Chart System has been slow to develop due to both technical and financial reasons but there are reasons to believe that it is now proceeding far more rapidly. In the past there has been some intransigency in accepting the technical standards and some misunderstandings concerning possible reimbursement between Member States, but at the end of 1993, 79 small scale charts and 288 medium and large scale charts have been produced [6]. It is true that this is as yet a small portion of, the perhaps, 3000 charts that are needed to complete the set but the programme offers considerable economy for HOs in these days of shortened resources.

The advent of digital charts presents not only technical challenges to HOs and the IHO but an opportunity for a fresh start to design a system of producing, distributing and updating this new product. It is evident from experience with the distribution of paper products that for ships on international voyages "one stop shopping" is desirable. It is logistically difficult for such ships to obtain and utilize the charts of every country they might visit, except for the extreme terminal points of a voyage, where locally produced charts may offer greater detail. Not only must the charts be gathered together before the start of a voyage to provide for chart planning but there are great difficulties involved in ensuring that all the Notices to Mariners from different HOs are received and that the corrections are properly applied. In a recent paper it has been stated that there are 50,000 Notices to Mariners produced by HOs around the world each year applicable to the various national chart series [7]. For these reasons, most ships on international voyage use charts produced by one of the three worldwide charting agencies, namely the UK, USA and Russia or the charts of partial world folios such as those of France, Germany and Japan. This simplifies the assembly of charts for their voyages but particularly it

means that they need only process one set of Notices to Mariners to plan and execute an international voyage.

As we plan for the era of digital charts we can re-examine the parallels between the paper chart service and the digital chart service. We must surely be as economic as possible and avoid duplication of effort. We must standardize the products. We must respect national rights and ownership of data. These and other Principles have been listed and proposed by the WEND Special Committee.[8] As we wish to develop a complete worldwide system it is desirable that it be fitted into a global geodetic reference system. To this end it has been agreed that the World Geodetic System (WGS) 84 be used [9]. The technical and legal difficulties of doing this have been explained in several other papers [10]. Language presents a difficulty in several areas of navigation. It was earlier proposed that digital charts should only be made available in English but the reality of it is that although this may be imposed in the aviation industry, many thousands of navigators at sea utilize many languages and many navigators on international voyages are not well versed in English. This is particularly the case in national shipping. In a digital world it is to be hoped that substituting one language for another may not prove an insurmountable problem and might help to improve understanding/safety but this remains to be verified through experience.

In its proposal in 1991 to develop a Worldwide Electronic Chart Database Norway offered to provide a central point for the collection and distribution of digital data for ECDIS covering all the world. This proposal was countered by Chile, which suggested that a regional approach would be more acceptable in that it would allow greater participation of the Member States. Taking up these suggestions, the IHB representative during the second meeting of the WEND Special Committee proposed a schematic plan to develop a WEND through linked Regional Centres which would be formed by certain volunteering HOs. This plan was subsequently modified and formed a conceptual model on the grounds that at this early stage Member States could not be bound by a firm plan and that individual Regional centres may need to develop along different lines. (See Figure 1).

## THE CONCEPTUAL MODEL

The IHO has a consultative nature and is not a regulatory body. Therefore any plan involving its Member States must be voluntarily adopted and cannot be binding. IHO achieves its purposes by producing Resolutions, which under most circumstances, are followed by its Member States. However when a programme is developed to serve a common purpose, such as that of the INTernational Chart, it is normally counter productive to the common cause if individual Member States cannot support the plan. Therefore in designing the Conceptual Model the expectation is that there will be some uniformity in procedures of the Regional ENC Coordinating Centres (RECCs). This can normally be achieved when proposals are designed to enhance maritime safety. In some programmes of the IHO the world has been divided, by agreement, into specific areas, as can be seen in the NAVAREAs (Figure 2) and the Regional INTernational Charting Group (see Figure 3) areas. While this might have been ideal for the WEND, the immature nature of the

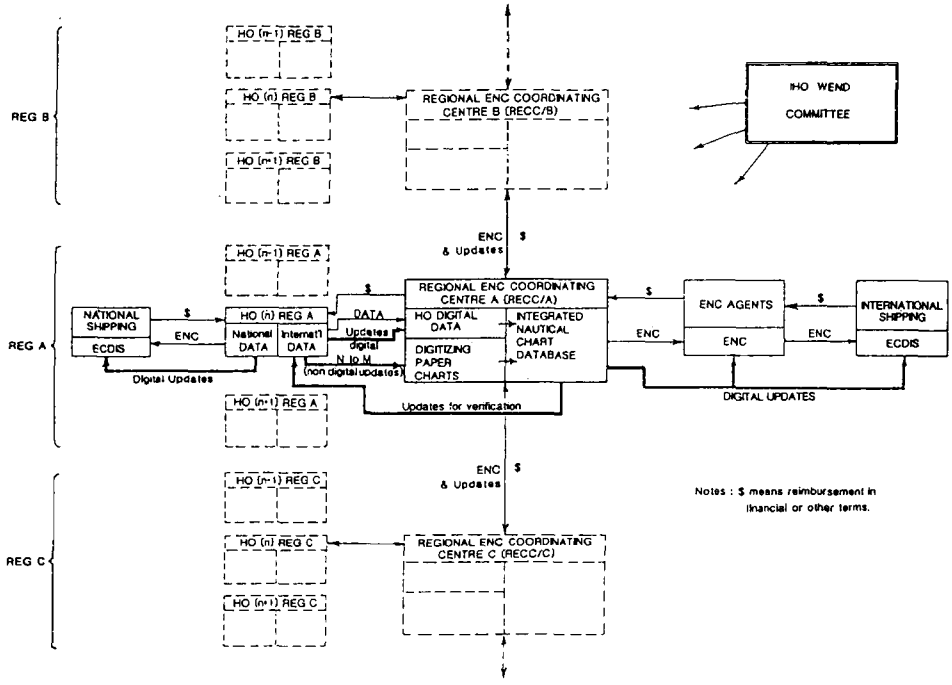


FIG. 1.- A Conceptual Model of an organization for a Worldwide Electronic Navigational Chart Data Base.

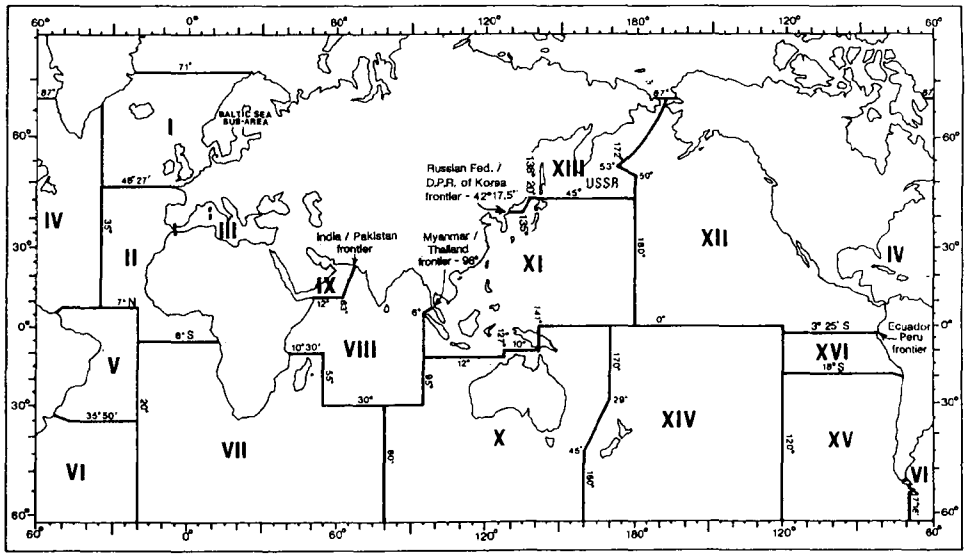


FIG. 2.- NAVAREAS.

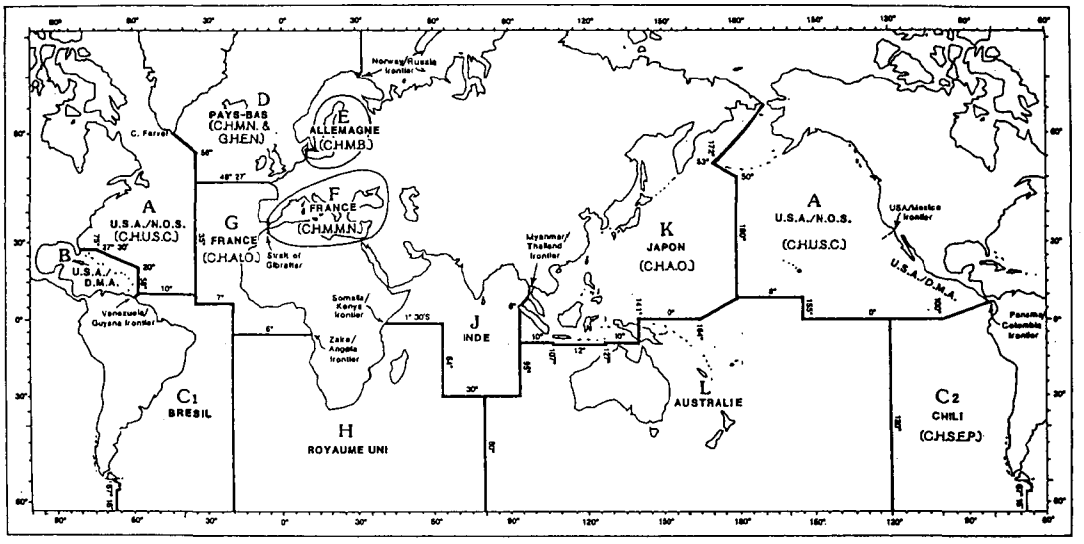


FIG. 3.- INT Chart Schemes Medium and Large Scales.

database creation and the varying skill levels of different HOs, has made the pre-planning of the RECC areas of operation difficult. Instead it is to be hoped that each Member State volunteering to provide a RECC will define its own area. It will then be the task of the new WEND Committee to discourage overlaps and encourage either expansion of existing RECCs of the formation of new RECCs to fill gaps. The tendency at present appears to be for RECCs to form in the areas covered by the Regional Hydrographic Commissions. At this stage the situation is as follows: - Norway has agreed to include the areas covered by the North Sea and Baltic Sea Hydrographic Commissions in its RECC operation. Italy has proposed to discuss with France and Spain the formation of a RECC that would provide service over the Western Mediterranean. Japan, which until 1995 is concentrating on its national waters, has proposed that it is willing to provide a RECC, will likely propose southward coverage of the China Seas. In North America, the USA and Canada will presumably jointly form a RECC covering all the coastal and inland waters of these two countries. At this time, there are many gaps in coverage. It is not known how the Northern Europe database and the Western Mediterranean database will link up. France plans to complete a database of all its national waters by 1996 and this will be a great help in filling this gap but it is not known how the actual RECC for this area will develop. There is a great need for ECDIS data in the Arabian Gulf and the Red Sea and this will need to be covered by a RECC. Australia, New Zealand and perhaps extending up to Indonesia may be the location of another RECC. The Caribbean and Gulf of Mexico would seem to be yet another potential region. South America may eventually follow a system similar to that developing for the USA and Canada for North America. Figure 4 is an attempt to graphically show how the RECCs might develop.

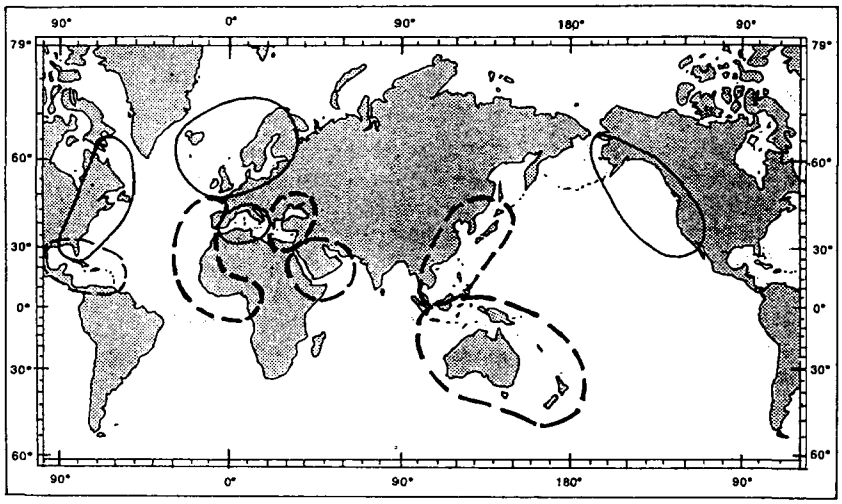


FIG. 4.- RECC areas in a probable state of development _____
RECC areas for possible future development - - - - - - - - - -

There is no firm agreement on the source of the digital data. At one time there was some thought that it might be the basic survey data and that ECDIS would operate on this data to produce a compiled chart with information provided at an appropriate scale. This idea has for the moment shown to be overly complicated and most HOs have chosen to digitize the information from the existing paper charts. This approach has not been universally adopted but for those HOs that do digitize the paper charts it is recommended that if they exist they digitize charts of the INTernational Series. If they are not available it has been recommended that they use the national chart that most closely fits the INTernational chart scheme as the source for digitizing. It must be hoped that Member States will abide by the WEND Principle 2 a), which states "the development of overlapping data sets from different sources should be avoided if possible". This is the analogue to the INTernational Chart goal of having one unique set of charts without differing national schemes of varying scale and coverage.

An important matter for all HOs and for the IHO itself as we enter the digital era is the maintenance of data quality and the legal liability consequent to a failure to do so. This is a matter of continuing concern but it seems clear that the originating HO is responsible for the quality of its own data unless it becomes modified in some way by another organization. Therefore in the case of the conceptual model the first point to watch is the provision of the digital data from the original source. If this is provided in digital form from the national HO, that body will be responsible for its quality. If however, in the case where a RECC may digitize a chart on behalf of an HO, there must be a feed back for the national HO to satisfy itself of the accuracy and completeness of the digital form of its own paper chart. It is not clear at this stage if the RECCs will be able to simply butt together the national data sets or if it will be required to make some adjustments when integrating them into a regional data base. However, following the example of the paper charts it seems likely that if the RECCs make any changes they will likely bear

at least some legal responsibility for the data. This matter must be borne in mind not only for the original data but when updates are provided by the RECCs in an integrated form.

There has been concern that individual Member States will lose revenue when digital data of their coasts is sold by the RECCs. This is not the intention. It is proposed that every transfer of data has either an arrangement for data exchange or a transfer in the opposite direction of some form of reimbursement. That is, data will be provided by individual Member States to the appropriate RECC and in return, the RECC will re-imburse the Member State. The amount of reimbursement will depend upon the mutual arrangement and the type of data provided. That is, data completely digitized and coded according to S-57 will result in a higher re-imbursement than granting the simple rights to digitize a paper chart. The amount of reimbursement may also be affected by the volume of sales by the RECC to international shipping through the ENC Agents. However, above all, it must be stressed that all Member States that provide data for the WEND will receive re-imbursement.

Updates are a particularly important element of the WEND Conceptual Model. It is undesirable that individual HOs distribute digital updates to international shipping although they should distribute them to national shipping in their own waters. Updates for international shipping should follow the same path as the basic data. Once again if an HO does not have the technical capability to convert its Notices to Mariners to a digital form they will pass the paper copies to the RECC which will do the necessary encoding. The RECC will then integrate the updates, referenced against each database cell and pass them to international shipping. The exact procedure for this will be as advised by the Updating Working Group of the Committee on ECDIS. Whether there is a financial or other reimbursement associated with the provision of updates is a matter yet for consideration. At present, paper Notices to Mariners are provided free by most HOs but in view of the labour involved in preparing digital updates some form of reimbursement, such as a combined chart and updating subscription, may have to be considered.

## INTEGRATION OF RECCs

International shipping will not always stay within a particular RECC area, although some ships, such as ferries and short sea trading vessels, may remain within a RECC area. It is therefore proposed that a ship with truly international operations may acquire all necessary ENCS and maintain an updating service by application through one point. That is the overall system of connected RECCs is transparent to the user who sees it simply as one world coverage database with an updating service. How can this be achieved? One option is to have a distributed system in which every RECC holds the data and the updates of all the other RECCs. Another option would be for each RECC to act as a purchasing agent and acquire data and updates from any other RECC area in which a ship plans to sail. Yet another model would be for there to be one central coordinating RECC which would hold the data and updates for all other RECC areas. For the provision of ENCs in

the first place it does not seem too critical which option is chosen and may be simpler if each RECC maintained the data for its own area and acquired data from other RECCs when requested by a customer.

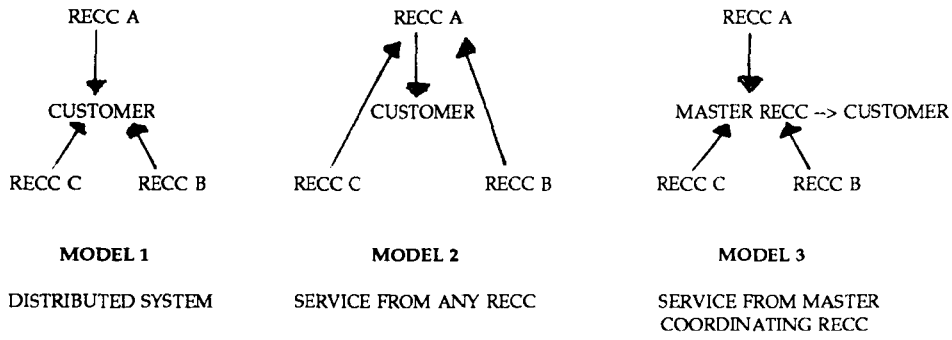


FIG. 5.- Integration of RECCs.

Model 1 may be satisfactory for international shipping over a limited area involving just two or three RECCs, such as voyages within Europe but may be inconvenient for ships on long international voyages. Model 2 will require excellent communication between all RECCs, particularly to ensure that all updates continue to be passed during a ships'voyage. Model 3 is analogue to an agency that provides worldwide paper chart coverage, such as the UK HO, the USA-DMA or the Russian Head Department. It will require considerable logistical capability in the Master RECC and faultless communications between the individual RECCs and the Master. However, a Master RECC familiar with each of the individual RECC's may be less complex than having all individual RECC's having to be familiar with one another. Fast evolving technology in communication will assist whichever option is chosen but there will always remain the need for careful administration to ensure that customers are provided with the latest and most complete data for the area in which they will navigate.

So far the lower hierarchal level of organization has not been discussed. That is the delivery of data and updates through agents. There seems no reason why agents cannot be used in a similar manner to that used for paper charts. National HOs could identify potential agents in their country to the RECC. The RECC would have to decide how many of these would be needed and where they should be placed. Because in the future it may be desirable to send data by CD-ROM and/or telecommunications to the agents they would have to have suitable technical capabilities. If it is decided to go with Model 3, an arrangement similar to the international chart agents of a world charting authority would have to be established.

A concern of some HOs has been the availability of digital data for their navies. This does not require these HOs to produce their own data. In fact an examination of the paper chart world will show that the major powers, which also happens to be the world chart producers, actually obtain much of their data from foreign chart sources over which they exercise little or no control. Under the WEND

conceptual model and associated principles any HO that chooses to have on hand a worldwide folio of digital charts will be able to simply obtain them from either one of the RECCs or the master RECC depending upon the exact model being used. There is perhaps the concern for the denial of this in the event of the outbreak of hostilities but the situation with a digital database will be not different from that existing at present with paper charts.

## CONCLUSIONS

The proposed conceptual Model for WEND is designed to serve an international goal of the IHO. As such it is very similar to the existing International Chart programme for paper charts. It provides an opportunity for all Member States to participate in the provision of digital data for international shipping and at the same time, by minimizing duplicative effort, it is internationally the most economic organization available. Like the International Chart System, it does not prevent any HO developing its own folio for its navy or other national purpose. For the overall economic functioning, it requires that Member States do not compete in the provision of services for international shipping. It does permit an HO to serve its own national shipping in its own waters but care must be taken to ensure consistency in updates provided for international and national shipping. Finally let it be concluded that although individual HOs may feel that they lose some of their identity in such a plan the overall effect is to provide an effective and economic system that will be of great benefit to international shipping.

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