

## An on-board data management solution.

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**Abstract:** *A Marine Data Management System (MDM-400) has been installed on the Instituto Español de Oceanografía (IEO) research vessel B/O Cornide de Saavedra. It is an experience of how a commercial solution has been developed and fully adapted to the ship characteristics, including an external communication by Universal Mobile Telecommunications System (UMTS) connection that facilitates the maintenance works. The system runs on 4 windows based computers interconnected by a LAN (Local Area Network). The current work mainly focuses on discussing the technical solutions that have been taken, real-time integration, data storage and transmission, and external communications.*

Keywords: data management system, data acquisition, communications systems.

### 1. INTRODUCTION.

The B/O Cornide de Saavedra (<http://www.ieo.es/buques/cornide.htm>) was built in 1970 and since then has been working as research vessel focused in collecting physicochemical parameters as well as in fisheries studies. As the time has been passing, the procedures, instruments and communications have been evolving and because of it, nowadays, the scientific requirements are much stronger than formerly. Thorough the last years, a big effort to bring up to date the ship capabilities has been done including the equipment integration and communication systems. In this course of action, during 2008, the Instituto Español de Oceanografía (IEO) has installed a MDM400 Marine Data Management System on the research vessel B/O Cornide de Saavedra in order to integrate in a unique database the navigation information and scientific equipment installed on board. The main difficulties are related to the special characteristics associated to an aged ship and the adaptation of the different datagrams and formats to a common one. The current system is a commercial solution that has been developed and fully adapted to the ship characteristics by IEO and SIMRAD. The system runs on 4 windows based computers interconnected by a LAN. One of the computers is configured as MDM Server, who receives the data from several instruments, and also supports the database. All the data collected underway are received, stored and distributed in real-time. The other PCs connected on the LAN act as Clients where the users are able to list, plot and download data in different formats including ASCII files that are easily readable by any post-processing software, regardless the platform.

Besides, in order to bring up to date the communication system on board, Dixita has implemented a remote connection via Universal UMTS to all the PCs in the network that has been proved very useful in the first steps of MDM installation to check if the system was working properly and also facilitate the maintenance works. The same connection allows an access to Internet, VoIP and email services when the ship is near coast (under UMTS coverage). The whole system benefits the research activity permitting a remote access to marine data and information systems, but also an easier and faster communication between ship and research institutions onshore.

## 2. DATA MANAGEMENT SYSTEM

The MDM400 system runs on 4 MS-Windows based computers connected by Ethernet LAN. Real-time logging system consists of several separate software modules that have been installed on the MDM Server computer, where it is also the MS SQL Server database where all the data is logged and some configuration data is stored.

### 2.1. Sending data to MDM400.

All the instruments on board are cable-connected to the MDM Server. Today the implemented system is capable of acquiring, sharing and storing navigation data from several GPS and Seapath20Nav satellite compass system, meteorological data from an Aanderaa weather station and two monitoring systems, physico-chemical sea water properties from the SeaBird-21 thermosalinometer and Turner-10 fluorometer, echograms from EA600 hydrographic and EK60 scientific echo-sounders, current velocity profiles from the vessel mounted ADCP and fishery related information from ES60 fish-finding echosounder, SCANBAS and FS20-25 trawl monitoring systems. These instruments are connected to the MDM Server via serial or UDP ports.

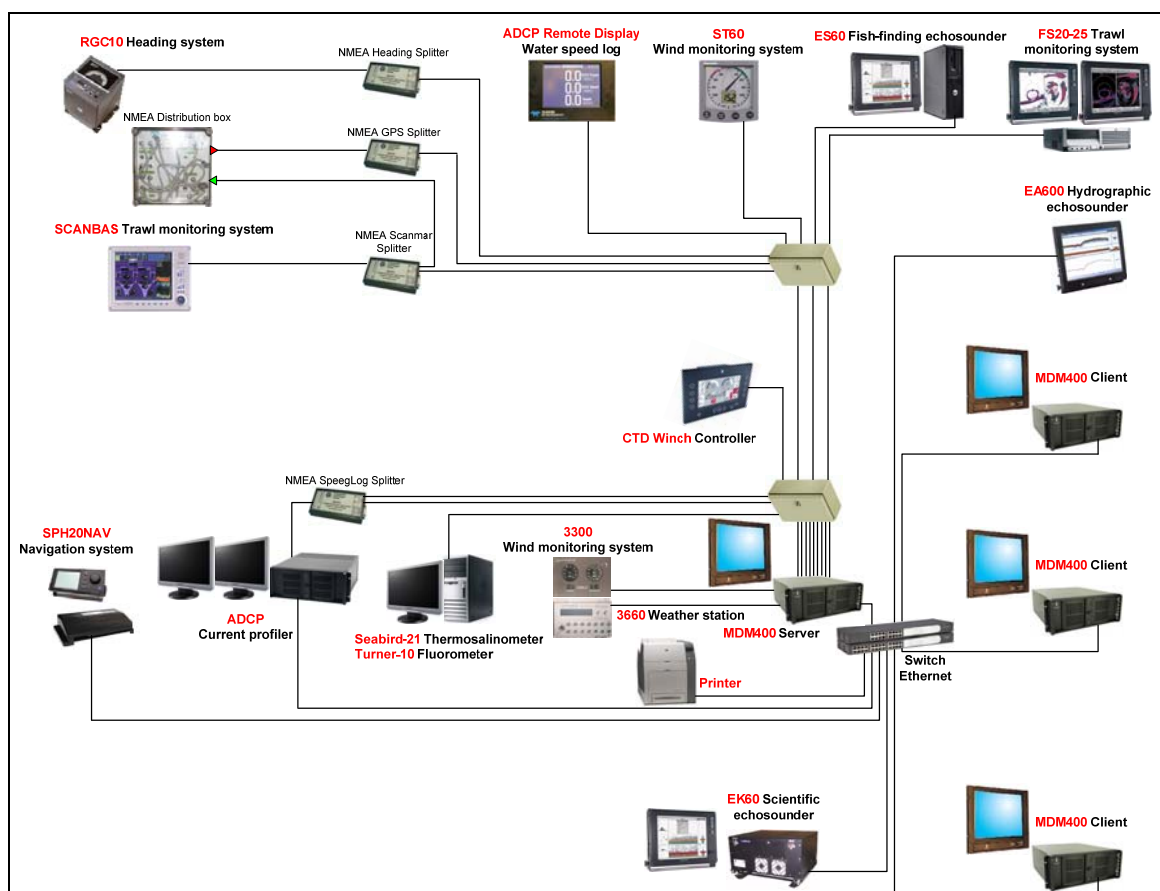


Fig 1: Schema of the MDM400 System installed on the research vessel "Cornide de Saavedra"

### 2.2. Decoding and storing the data.

The way to incorporate data from the installed devices is through dedicated drivers. The drivers are designed to receive and decode data from a specific instrument; an exception to this is the generic driver. This is a driver that can be configured by the end-user to log data from almost any instruments that are capable of outputting text or ASCII data.

The instrument or sensor interfaces consists of a set of three ActiveX modules. These are called Agent Driver, Server Driver and Display Driver and they are responsible for decoding, storing and presenting on-line data respectively:

- The Agent Drivers are responsible for receiving and decoding data from the instrument, this data will be time tagged. The drivers are controlled by the Agent Manager, only one Agent Manager is active in the MDM400 system.
- The Server Drivers are responsible for decoding the data packages that are received from the Agent Manager so that the data can be stored correctly in the Database. The drivers are controlled by the Server Manager, only one Server Manager is active in the MDM400 system.
- The Display Drivers are responsible for remote display of data. The display drivers are controlled by the Display Manager. Display Manager it is installed on the MDM Client computers and can be used to monitor data from one or several instruments.

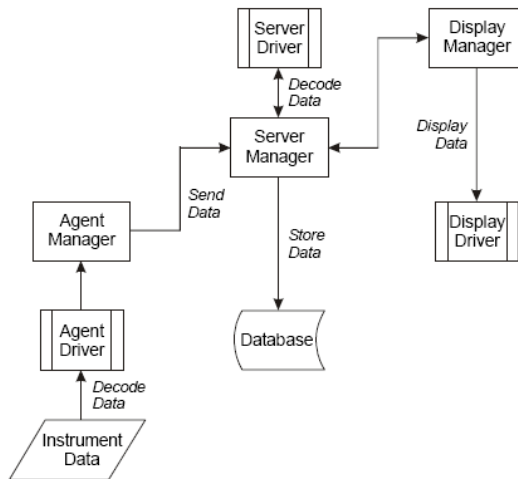


Fig 2 Data flow diagram.

Currently all the drivers are configured to store one sample by minute, to reach a compromise solution between time resolution and store capability, but it could be customized according to scientific requirements by changing the storing parameters in the Server Manager.

### 2.3. Retrieving data.

Since all data is time tagged by the Agent Drivers it is possible to extract data from several instruments from the same location based on the common timestamp. As all logged data is stored in a MS SQL Server database, the data is easily accessible to other application through an ODBC or ADO connection.

A report application called *Report Manager* exists to easy extract data from the database. It is possible to extract data from a single instrument, two independent instruments or from a Logging Group as configured in the Server Manager.

A second application, called *MDM CrossReport*, is used to extract data as a cross-tab report, the leftmost column is the time stamp for the controlling item and data for all other items are in the other columns. The application can be configured to create an automatic report and can be run at a scheduled interval using the MS Windows scheduler.

The extracted data from both of these applications can be exported to an ASCII file for further processing by third party applications or it can be directly combined with MS Word and Excel applications.

To take advantage of the possibilities given by the interconnected PCs, the specific SeaBird software used to configure and collect CTD data has been implemented on 2 clients. The MDM400 *Filestore* application permits the users to store directly the obtained raw or/and processed files in the server Database, that in this case acts as backup, keeping data as independent files that could be retrieved in the same formats from any other client PC or removable device.

Another facility from MDM400 system is the Time Server feature. The GPS Agent Driver supplies time corrections to the Time Server application installed on the MDM Server computer. This Time Server application will also send time corrections to the Time Clients, installed on the MDM400 Client computers.

### 3. COMMUNICATIONS SYSTEM

To facilitate the maintenance works, bring up to date the software, antivirus, etc. a remote connection via UMTS to all the PCs in the network, and also to other PCs on board, has been implemented. It allows a flexible and secure integration of an existing IP remote network into the Intranet of the vessel, enables remote LAN/WAN integration making use of the wireless data services (GPRS/3G/3G+based).

This has been proved very useful in the first steps to check if the system was working properly and also to solve problems when the vessel was on surveys.

The same UMTS connection allows an easier and cheaper access to Internet services, VoIP services and email when the ship is near coast -under UMTS coverage-. With a UMTS Marine Antenna (<http://www.dixita.com/docs/UMTSantenna.pdf>) it's possible get a coverage about 20 miles. The system allows connecting the vessel LAN with the central IEO LAN, achieving a complete vertical integration. It facilitates the report sending of the MDM daily automatic output by direct email and data replication to the datacenter onshore. In the same way, the system permits a daily report to Coriolis of thermosalinometer data, as it is part of the international IEO commitments in the field of the operational oceanography, also allows scientists to use the software for data acquisition equipment, and manage the computers of the vessel from their research labs on land with a Virtual Private Network (VPN).

### 4. CONCLUSIONS

This experience has proved very useful in testing this kind of data management systems in order to install them on the new IEO vessels currently under construction. This system reduces the complexity of the previous one and increases data sharing and device connectivity capabilities. The improvement in real time data access is very important in order to face up to new demands linked to operational oceanography programs, large amount of data storage and management and social requirements.

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