

## MARITIME COMMUNICATION EMBEDDED CONTROLLER

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*This paper describes low costs data embedded communication controller used in maritime environment. This controller can be installed on any maritime boat or ship. The controller can be connected directly with satellite transceiver, to ensure a connection with satellite network, and on the other side with GPS (Global Positioning System), signal from vessel SCADA (Supervisory Control and Data Acquisition) system and satellite operator terminal (console). The system can be used as vessel remote control unit from terrestrial operator. Also the system will be able to send vessel status, DSC signals (Distress Call Signal) and silent DSC signals and also messages (predefined messages). The controller can be used in LRIT systems (Long Range Identification and Tracking Systems).*

**Keywords:** maritime electronics, microcontrollers

### 1. INTRODUCTION

In the last few years the IMO (International Maritime Organization) create a direction for development of vessel identification and tracking systems. Right now is implemented in all port AIS system (Automated Identification System). This system is working near the coast area and supervising all traffic in coast area. The new IMO request is to trying to cover a large maritime and oceanographic area. In this time many producers offer long range tracking and identification services. This systems request INMARSAT-C station with console or a specialized controller connected with a satellite transceiver. Many providers offer own controllers for their services.

Here we present a low cost solution, which can be integrated in LRIT system. The controller will be able to be connecting directly with Inmarsat-C transceiver, and it can be preprogrammed to send a few messages by mail or fax to predefined addresses. The activation of sending messages is possible by simply closing of contacts, or at the activation of a signal. The system has internal implemented of two kinds of DSC signals: one is a general DSC signal and the other one is a silent DSC signal. DSC (Distress Call) signals are activated from two buttons. Controller also will have possibility to be connected to IEEE 802.3 network via internal Ethernet connector.

### 2. HARDWARE

We are using Intel 486 CPU board with PC104 bus extension, three serial RS232 connectors one RS232/RS485 serial connector and Ethernet network connector (see Fig. 1). Optional the CPU can be connected with a LCD monitor and keyboard, and the system will be able to be programmed locally without additional computers request.

The program and operating system is burned on a local flash drive. Other system configurations files also are stored on the flash. Temporary files are stored on RAM drive (if system reboot these files are loosed).

The system statuses are presented on a six LEDs front panel (each LED represents: RUN status, satellite LINK status, TX send data via satellite network, RX receiving data from satellite network, GPS status ok, Error status).

The system RS232 serial connectors are allocated as follows:

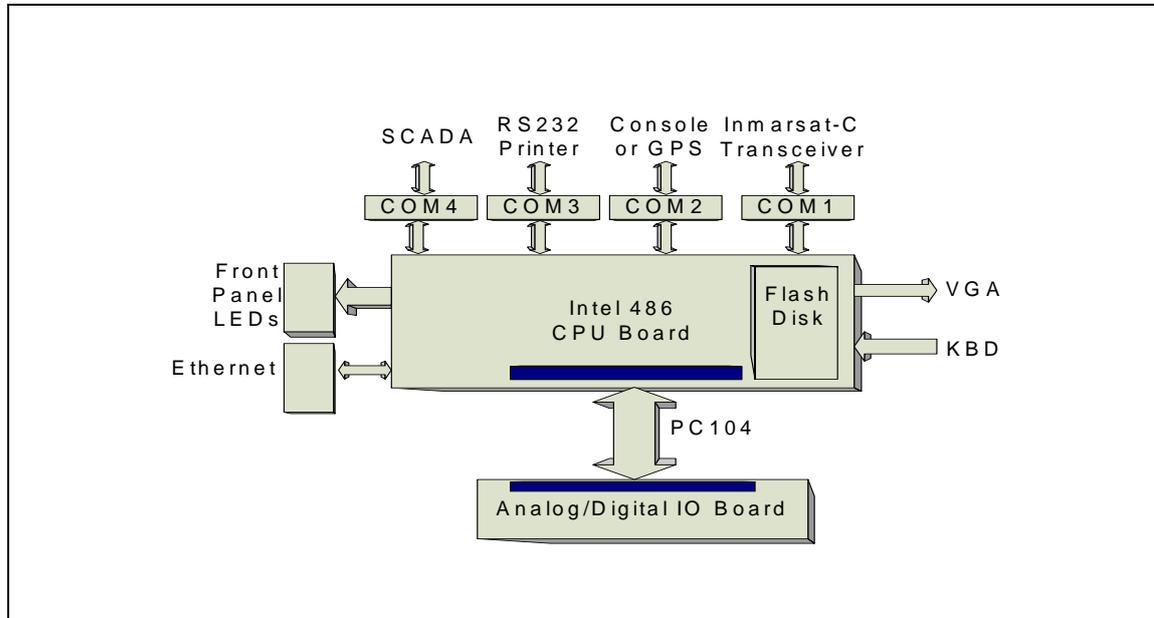


Fig. 1

1. COM1 for connection with Inmarsat-C transceiver (programmed with speed=4800, parity=none, bits=8, stop bits=1 parameters);
2. COM2 for connection with Inmarsat-C console or GPS via NMEA 0183 interface (programmed with speed=4800, parity=none, bits=8, stop bits=1 parameters);
3. COM3 for connection with printer via RS232 interface (programmed with speed=4800, parity=none, bits=8, stop bits=1 parameters);
4. COM4 for connection with a SCADA system via a RS485 or NMEA-0183 interface (programmed with speed=9600, parity=none, bits=8, stop bits=1 parameters).

Also to this board we can connect a VGA LCD monitor and a 101 keys US keyboard to be able to configure controller. Also the configuration of this board is able to be accessed via TCP/IP network (using HTTP support).

The controller has inside a digital/analog IO board connected with CPU board via PC104 interface.

On main board we have installed 256 MB flash drive for operating system and applications, and 128 MB RAM.

### 3. SOFTWARE

#### 3.1 Operating System

Operating system is installed on the flash drive of this system. We choose Linux based platform for this system (Linux Red Hat 6.2 Embedded). The Linux configuration will be loaded in the 64 MB of RAM. The rest of 64 MB of RAM will be used for ram drive.

In boot process the operating system and drivers will be expand from flash drive into ram drive. The controller's applications are stored on flash and will be started from flash drive. Also in ram drive we will store the temporary files.

After boot process is ended the Linux operating system with drivers is loaded and running, the boot script will starting-up the main task of controller application.

The Linux operating system configuration contains the following drivers:

1. physical device drivers:

- RS232 four serial device driver;
- Ethernet Realtek RTL 8029 device driver;
- VGA and 101 keys US keyboard device driver;
- printer device driver, redirected over serial COM4;

2. logical device drivers:

- TCP/IP device driver over Ethernet;
- flash disk device driver;
- ram drive device driver;
- raiser fs (file system) device driver;

Linux and network services installed at boot time:

1. TCP/IP telnet service (to be able to configure system from network),
2. TCP/IP ftp service (to be able to update from network),
3. TCP/IP web service – httpd – (to be able to configure and access data over the network);
4. scheduler service – crond -;
5. Internet daemon service – inetd -;
6. name daemon service – named -.

#### 3.2 Controller Application

The main controller applications are installed on flash drive. The applications are started by Linux start-up script. The application is organized in a multi-threading single task application. The application threads are:

1. Inmarsat-C transceiver thread; this thread is involved in interfacing of Inmarsat-C transceiver with controller's application. All received Inmarsat messages will be processed on this thread. If on Com2 controller detect a console terminal signal, then all messages will be rerouted to that interface, and also all messages from Com2 are sent through Com1. This thread also synchronize local message sending to a programmed location using Inmarsat satellite data network. All receiving messages and all send messages through interface Com1 are printed on local printer, installed on Com3.

2. NMEA-0183 interface thread. This thread listen GPS data over Com2 port. If a satellite login request incoming is received on this interface, the thread will consider that on the other side is connected an Inmarsat console and in this case the communication will start working in bidirectional mode and all messages from console will be delivered directly to Com1.

3. SCADA interface thread. This thread monitor SCADA signals received on Com4 and also this thread will store the analogue and digital data acquired with PC104 digital/analog IO boards in a local database named ScadaDatabase.

4. Monitor DSC thread. This thread monitor two digital inputs, one assigned for DSC calls and the other one is assigned for silence DSC calls. If any input is activated, a message will be send through Com1. If DSC input is activated the DSC message is printed on local printer.

5. Monitor vessel thread. This thread is activated on a timer signal. If any message is programmed to send data to any fixed address (fax/mail/text message i.e.), then this thread will read data from ScadaDatabase and compose message, then send it to the Com1 interface. When message is delivered, the message status will be writing on local printer.

6. Control vessel thread. This thread is listening if any message to change a status on vessel is delivered from an external user. If a message is received, this thread processes this message and sends command through SCADA interface or an internal analogue or digital output.

#### **4. CONCLUSION**

The controller presented in this paper can be installed on any maritime boat or ship. The controller can be connected directly with satellite transceiver, to ensure a connection with satellite network, and on the other side with GPS (Global Positioning System), signal from vessel SCADA (Supervisory Control and Data Acquisition) system and satellite operator terminal (console). The system can be used as vessel remote control unit from terrestrial operator. Also the system will be able to send vessel status, DSC signals (Distress Call Signal) and silent DSC signals and also messages (predefined messages). The controller can be used in LRIT systems (Long Range Identification and Tracking Systems).

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