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MFSTEP**E2-M3A BUOY
AUTOMATIC DATA DISPATCHING
PROCEDURE**

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1 SCOPE

Purpose of this document is to describe the new communication facilities installed on the E2-M3A buoy, as result of the adaptation work carried out on the existing Italian buoy BOMA (BOa Mediterranea per Alte profondità) according to the MFSTEP project requirements.

Summarising, the new features added to the system are

- a) the automatic transmission of the daily summary file from the buoy to an FTP server;
- b) the daily automatic notification via e-mail (SMTP) of the technical status of the buoy to pre-defined e-mail addresses;
- c) the automatic notification via e-mail (SMTP) of alarm conditions.

All these three features are achieved thanks to an ISP¹ connection.

2 APPLICABLE DOCUMENTS

[1] MFSTEP – E2-M3A Buoy Design (Tecnomare Document A1356-REL-W100-002.0)

3 ACRONYMS

UCM-C	Unità di Controllo Missione e Comunicazioni (Mission and Communication Control Unit)
UCM-D	Unità di Controllo Missione e acquisizione Dati (Mission and Data acquisition Control Unit)
UPQ	Unità di Prelievo a più Quote (MultiQuote Sampling Unit)
RCU	Remote Connection Unit
FTP	File Transfer Protocol
TCP/IP	Transmission and Control Protocol/Internet Protocol
SMTP	Simple Mail Transfer Protocol

¹ Internet Service Provider.



4 EXISTING COMMUNICATION SYSTEM

The communication system presently installed and operating in BOMA is based on E-TACS link and is composed of an E-TACS NEC P7-PLUS mobile phone, an AUDIOTEL AD-3400 (INT-3400) unit and a TDK 73M2901 modem module.

This link is used to connect to the buoy on demand via either a terminal application, e.g. the Hyperterminal application of Windows O.S., or the buoy management MMI (Man-Machine Interface), to:

- check the status of the buoy;
- check the status of each single sensor (CTDs, Nutrient Analyser, Meteo Sensors, Multiparametric Probe);
- start and stop a mission;
- download the mission configuration file;
- upload the log files created by the buoy during its working tasks.

As described in detail in [1], communications are managed by the UCM-C board, that is provided with 5 auxiliary serial ports:

- the 1-st one is for the compass;
- the 2-nd is for the GPS;
- the 3-rd and 4-th are not currently used in the BOMA configuration and is planned to use them for respectively the water detect and acceleration unit and the hereby described Remote Connection Unit;
- the 5-th is to connect to the UCM-D unit (managing the scientific payload).

5 HARDWARE ARCHITECTURE

To allow automatic file upload and notification e-mail sending, a new unit, hereafter referred to as “Remote Connection Unit” or RCU, has been developed.

It is based on a E-TACS mobile phone, a telematic unit and a PSTN modem.

A block diagram of the hardware architecture of this unit is shown in Figure 1.

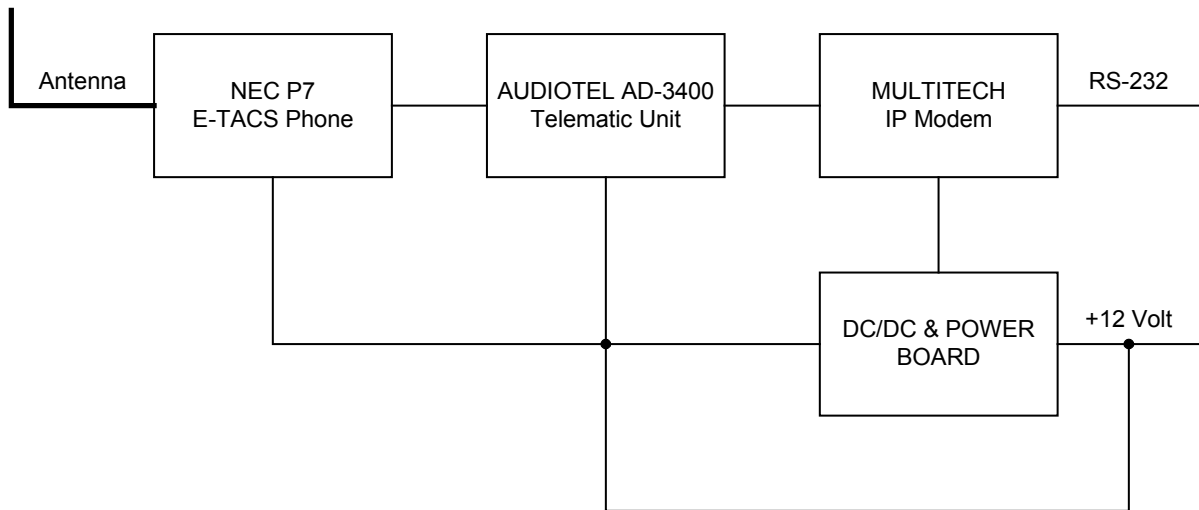


Figure 1: RCU block diagram

5.1 The E-TACS Mobile Phone

An E-TACS mobile phone (NEC P7plus) has been adopted because of the non availability of the GSM network on the buoy location.

The only limitation of this choice is due to the V22 protocol interface: the data throughput cannot exceed 1200 bits per second.



5.2 The Telematic Unit

This unit makes available a PSTN phone line instead of the E-TACS analog phone line. Thanks to this adaptation data transmission can be achieved.

The telematic unit is an AUDIOTELE AD-3004 (or INT-3004).

5.3 The Modem

The Multitech Modem Module is just a PSTN modem making available a complete set of TCP/IP facilities so it can be used as an Internet interface for microcontrollers, e.g. the CPU board of the UCM-C unit of the E2-M3A buoy.



6 SOFTWARE ARCHITECTURE

The management of the RCU is a responsibility of the UCM-C.

The RCU is connected to 4-th auxiliary port of the UCM-C.

The UCM-C software has been upgraded to:

- a) upload the summary file to the FTP server once a day at about 00:40:00;
- b) send the notification e-mail once a day immediately after the FTP session if no alarm conditions raise;
- c) send an asynchronous e-mail as soon as an alarm condition occurs.

The two sequences implemented on the UCM-C to perform such operations are described herebelow:

Summary File Upload

- 1 turn on the RCU;
- 2 connect to the ISP and login;
- 3 save daily summary file on the remote FTP server;
 - 3.1 get the content of the last created summary file;
 - 3.2 open the the FTP session to the remote OGS FTP server;
 - 3.3 save the file content;
 - 3.4 close the FTP session reporting for operation success;
- 4 logout and turn off the RCU.

Notification E-Mail Transmission

- 1 turn on the RCU;
- 2 connect to the ISP and login;
- 3 send notification e-mail;
 - 3.1 get the current status of the buoy;
 - 3.2 prepare the notification e-mail;
 - 3.3 send it reporting for operation success;
- 4 logout and turn off the RCU.

The following errors can occur during both the FTP and the SMTP session:

1. failure to connect to the ISP despite the 3 trials automatically done by the TCP/IP modem module;



2. an FTP data packet transfer failure; note that to reduce modem module overhead the summary file is splitted into 256 bytes size packages;
3. unavailability of either the SMTP or the FTP server;
4. loose of the phone link connection.

In case of a failure a second trial is done one hour later the first, i.e. about 01:40:00 GMT.

Error diagnostic messages are saved in the *RCU.log* text file in the UCM-C mass memory to have a report of the remote connection operations.

Because of the hourly status check of the whole system the following alarm conditions are available:

- water detect in each one of the three compartments of the buoy;
- buoy displacement out of the safety circle.

As soon as an alarm condition is found a notification e-mail is sent with a maximum delay of one hour from the event detection. The e-mail will be send hourly until the disappearing, or removal, of the alarm condition.

If no alarm occurs, the notification e-mail is sent according to point b).

6.1 Summary File Content

On Table 1 is reported the content of the summary file as already described in [1].



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DATA NAME	DATA MEANING
SUMMARY FILE BASIC INFORMATION	
<i>Date</i>	The date that relates the current acquisition period. The same as <i>YYMMDD</i> .
<i>Time</i>	The beginning of the acquisition hour pertaining the data of the corresponding row; e.g., 04:00:00 means that this row pertains to data acquired between 04:00:00 and 04:59:59.
<i>Flag</i>	This field can assume values: <i>Full</i> (if the sample is good, i.e. data was properly acquired); <i>ERR</i> (if something went wrong and data is corrupted); <i>EMPTY</i> if the record is empty (due, for example, to a later start of the mission). The latter two cases implicates that all the following columns in the row are empty.
<i>Index</i>	An ordinal, providing the absolute count (from the beginning of the mission) of the record.
GPS DATA	
<i>GPS_Flag</i>	Fields starting with <i>GPS_</i> holds data coming from the GPS package. The meaning is similar as for the field <i>Flag</i> . If <i>GPS_Flag</i> is not <i>OK</i> , then all the next columns starting with <i>GPS_</i> will be blank.
<i>GPS_Date</i>	Date coming from GPS.
<i>GPS_Time</i>	Time coming from GPS: this is acquired 40 minutes after the beginning of the current hour (field <i>Time</i>). A drift over time in this field shows that system microcontroller time is losing alignment with "true" time reference.
<i>GPS_Nsat</i>	Number of satellites seen by the GPS package. Can be 0 to 8.
<i>GPS_Lat[SWG84]</i>	The Latitude of BOMA buoy at GPS sampling time. The measure unit is standard SWG84 [deg.12345] format.
<i>GPS_Long[SWG84]</i>	The Longitude of BOMA buoy at GPS sampling time. The measure unit is standard SWG84 [deg.12345] format.
<i>GPS_Alarm</i>	1 if the buoy is outside the confidence circle 0 otherwise.
<i>GPS_Displace[meter]</i>	Displacement from the confidence circle error (position error).
COMPASS DATA	
<i>Compass_Flag</i>	Fields starting with <i>Compass_</i> holds data coming from the Compass package. The meaning is the same as <i>GPS_Flag</i> .
<i>Compass_Heading[deg]</i>	Instantaneous value of <i>Heading</i> angle of the buoy, expressed in [degrees].
<i>Compass_TX[deg]</i>	Instantaneous value of <i>TiltX</i> angle of the buoy, expressed in [degrees].
<i>Compass_TY[deg]</i>	Instantaneous value of <i>TiltY</i> angle of the buoy, expressed in [degrees].
<i>Compass_Temp[°C]</i>	Instantaneous temperature coming from the Compass package.
SOLAR PANELS DATA	
<i>I_p1[A]</i>	Instantaneous value of the current coming from the first pair of solar panels, in [Ampere].



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DATA NAME	DATA MEANING
<i>I_p2[A]</i>	Instantaneous value of the current coming from the second pair of solar panels, in [Ampere].
<i>I_p3[A]</i>	Instantaneous value of the current coming from the third pair of solar panels, in [Ampere].
<i>I_L[A]</i>	Instantaneous value of the current adsorbed by the entire buoy electrical load, in [Ampere].
<i>I_B[A]</i>	Instantaneous value of the current flowing out of the battery pack, in [Ampere]. Positive values means that the batteries are delivering power, whilst negative values means that panels are charging the batteries.
<i>V_L[V]</i>	Instantaneous electrical load voltage, in [Volts].
<i>V_B[V]</i>	Instantaneous battery pack voltage, in [Volts].
<i>T_R[°C]</i>	Instantaneous temperature coming from the Panels Regulator Box.
WATER DETECT & ACCELEROMETER DATA	
<i>WD_Flag</i>	Flag containing water detect alarms according to the following map: <i>b0</i> : compartment 1 water detect alarm; <i>b1</i> : compartment 2 water detect alarm; <i>b2</i> : compartment 3 water detect alarm; <i>b3÷b7</i> : unused.
<i>WD_Acc[m/sec²]</i>	Buoy vertical acceleration (Squared Mean Value).
UCMC DATA	
<i>UCMC_Reboot</i>	Fields starting with <i>UCMC_</i> holds data provided by UCMC board. This field is a counter of the reboots executed by UCMC.
<i>UCMC_CF_Size[bytes]</i>	Total size of <i>CompactFlash</i> mass memory mounted on UCMC, in [bytes].
<i>UCMC_CF_Free[bytes]</i>	Size of available free mass memory pertaining UCMC.
SEA STATE DATA	
<i>Sea_State_ErrNum</i>	Number of acquisition error from the compass board during the 20 mins to produce the SEA state file which data are used to evaluate the next two fields.
<i>Sea_State_StDevTX[deg]</i>	Evaluated standard deviation of <i>TiltX</i> angle based on 20 mins of acquisition, in [degrees].
<i>Sea_State_StDevTY[deg]</i>	Evaluated standard deviation of <i>TiltY</i> angle based on 20 mins of acquisition, in [degrees].
UCMD DATA	
<i>UCMD_SUM_Flag</i>	The following fields are related to UCMD board. When this flag is <i>OK</i> , data coming from UCMD was properly acquired.
<i>UCMD_SUM_Date</i>	Date of the acquired data from UCMD.
<i>UCMD_SUM_Time</i>	Time of the beginning of acquisition by UCMD board.
<i>UCMD_SUM_Index</i>	Counter of the hourly acquired records from UCMD.
SURFACE CT DATA	
<i>CT_Flag</i>	<i>CT_</i> fields pertains data coming from CT sensor; <i>OK</i> means that the CT was acquired correctly.
<i>CT_Temp[°C]</i>	Temperature of sea water read by CT.
<i>CT_Conductivity[S/m]</i>	Conductivity of sea water, expressed in [Siemens / m].



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DATA NAME	DATA MEANING
CT_Salinity[psu]	Salinity of sea water, in [psu].
CT_SoundSpeed[m/s]	Evaluated sound speed in the sea water, [m/s].
CT CHAIN DATA	
CT_Chain_xxx_Error	Flag reporting error getting xxx-th CT data.
CT_Chain_xxx_On	Flag reporting the on/off status of the xxx-th CT.
CT_Chain_xxx_Enable	Flag reporting the measurement enabled on the xxx-th CT.
CT_Chain_xxx_Valid	Flag reporting the validity of the single data measurement enabled on the xxx-th CT.
CT_Chain_xxx_Conductivity[S/m]	Conductivity value of the xxx-th CT.
CT_Chain_xxx_Temperature[°C]	Temperature value of the xxx-th CT.
CT_Chain_xxx_Pressure[dbar]	Pressure value of the xxx-th CT.
CT_Chain_xxx_V0[Volt]	Voltage value of the 1-st auxiliary input of the xxx-th CT.
CT_Chain_xxx_V1[Volt]	Voltage value of the 2-nd auxiliary input of the xxx-th CT.
CT_Chain_xxx_V2[Volt]	Voltage value of the 3-rd auxiliary input of the xxx-th CT.
CT_Chain_xxx_V3[Volt]	Voltage value of the 4-th auxiliary input of the xxx-th CT.
METEO DATA	
METEO_Flag	METEO_ fields are related to the Meteorological scientific package; data is taken when this sensor is enabled, thus this field could be <i>Enabled</i> or <i>Disabled</i> .
METEO_Errors	Number of Meteo samples not correctly acquired during an hour.
METEO_Mean_Val_Flag	Could be <i>ERR</i> or <i>OK</i> ; shows whether there was problems or not in the first 10 minutes' mean values evaluation.
METEO_Mean_WSpeed[m/s]	The vectorial average wind speed in the first 10 minutes of the hour, in [m/s].
METEO_Mean_WDir[deg]	The vectorial average wind direction in the first 10 minutes of the hour, in [degrees], relative to true (magnetic) North.
METEO_Mean_Temp[°C]	The average temperature in the first 10 minutes of the hour.
METEO_Mean_Humidity[%]	The average relative humidity in the first 10 minutes of the hour, in [percentage] relative to saturation.
METEO_Mean_Pressure[mbar]	The average atmospheric pressure in the first 10 minutes of the hour, in [mbar].
METEO_Mean_Compass[deg]	Average of Meteo compass in the first 10 minutes of the hour, in [degrees].
METEO_Relative_Wdir[deg]	Wind direction relative to the meteo compass reference mark.
METEO_Sustained_Gust_Flag	This flag is <i>OK</i> when evaluations of Gust and Sustained wind speed and direction data was correct; otherwise, it is <i>ERR</i> .
METEO_Sustained_Wspeed[m/s]	Maximum among the 60 scalar averages over 1 minutes evaluated during the whole hour in [m/s].
METEO_Sustained_Wdir[deg]	The vectorial average wind direction calculated over the period of 1 minute relative to the Sustained Wspeed



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DATA NAME	DATA MEANING
	described above.
METEO_Gust_Wspeed[m/s]	Maximum among the 1200 scalar averages over 3 seconds evaluated during the whole hour in [m/s].
METEO_Gust_WDir[deg]	The vectorial average wind direction calculated over the period of 3 seconds relative to the Gust Wspeed described above.
METEO_Solar_Radiation	One or more columns of data <u>to be defined</u>
CDT CHAIN NAS DATA	
NAS_MACRO_R_Nas2E	Flag (<i>OK, ERR, Disabled</i>) indicating the result of the hourly execution of the cadmium column refresh macro of the nutrient analyser.
NAS_MACRO_T_Nas2E	Flag (<i>OK, ERR, Disabled</i>) indicating the result of the daily execution of the <T> macro of the nutrient analyser: it is the calibration macro
NAS_MACRO_T_V1	Voltage relative to the white measure during a calibration of the NAS2E nutrient analyser: it is expressed in mV in the range 0..4095 mV
NAS_MACRO_T_V2	Voltage relative to the measure during a calibration of the NAS2E nutrient analyser: it is expressed in mV in the range 0..4095 mV
NAS_MACRO_S_Nas2E	Flag (<i>OK, ERR, Disabled</i>) indicating the result of the execution of the <S> macro of the nutrient analyser: it is the measurement macro
NAS_MACRO_S_V1	Voltage relative to the white measure during a measurement macro of the NAS2E nutrient analyser: it is expressed in mV in the range 0..4095 mV
NAS_MACRO_S_V2	Voltage relative to the measure during a measurement macro of the NAS2E nutrient analyser: it is expressed in mV in the range 0..4095 mV
UPQ DATA	
UPQ_Flag	Flag that describes availability of UPQ data (next fields); data is available every three hours, only if UPQ package is enabled. In this case this field is <i>OK</i> ; otherwise, it could be <i>Disabled</i> or <i>Empty</i> .
UPQ_WWmeas	Yes / No. If YES, enable measure of the washing water before the first quote data acquisition and after the last (deepest) quote data acquisition.
UPQ_xxx_Probe_Flag	In this and in the following fields, the xxx can be: <i>Initial, End, 1st, 2nd, 3rd, 4th, 5th</i> ; these are the various probes involved in the sea water analysis; these fields are grouped for each probe. <i>Initial</i> and <i>End</i> probes refer to analysis on washing water samples; the other five probes are related to sea water sampled at the five different depths. This flag shows whether the measure was good (<i>OK</i>) or if there was an acquisition error (<i>ERR</i>).
UPQ_xxx_Probe_Temp[°C]	Temperature of the water relative to xxx probe.
UPQ_xxx_Probe_Cond[mS/cm]	Conductivity of the analysed water, in [milliSiemens / cm]
UPQ_xxx_Probe_O2[%sat]	Percentage of dissolved Oxygen, relative to saturation.
UPQ_xxx_Probe_Turb[FTU]	Turbidity of analysed water, in [FTU].



DATA NAME	DATA MEANING
UPQ_xxx_Probe_Fluorometer[mg/m3]	Dissolved Fluor (Chlorophyll-A) expressed in [milligrams / m ³].
UPQ NAS DATA	
UPQ_MACRO_R_Nas2E	Flag (<i>OK, ERR, Disabled</i>) indicating the result of the hourly execution of the cadmium column refresh macro of the nutrient analyser.
UPQ_MACRO_T_Nas2E	Flag (<i>OK, ERR, Disabled</i>) indicating the result of the daily execution of the <T> macro of the nutrient analyser: it is the calibration macro
UPQ_MACRO_T_V1	Voltage relative to the white measure during a calibration of the NAS2E nutrient analyser: it is expressed in mV in the range 0..4095 mV
UPQ_MACRO_T_V2	Voltage relative to the measure during a calibration of the NAS2E nutrient analyser: it is expressed in mV in the range 0..4095 mV
UPQ_MACRO_S_Nas2E	Flag (<i>OK, ERR, Disabled</i>) indicating the result of the execution of the <S> macro of the nutrient analyser: it is the measurement macro
UPQ_MACRO_S_xxx_V1	Voltage relative to the white measure during a measurement macro of the NAS2E nutrient analyser at the quote xxx: it is expressed in mV in the range 0..4095 mV
UPQ_MACRO_S_xxx_V2	Voltage relative to the measure during a measurement macro of the NAS2E nutrient analyser at the quote xxx: it is expressed in mV in the range 0..4095 mV

Table 1: summary file content

6.2 Notification E-Mail Content

The e-mail content is:

- current buoy position:
 - longitude and latitude;
 - orientation;
 - confidence circle alarm and centre distance;
- water detect for each one of the three compartments of the buoy;
- battery voltage.

6.3 TCP & FTP Configuration

The configuration parameters for both the ISP connection and the FTP session are listed in following Tables 2 and 3.



These parameters are permanently stored on the modem: if at least one of them has to be modified, the modem must be reconfigured.

ISP Name	www.infinito.it
ISP Phone Number	080.2201400
User login	XXX
User password	XXX
SMTP Server	mail.infinito.it
POP3 Server	pop3.infinito.it

Table 2: ISP parameters

FTP IP Address	doga.ogs.trieste.it 140.105.70.100
FTP Login	E2M3A ²

Table 3: FTP parameters (for the connection to the OGS server)

² For safety reason the password is not reported.



7 BINARY DATA TO ENGINEERING DATA CONVERSION

Once uploaded to the FTP server the summary file needs to be converted to a readable form.

This step is automatically done thanks to a conversion utility developed by TECNOMARE converting binary data in text data (tab-separated form) so they can be read and post-processed (for example by the *EXCEL* application).