OPEN OCEAN GLIDER ACOUSTIC MODEM INTERFACES

Version1-01
Document Control Number: 3102-10007
06-06-12

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Document Control Sheet

Version	Date	Description	Originator
1-00	09-13-2011	Initial Draft	David Pingal (Teledyne Webb Research)
	10-27-2011	Responses to CDR comments	Ed Dever
	05-02-2012	Added Implementation details	Felipe Marcelino (Teledyne Webb Research)
1-01	05-18-2012	Minor formatting fix	Ed Dever
1-01	06-06-2012	Initial release as per ECR 1303-00702	Ed Dever

Table of Contents:

1 Introduction

1.1 Identification

This interface control document (ICD) describes the electrical and communications/logical data interfaces for the acoustic modem carried by the open ocean glider. The open ocean glider is the Teledyne Webb Research Slocum SG-2. The Teledyne Benthos acoustic modem model 890 carried on this glider communicates with the Global Mesoscale Flanking Mooring developed at Scripps Institution of Oceanography (SIO). The mesoscale flanking mooring is equipped with a compatible acoustic modem. This document includes a description of the logical/data interfaces needed to communicate with this mooring. This document also includes a description of the electrical/hardware interfaces between the acoustic modem and the glider and are the logical/data interfaces between the acoustic modem and the dockserver used to operate the glider.

1.2 Ocean Observatories Initiative (OOI) System Overview

The Ocean Observatories Initiative (OOI) consists of sensors, networks, and support systems that will collect and make available ocean and seafloor data in a coordinated fashion to provide persistent observations over ranges of minutes up to years and decades. OOI will enable researchers to make simultaneous, interdisciplinary measurements to investigate a spectrum of phenomena including episodic, short-lived events (tectonic, volcanic, oceanographic, biological, and meteorological), and more subtle, longer-term changes and emergent phenomena in ocean systems (circulation patterns, climate change, ocean acidity, and ecosystem trends). For additional information on OOI, the reader is directed to the OOI Final Network Design (FND) document.

1.3 Document Scope and Organization

This document is organized into the following four sections:

1. Introduction – provides the scope, document organization and change control procedure for this document.
2. Related Documentation – cites other documents that provide input and reference for this ICD.
3. Description of Interfaces – provides details of the interfaces.
4. Notes – contains general information that aids in the understanding of this document.

1.4 Change Control

This Interface Control Document is subject to the policies and procedures called out in the OOI Configuration Management Plan, 1000-00000, Section 3 and the CGSN CMP, 3101-00047. Changes to the released version of this document may only be made via an Engineering Change Request (ECR) that has been approved by the Coastal Global Scale Nodes (CGSN) Change Control Board (CCB).

The most recent document revision of this ICD maintained in the OOI Document Management System (DMS) is the authoritative version, as printed hard copies are not controlled. Prior revisions of this document may be maintained in the OOI DMS for reference reasons, but are not authoritative.

2 Related Documentation

2.1 Parent Documents

The following documents are the parents from which this document's scope and content derive:

1000-00000	OOI Configuration Management Plan (CMP)
3101-00047	CGSN Configuration Management Plan (CMP)
3304-00004	Open Ocean Glider Specification

2.2 Reference Documents

The following documents or drawings are referenced herein and are directly applicable to this document. In the event of conflict between any of these documents and this ICD, this document shall take precedence.

1012-00000	Cybersecurity Management Plan
1101-00000	Final Network Design (FND)
	L2 Reference Module (maintained in DOORS)

2.3 Informational Documents

The following documents amplify or clarify the information presented in this document, but are not binding.

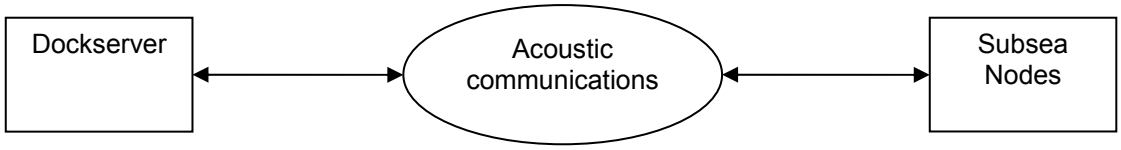
D-270-056	OUTLINE, ATM-965 (ATM-887 4G) (Teledyne Benthos)
M-270-26	ATM-900 Series Acoustic Telemetry Modems User's Manual (Teledyne Benthos)

3 Description of Interfaces

3.1 Overview

The communications system consists of 3 separate subsystems: A single shoreside control system (dockserver), one or more gliders, and one or more subsea nodes. Gliders can communicate directly with the dockserver via an Iridium satellite connection while at the surface. They can communicate directly with the subsea nodes via an acoustic modem, within a limited range. The objective of the communications capability is to convey commands, status and acquired data between the dockserver and subsea nodes. The nodes will be provisioned for the system prior to deployment.

Related interfaces external to this capability are: mooring acoustic modem interfaces to other subsea node components (mechanical, power and data interfaces), and the glider dockserver interface to CI (data interface). These interfaces will be described in future ICD's.



The dockserver receives from the glider operator:
- System configuration data
- Subsea node commands

The dockserver displays to the glider operator:
- Communications status
- Subsea node status
- Subsea node acquired data

The dockserver receives from the subsea nodes:
- Node status
- Acquired data

The dockserver transmits to the subsea nodes:
- Node commands

3.2 Shoreside data interface

3.2.1 Electrical

Does not apply to this interface.

3.2.2 Mechanical

Does not apply to this interface.

3.2.3 Logical/Data

The glider operator shall provide commands to the glider acoustic communications subsystem, and receive data files and status messages in return, by means of files placed in specific subdirectories on the shoreside dockserver system.
The dockserver is configured by default to provide remote file access service to these directories by either ftp or ssh protocols. An example default user account shall be provided to access these files; for security reasons this account should be removed and installation-specific accounts should be set up by the installation site administrator.

3.2.3.1 Data types

Name	Type / Representation	Description
gliderID	String, 1-20 characters, allowable characters: lower case alphabetic + numeric + underscore + hyphen	Unique ID for each glider in the system.
node	Numeric: range 0 to 250 inclusive	Unique ID for each subsea node in the system.
Offset	Numeric: range 0 to 2^{32}-1	Position of data records within serial stream.
Coordinates	Tuple: longitude in degrees, ≥ −180 and <= 180, positive = east latitude in degrees, ≥ −90 and ≤ 90, positive = north depth (altitude), in meters above sea level: e.g. 41.6342, -70.5354,-15.4	Geographic position of assets.

Timestamp	Combined date and UTC time per ISO 8601 (no time zone): e.g. 2001-09-02T19:46:05	Time of a system event.
the8x3_filename	8 digit filename	Name of the originating file on the glider.
full_filename	ID string	Coding of the full filename which contains the vehicle name, year, julien date, mission number and segment number. e.g. <veh_name>-<year>-<Julian date>-<mission #>-<segment #> unit_276-2012-134-5-0
filename_extension	3 characters	For the MDD file, this value is always “mdd”
fileopen_time	Date/timestamp string	Contains timestamp of when data is recorded. <day of week>_<month>_<day>_<hh:mm:ss>_<year>
mission_name	ASCII String	Contains the mission name.

3.2.3.2 MDD file definition

3.2.3.2.1 MDD file names

MDD files are generated by gliders in the system. They consist of a single section of tagged ASCII data at the start of the file, followed optionally by a single section of binary data in flat format. Each ASCII data item is on a separate line, delimited by a single newline character (ASCII code 10 decimal). A single colon and zero or more spaces or tabs separate the tag and value fields (e.g.: “NODE: 0”). The value field can contain any printable non-whitespace ASCII value.Required MDD tags

the8x3_filename
This tag contains the name of the file as it is recorded on the glider. The location of this file can be found in the c:\logs directory or the file has already been sent to the shore side, it will be found in the c:\sentlogs directory.
full_filename
This tag contains the name of the file as it is recorded on the shore side. The location of the file can be found in the “from_glider” directory for that particular glider.
filename_extension
This tag indicates the 3 character file extension of the file. In the case of Modem Data files, this tag will always be set to *mdd*.
fileopen_time
This tag contains the timestamp of when the data block below was written to the MDD file.
mission_name
The mission_name tag contains the name of the mission that was being run at the time the MDD file was generated.
NODE
The *NODE* record identifies the subsea node where the following data originated from.
PORT
The *PORT* value identifies which port on the subsea node the following data block originated from.
STARTOFFSET
The *STARTOFFSET* tag identifies the starting byte offset of data with respect to the subsea node.
ENDOFFSET
ENDOFFSET identifies the ending byte offset of the data with respect to the subsea node.

3.2.3.2.2 Sample MDD File

A sample MDD File would take the following format.

the8x3_filename: 01280000
full_fileanme: unit_276-2012-134-5-0
filename_extension: mdd
fileopen_time: Mon_May_14_19:24:47_2012
mission_name: BADD2.MI
NODE: 20
PORT: 1
STARTOFFSET: 100
ENDOFFSET: 844
<745 bytes of data> (address 100 - 844 as found on the subsea node)

3.2.3.3 File locations

Subdirectories off a single path, the path is configurable by modifying the invocation parameters of the service. The default base path is/var/opt/gmc/acomms

/var/opt/gmc/acomms/
/config
/inbound
/outbound

3.2.3.4 System configuration files

These files are read by the server at startup. They indicate to the server the characteristics of the assets (gliders and subsea nodes) in the system.

3.2.3.4.1 System description file

Path: …/config/system
The system description file shall contain the list of subsea nodes, and gliders in the system. Each glider shall be identified by a unique alphanumeric ID. Each node description shall consist of a numeric identifier and a geographic location.
Path: ../config/system
Format: XML.
Required elements:
gliderList
The system description file is required to have exactly one *gliderList* element, which contains one or more *glider* subelements. The list specifies the gliders that are expected to participate in the communications capability.
glider
Each *glider* element is required to have a single *gliderID* subelement.
gliderID
See gliderID data type definition.
nodeList
The system description file is required to have exactly one *nodeList* element, which contains one or more *node* subelements. The list specifies the subsea nodes that are expected to participate in the communications capability.
Node
Each *node* element is required to have exactly one each *nodeID*, and *coordinates* subelements.
nodeID
See nodeID data type definition.
coordinates
See coordinates data type definition.

3.2.3.5 System status / data files

These files shall be read and/or updated on a regular basis by the server during operation. They carry data in both directions between the server and the glider operator.

3.2.3.5.1 Subsea node command files

Commands to each subsea node shall be transferred from files on the dockserver, through gliders, to serial port 2 on the respective node. Upon receipt by the dockserver of acknowledgement from a glider that the commands were received (not necessarily processed) by the node, the command file will be moved away on the dockserver. If a second glider has approached within communications range of the subsea node during this time, it is possible that the same command message may be sent to the node multiple times.
Path: ../outbound/cmd*nnn*, where *nnn* is the node ID of the subsea node.
Data: Command files may contain 0 – 2048 bytes of arbitrary binary data. The data in the files is transferred to the subsea nodes without modification; neither the gliders nor the dockserver interprets this data in any way. Zero length files will be removed by the dockserver and not otherwise processed.
Subsea node command files carry the MDT (Modem Transfer) extension. The contents of the files are not processed by the glider or modem, but are passed through directly. As such there are no supported tags in MDT file types.

3.2.3.5.2 Transfer request files

Gliders shall perform data transfers from the subsea nodes only when requested by the dockserver. Upon receipt by the dockserver of acknowledgement from a glider that the commands were received (not necessarily processed) by the node, the command file will be moved away on the dockserver. If a second glider has approached within communications range of the subsea node during this time, it is possible that the same command message may be sent to the node multiple times.
Path: ../outbound/req*nnn_glider*, where *nnn* is the node ID of the subsea node, and *glider* is the glider ID of the vehicle to request the data. The gliderID is optional; if not specified, any glider within range will be commanded to perform the data transfer.
Data: MDR format, no binary data, additional tags:
node
The node that is being addressed.
startOffset: The byte offset of the first byte of the data.
endOffset: The byte offset of the last byte of data.
Port Specifies the modem port from which the data was received. The value is a decimal number, 1 or 2. Port 1 data is sensor data. Port 2 is logger status.

Multiple sets of *startOffset, endOffset* and *port* tags can exist in a single file, and shall result in multiple transfers. All three tags must be present for each transfer. Each transfer shall result in one or more separate logger data files (see below), even if no data is successfully transferred. If the endOffset value exceeds the amount of data stored in the logger, the data transfer will terminate successfully at the logger end offset.

3.2.3.5.3 Sample Modem Request File

A sample MDR file to request the frist 1024 bytes from each port on the subsea node would take the following format.

```
NODE: 20
STARTOFFSET: 0
ENDOFFSET: 1024
PORT: 1

STARTOFFSET: 0
ENDOFFSET: 1024
PORT: 2
```

3.2.3.5.4 Modem Log file

Each time a glider transfers a command file to a subsea node, and receives an acknowledge message, indicating that the file has been received by the subsea node modem, it will record the message in a modem.log file. This file does not include the response of the subsea node; it only indicates that the message has been received by the modem. This file will be made available to be sent to the dockserver at the next available opportunity.
The modem log file is called modem.log. There are no tags associated with this log file, but rather it contains an ascii log of all commands and responses which are sent to and from the modems.

3.2.4 Error Handling and Recovery

3.2.4.1 File transfer from dockserver to gliders

The dockserver will repeat sending command files to gliders until it receives an acknowledge message from a glider for that message, or until the node command file is manually deleted.

3.2.4.2 Acoustic communications between gliders and subsea nodes

In the event of acoustic communications errors between the gliders and subsea nodes, the gliders will retry each data block up to the number of times configured in the modem (default 3/block). After all retries have been exhausted, the glider will surface and report the data transfer status via transfer status and logger data files.

Upon notification of an incomplete data transfer, the dockserver will command the glider to repeat the dive and transfer of only the unsuccessfully transferred data. Under control of the glider mission, the dockserver may command the gliders to perform additional dive and transfer attempts or abandon the transfer and proceed with other mission elements.

3.2.5 Privacy and Security

All files and directories shall be owned by the daemon process user, called “dockserver”.

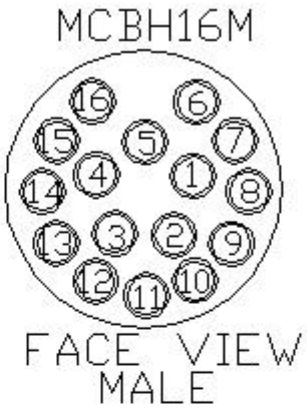
The inbound directory will have group and other read and search permissions. All files created by the server shall be readable by all users, writable only by the owner.
Files in the inbound and config directories are required to be readable by the user “dockserver” for the system to operate correctly.

3.3 Subsea Interface

The OOI subsea sensor node controller shall interface to a Teledyne Benthos ATM-965-LF1-B acoustic modem (henceforth referred to as “the modem”) which will collect sensor data and command status while providing an acoustic communications link between the glider and the sensor array controller.

3.3.1 Electrical

The electrical interface to the modem is via 16-pin connector, part number MCBH16M. The connector contains pins for power supply, external device enable, and two RS-232 serial ports. The pinout of the connector is shown below. A suitable cable with complementary female connector should be used to connect the sensor array controller with the modem.



Subsea Modem POWER/SERIAL Connector PInouts

PIN	LABEL	PORT	FUNCTION	PIN
1	Power		External Power Input (21-xxVDC)	To Modem
2	SPARE			
3	GND		Ground	
4	TX(+)	PORT 1	RS-422 Transmit(+)	Modem to Host
5	DE	PORT 1	Device Enable (See NOTE below.)	Modem to Host
6	RTS/RX(+)	PORT 1	Request to Send/RS-422 Receive(+)	Modem to Host/ Host to Modem
7	TX(-)	PORT 1	RS-422 Transmit(-)	Host to Modem
8	RXD	PORT 1	RS-232 Receive	Host to Modem
9	TXD/RX(-)	PORT 1	RS-232 Transmit/RS-422 Receive(-)	Modem to Host/ Host to Modem
10	GND	PORT 1	Ground	
11	RXD	PORT 2	RS-23 Receive	Host to Modem
12	TXD	PORT 2	RS-232 Transmit	Host to Modem
13	RTS	PORT 2	Request to Send	Host to Modem
14	DE	PORT 2	Device Enable	Host to Modem
15	GND	PORT 2	Ground	
16	SPARE			

Serial port 1 shall be connected to the sensor array controller using pins 8, 9, and 10. Serial port 2 shall be connected to the sensor array controller using pins 11, 12, and 15. No other connections are necessary for serial communications. If power is to be supplied externally, it shall be done using pins 1 and 3.

3.3.2 Mechanical

For mechanical specifications of the ATM-965 acoustic modem, please refer to Teledyne Benthos document M-270-26 Rev A: ATM-900 Series Users Manual, page 9-11.

3.3.3 Logical/Data

3.3.3.1 Acoustic Communications

Acoustic communications will be the method by which data is moved from the ATM-965 modem to the glider. The glider shall query the modem on the sensor array for data, and the array modem will respond with the requested information. Acoustic communications are achieved using MFSK modulation in the frequency band 9-14 kHz and sent at rates anywhere from 140 to 1200 bps, conditions permitting. During deployment, positive acknowledgements will be enabled such that any data transferred from sensor array modem to glider and vice versa are confirmed with a brief acoustic acknowledgment.

In addition to retrieval of sensor and command response data, and the issuing of commands to the sensor array controller, the acoustic communications channel may also be used to clear the modem's on-board data logger. This will allow more data to be collected from the sensor array controller once it has been off-loaded to the glider.

3.3.3.2 Serial Port Communications

The subsea cable used to join the modem with the sensor array controller contains RxD, TxD, and ground connections for two RS-232 serial ports. Both serial ports will be configured to run at 9600 baud with 8-bit bytes, no parity, and one stop bit (9600-8-N-1). This configuration may be changed should it be deemed necessary, as the modem will support RS-232 baud rates up to 115200. See electrical interface specification for details on which pins to use for proper serial port hookup.

The sensor array controller shall send in collected data on serial port 1, and send in any command status on serial port 2. This allows the different data types to be collected independently by the glider via acoustic communications. No flow control is needed if the data is restricted to 9600 baud, or if no more than 4096 bytes are sent in at a time on a given serial port.

Any commands being transmitted to the sensor array modem from the glider will be output on serial port 2, where they may be processed by the array controller.

3.3.3.3 Data Logger

The modem contains an internal data logger with a maximum capacity of about 6 MB of data (plus meta-data used for indexing and accessing purposes). The modem will be configured to run in "dual data logger" mode during deployment, allowing for the logging of data from both serial ports. Any characters received from the sensor array on either serial port will be placed in the modem's internal data logger. The data from the separate serial ports will be serialized before logging, even if received concurrently, and will be de-interleaved upon retrieval. Data from either serial port may be independently retrieved via acoustic communications, allowing priority to be given to command response or sensor data retrieval as is required.

The data logger will default to "flat" mode, meaning that once the logger has filled up it will stop logging data until it is cleared.

For more detail on the ATM-900 series enhanced data logger, please refer to Teledyne Benthos document M-270-26 Rev A: ATM-900 Series Users Manual, page 5-15, in the section entitled "Datalogger Mode."

3.3.4 Error Handling and Recovery

Does not apply to this interface.

3.3.5 Privacy and Security

In order to protect the integrity of the data saved in the modem's data logger, a password-protect mechanism is implemented on the acoustic command used to remotely erase the data logger.

This will prevent another ATM-900 series modem owner from indiscriminately erasing the data collected from the OOI sensor array. Only data logger erasure requests containing the proper user-defined password will cause the data to be erased.

4 Notes

The principal contact at Teledyne Webb concerning the open ocean glider acoustic modem interface is David Pingal (dpingal@teledyne.com), 1-508-545-2077. The principal contact at Teledyne Benthos concerning the Teledyne Benthos acoustic modem is Ken Scussel (kscussel@teledyne.com), 1-508-563-1000.

5 Appendices