OCEAN OBSERVATORIES INITIATIVE

GLOBAL SURFACE PIERCING PROFILER ICD

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Document Control Sheet

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1 Introduction

1.1 Identification

This interface control document (ICD) describes the electrical, mechanical, and communications/logical data interfaces between the Global Surface Piercing Profiler (GSPP) and Global Hybrid Profiler Mooring (HYPM) developed at Scripps Institute of Oceanography (SIO). The GSPP selected for the HYPM is the GSPP developed by the Bedford Institute of Oceanography (BIO), Dartmouth, NS, Canada. The GSPP inductively interfaces with the HYPM through the SIO Platform Controller. This ICD describes the interfaces between the GSPP and the HYPM and shore server/vessel. The interfaces addressed in this ICD include:

- Iridium (Circuit Switched Data, CSD or Router Unrestricted Digital Information Connectivity Solution, RUDICS)
- FreeWave
- Acoustic modem
- Inductive Modem

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 manner to provide persistent observations over ranges of minutes up to years and decades. The 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). The OOI Final Network Design (FND) document provides additional information on the OOI.

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

The GSPP ICD is subject to the policies and procedures outlined in the OOI Configuration Management Plan (CMP), 1000-00000 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 CGSN Change Control Board (CCB).

The most recent document revision of this ICD is 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)
3310-00005	Open Ocean Surface Piercing Profiler Specification
N/A	L4-CG Profiler Requirements Module

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.

1101-00000	OOI Final Network Design (FND)

2.3 Informational Documents

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

None	

3 Description of Interfaces

3.1 Overview

There are three control sections on the GSPP (mechanism float, instrument float and communications float) and there is a shore station computer which handles the remote user interface and automated telemetry tasks.

Master control is maintained by electronics on the instrument float (InstFloat). The InstFloat controller keeps track of all scheduling, monitors profiling depth, turns science sensors on/off, controls communication start-up, provides file uploads, logs data, accepts new commands and controls winch start-up.

The mechanism float (MechFloat) contains a winch which is controlled locally by a separate electronics module attached to the winch drive system located on the winch drum. The Winch Control electronics logs engineering data and controls most aspects of winching once the "start command" is received from the Master Control. One exception to this is confirmation that the InstFloat has achieved its "surface stop-depth" as measured by the CTD (on the InstFloat).

The Winch Control electronics provide a soft motor start-up (including brake release), and monitors a variety of parameters including: motor current, cable tension, the amount of cable out, electronics temperature, pendulum flips and the drum "docking" (or "home") position which determines when the profile is complete and the InstFloat is safely back down to depth. If any of these conditions are met, the profile is stopped. If the profile-stop condition was anything other than the sensing of the home-position, then shore communication is attempted before rewinding to dock.

The Master Control electronics will pass control to the Communication Controller located in the communications float (CommFloat) whenever shore communication is attempted. The Communication Controller communicates with the InstFloat and the Shore Station to transfer data files and receive new profiling commands. The Communication Controller also archives all data received.

The following chart illustrates the GSPP control sequence used on a typical profile.

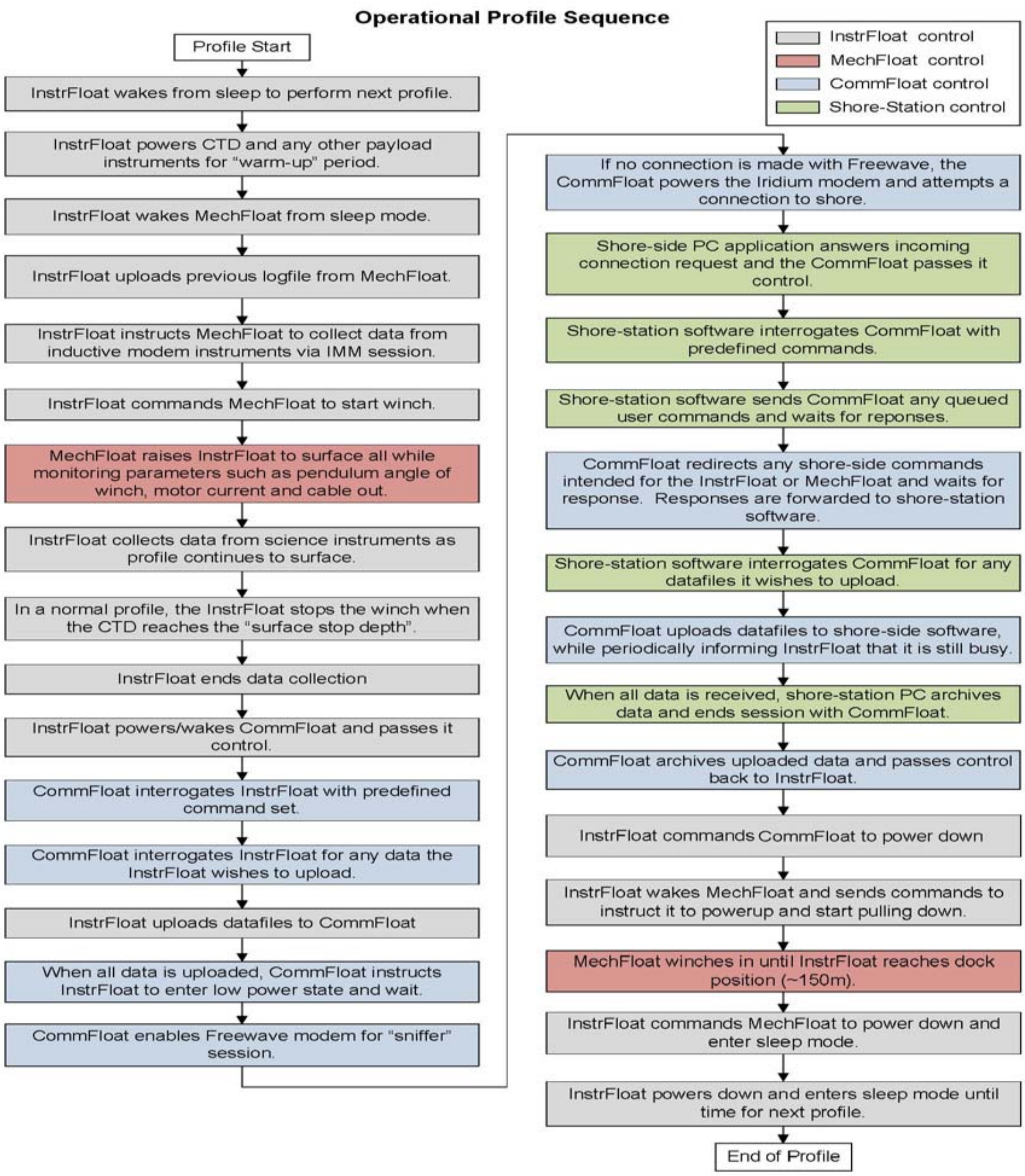

Figure 1 GSPP Operational Profile Sequence

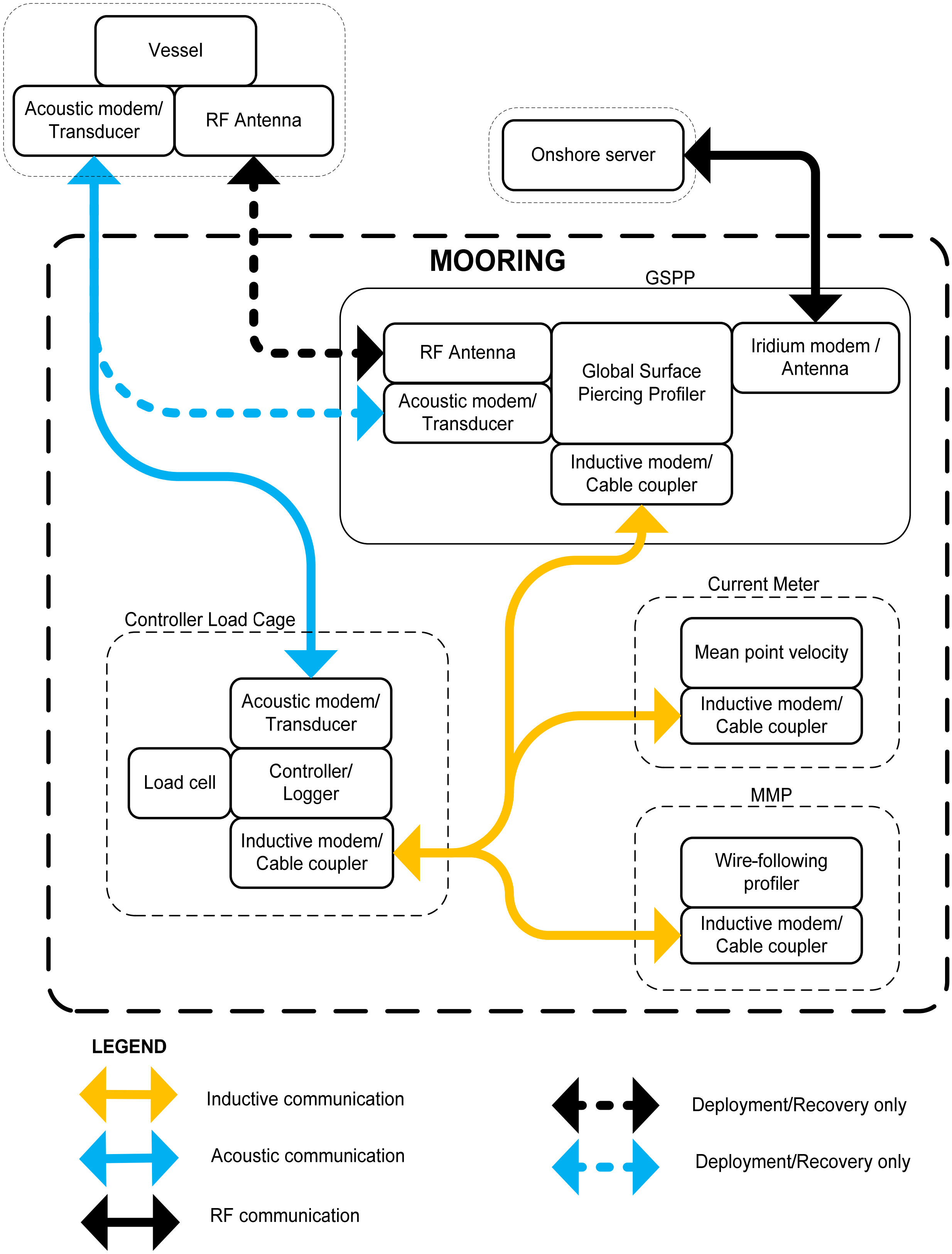

Figure 2 Hybrid Profiler Mooring Block Diagram

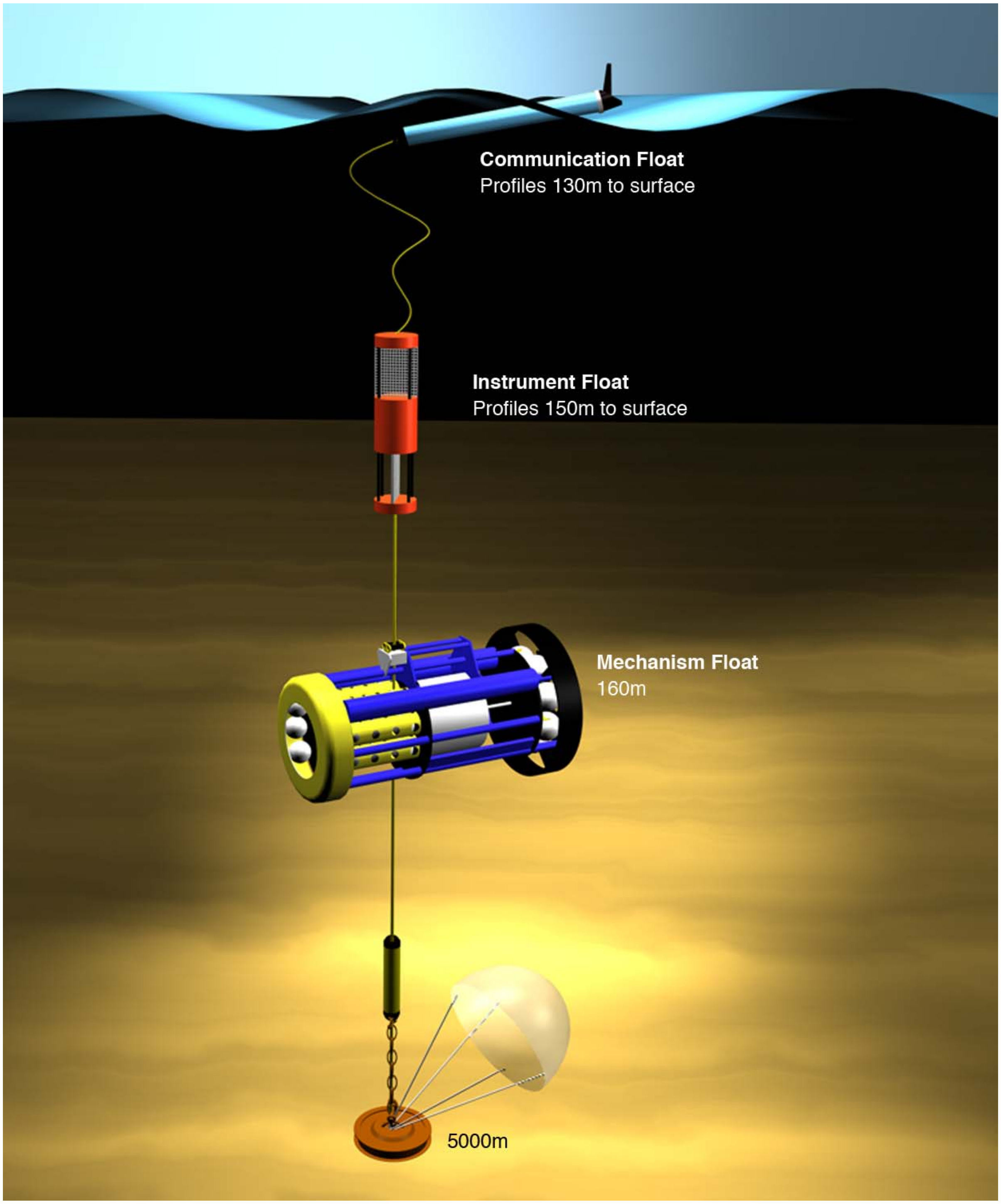

Figure 3 GSPP Diagram

3.2 GSPP Controller – Iridium Interface

3.2.1 Electrical

3.2.1.1 Connection and Cabling

The Iridium RF connection operates in the 1616 to 1626 Mhz band and has an effective data rate of 2400 baud. Local connections are full duplex RS232 at 9600 baud with handshaking.

3.2.1.2 Input Power

Input power is supplied to the Iridium modem from the InstFloat via a 14V (nom.) lithium battery pack. Power is switched to the modem locally in the CommFloat.

3.2.1.3 Grounding

Grounding is established via direct cabled ground connections inside the CommFloat.

3.2.1.4 Isolation

Modem and CommFloat grounds are electrically isolated from seawater.

3.2.2 Mechanical

3.2.2.1 Electrical Connection

The modem and antenna are internally connected within the CommFloat pressure case.

3.2.2.2 Pressure Rating

Pressure rated to 1000 Meters.

3.2.2.3 Mounting

The modem is mounted inside the CommFloat pressure case. The antenna is mounted on a custom Delrin mount at the opposite end of the CommFloat from the control electronics pressure case. A stainless steel tube maintains atmospheric pressure between the CommFloat pressure case and the antenna mount.

3.2.2.4 Grounding

Local grounding for the Iridium modem is provided by direct cabling from the modem to the PCB in the CommFloat controller. This ground is electrically connected to the InstFloat ground

3.2.3 Logical Data

The GSPP CommFloat can use two types of Iridium connection protocols.

1) Circuit Switched Data (CSD) which is a direct modem to modem connection, and

2) Router Unrestricted Digital Information Connectivity Solution (RUDICS) which is a more specialized type of Iridium connection that is partially over the Internet.

The CSD connection requires a dedicated modem connected to the shore-station computer and the RUDICS connection requires a dedicated network connection for the shore-station computer. There are benefits to each system. The CommFloat firmware and hardware can use either protocol; however the SIM card in the Iridium modem must be selected for the appropriate protocol before deploying the GSPP.

Each time the GSPP surfaces, the CommFloat establishes a direct two-way link to the shore-station. The shore-station software (STS-DDS), then takes control of the session and downloads any data available from the CommFloat in addition to sending any commands destined for the deployed system. The shore-station application allows the user to queue commands to be sent and executed on next contact or after some time in the future. Once the CommFloat receives a remote command from the shore-station, it determines if the command is intended to be executed locally (in the CommFloat) or needs to be routed to the InstFloat or the MechFloat for action. The software fully automates the transfer of all profiling commands and data files.

Two files are transmitted during the surfacing phase of each profile: a data file and an engineering file. The data files are approximately 17 KBytes and the engineering files approximately 150 KBytes each. A ZLIB compression algorithm has been implemented in the CommFloat controller which compresses these files to approximately 6 KBytes and 28 KBytes respectively. These files are automatically uncompressed and archived by the shore station software. The total Iridium time required to transfer both files, update the GPS information, and receive new commands is approximately four minutes. This represents less than $2.40 in Iridium cost per profile (when using RUDICS).

3.2.4 Error Handling and Recovery

Error handling and recovery are accomplished with a simple checksum at the end of each packet. In the event of errors, the transfer protocol will attempt to re-transmit the packet a maximum of three times. However the complete file may be requested for re-transmission an unlimited number of times during the session prior to reaching the timeout limits. The checksum error handling feature has not been thoroughly field tested and will require testing prior to deployment. The user will still retain the ability to request retransmission of the complete file.

3.2.5 Privacy and Security

No special privacy and security controls are currently designed into the GSPP protocol, other than the features provided by the Iridium system and the local service provider for the shore-station software. The transferred files from GSPP to the shore-station software are compressed, however the compression is not password protected.

3.3 GSPP controller – Freewave Interface

The user interface is flexible and seamlessly adapts to either Iridium or FreeWave communication systems. When a communication session is started, its first task is to search for a configured FreeWave connection and then to switch to Iridium if it does not a FreeWave source. This feature can be turned on and off via remote commands sent during a telemetry session, in order to save unnecessary CommFloat surfacing time.

A FreeWave range test was conducted at sea using GSPP’s CommFloat in 1.2m seas. A hand-held FreeWave antenna on the bow of the ship maintained contact with the CommFloat’s new 3-way patch antenna to a range of 2.3 km.

3.3.1 Electrical

3.3.1.1 Connection and Cabling

The FreeWave RF connection operates in the 900 MHz band, using frequency hopping, and spread-spectrum protocol. Local connections are full duplex RS232 at 19200 baud.

3.3.1.2 Input Power

Input power is supplied to the FreeWave modem from the InstFloat via a 14V (nom.) lithium battery pack. Power is switched to the modem locally in the CommFloat.

3.3.1.3 Grounding

Grounding is provided via direct ground connections on the CommFloat controller PCB inside the CommFloat.

3.3.1.4 Isolation

Modem and CommFloat grounds are electrically isolated from seawater.

3.3.2 Logical Data

A direct two-way link to the shore-station software is established each time the GSPP surfaces the CommFloat, The shore-station software (STS-DDS), then takes control of the session and downloads any data available from the CommFloat as well as sending it any commands that are destined for the deployed system. The shore-station application allows the user to queue commands to be sent and executed on next contact or after some time in the future. Once the CommFloat receives a remote command from the shore-station, it knows if the command is intended to be executed locally (in the CommFloat) or if it was meant for the InstFloat or the MechFloat and relays it along accordingly. The software fully automates the transfer of all profiling commands and data files. Note that in the case where FreeWave telemetry is used, the shore-station (STS-DDS) software may reside on a laptop computer in relatively close proximity to the GSPP.

Two files are currently being transmitted during the surfacing phase of each profile: a data file and an engineering file. The data files are approximately 17 KBytes and the engineering files approximately 150 KBytes each. A ZLIB compression algorithm has been implemented in the CommFloat controller which compresses these files to approximately 6 KBytes and 28 KBytes respectively. These files are automatically uncompressed and archived by the shore station software.

3.3.3 Error Handling and Recovery

Error handling and recovery are accomplished with a simple checksum at the end of each packet. In the event of errors, the transfer protocol will attempt to re-transmit the packet a maximum of three times, however the complete file may be requested for re-transmission for an unlimited number of times within the session timeout limits.

3.3.4 Privacy and Security

No special privacy and security controls are currently designed into the GSPP FreeWave protocol, other than that which is provided by the unique ID pairing mechanism built into the FreeWave modems. The FreeWave modem in the CommFloat will only accept a connection to the manufacturer's unique ID programmed into the interrogating modem. The transferred files from the GSPP to the shore-station software are compressed, however the compression is not password protected

3.4 GSPP Controller – Acoustic Interface

An acoustic modem is installed on the InstFloat to provide a second two-way communication path to the GSPP's Master Controller. This interface currently only accepts one command string which executes a full system reset forcing GSPP to profile the CommFloat to the surface. This feature provides a method to reset the system defaults should the control program ever become corrupted or commanded to do something that limits its ability to surface and communicate using standard radio protocols.

Other features, such as reporting "system status" have also been programmed, but are currently disabled requiring further testing.

3.4.1 Mechanical

3.4.1.1 Pressure Rating

2000 Meters

3.4.2 Logical Data

The modems have the ability to generate a “break” signal to the RS-232 transmitter in response to a unique acoustic command received from an interrogating modem. This “break” signal is detected by the InstFloat electronics which in turn generates a hardware reset to the GSPP controller electronics. Any reset generated by the acoustic modem forces the GSPP to profile the CommFloat to the surface.

3.4.3 Error Handling and Recovery

No special error handling controls are currently designed into the GSPP acoustic modem protocol other than a strict adherence to the unique command set. Unrecognized commands are rejected and a message sent to the operator. The operator has the option to retransmit the command if an error occurred.

3.4.4 Privacy and Security

No special privacy and security controls are currently designed into the GSPP acoustic modem protocol, other than the features provided by the modem addressing mechanism built into the Benthos modems. The modem in the InstFloat will only accept commands from an interrogating modem programmed with the correct address.

3.5 GSPP Controller – Inductive Interface

A bi-directional inductive modem module (IMM) is incorporated into the winch control electronics located in the MechFloat and rotates (together with the cable coupler) on the winch drum. This creates a seamless data pathway from anchor to surface without the use of slip-rings, since both the profiling and mooring cables terminate on the winch drum.

Data is requested from the SIO Controller (located 2000m below the MechFloat) at the start of each profile and saved in the MechFloat for later transmission to shore via the InstFloat. Data sets from other inductive modem instruments can be transmitted in separate files if necessary.

3.5.1 Electrical

3.5.1.1 Connection and Cabling

The inductive modem has an effective data rate of 1200 baud. Local connections are full duplex RS232 at 9600 baud with handshaking.

3.5.1.2 Input Power

Input power is supplied to the inductive modem from a 9V regulated supply running off of the 24V battery packs in the MechFloat. Power is switched to the modem locally in the MechFloat.

3.5.1.3 Grounding

Grounding is provided via direct ground connections on the PCB inside the MechFloat.

3.5.1.4 Isolation

Modem and MechFloat grounds are electrically isolated from seawater.

3.5.2 Logical Data

The data communication interface between the SIO controller and the GSPP is done via an Inductive Modem Module (IMM) on each end. The communication is a pass-through mode activated by a certain command. The communication between the SIO controller and the GSPP is thus done almost transparently. The two units talk to their respective IMM via RS-232 at 9600 baud.

The IMM on the SIO controller will always remain in a low power mode, being able to listen for any incoming data as soon as the data is transmitted. The GSPP IMM will only be turned on at the end of each profile.

The communication protocol is defined by BIO and consists in a file transfer through the inductive line. At the end of each profile, the GSPP will turn on its IMM and sends a communication request through the inductive line. The SIO controller will then wait for a command from the GSPP to determine if it has to store and analyze commands sent from shore or start the data files transfer. In the latter case, the GSPP will request a file name which will be sent by the SIO controller. Upon receipt of the file name, the GSPP will request the data content of this file and store the data internally after verifying the data integrity. At the end of the file, the GSPP will request a new file and download it, and so on until all files have been sent by the SIO controller. The GSPP will then turn off its IMM until the end of the next profile.

3.5.3 Error Handling and Recovery

Error handling and recovery are accomplished with a simple checksum at the end of each packet. In the event of errors, the transfer protocol will re-transmit the packet a maximum of three times, however the complete file may be requested for re-transmission an unlimited number of times within the session timeout limits.

3.5.4 Privacy and Security

No special privacy and security controls are currently designed into the GSPP inductive modem protocol.

4 Notes

None.

5 Appendices