



UNCABLED COASTAL 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) documents all interfaces (data, electrical, mechanical, software, etc.) associated with the uncabled Coastal Surface Piercing Profiler (CSPP). The OOI uncabled CSPP (uCSPP) is a WET Labs Autonomous Moored Profiler (AMP), which WET Labs is rebranding as its Thetis Profiler.

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 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:

3310-00004	Coastal Surface Piercing Profiler Specification
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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.

1000-00000	OOI Configuration Management Plan (CMP)
1101-00000	Final Network Design (FND)
N/A	L2 Reference Module

2.3 Informational Documents

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

N/A	WET Labs AMP Host User's Guide
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3 Description of Interfaces

3.1 Overview

Moored profilers are one of the primary measurement tools used in the OOI to obtain time series of the vertical profile of important ocean properties. In general, moored profilers consist of a suite of sensors that are raised and lowered through the water column on a regular basis.

The CSPP is mounted on a bottom frame or base and raises sensors all the way to the surface. It receives commands from the shore station to alter the operation of the profiler, the sensor package, and the processing performed on collected data. The CSPP will be deployed on the continental shelf in water as deep as 133 meters and will be for periods up to 7 months. The goal is to obtain a water column profile from the air-surface to as close to the bottom as practicable.

The CSPP is specified to operate in one of two configurations. In the uncabled, or standalone configuration, the uCSPP will draw power from batteries throughout its deployment. When the uCSPP has surfaced, an Iridium satellite telemetry system sends data back to shore and receives new commands for the uCSPP. The uCSPP will also

contain an acoustic modem capable of receiving commands from and transmitting data to a nearby acoustic modem on an OOI surface mooring. The cabled CSPP (cCSPP) will draw power from and transmit data through an undersea cable through the profiler base. This document describes the interfaces for the uCSPP.

3.1.1 Interface Summary

This uCSPP has electrical, mechanical, and logical/data interfaces.

- The electrical interface consists of an RS-232 serial port used to directly interface with the uCSPP via a vendor-provided cable and two power ports for batteries. Two rechargeable batteries ship with each uCSPP.
- The uCSPP has an electrical interface with each of its instruments, but the instruments are considered part of the profiler for this document, so the interface with each instrument is not detailed here.
- Mechanically, the uCSPP is attached via a spectra line to the anchor. A winch within the profiler adjusts the distance between the profiler and the anchor. The anchor is provided by OSU not the profiler vendor.
- The main data interface is from profiler to shore via satellite telemetry. The profiler will be able to transmit data via an Iridium satellite modem. The profiler software and the shore-side software for communicating with the profiler are provided by the vendor. There will be no OOI Cyber-infrastructure presence on the profiler, nor will there be a shore-side CI agent/driver for interfacing with the profiler.
- The profiler will also have an acoustic data interface with an acoustic modem on OOI's nearby surface mooring.
- The profiler includes an additional Iridium beacon for emergency geo-location use. It is powered from internal batteries. Its operation is enabled/disabled via a magnetic switch.

3.2 Interface Details

3.2.1 Electrical

The electrical interface consists of an RS-232 serial port used to directly interface with the CSPP via a vendor-provided cable (see below for references to Impulse bulkhead types) and two power input ports that can be used when the uCSPP is not being powered via its batteries.

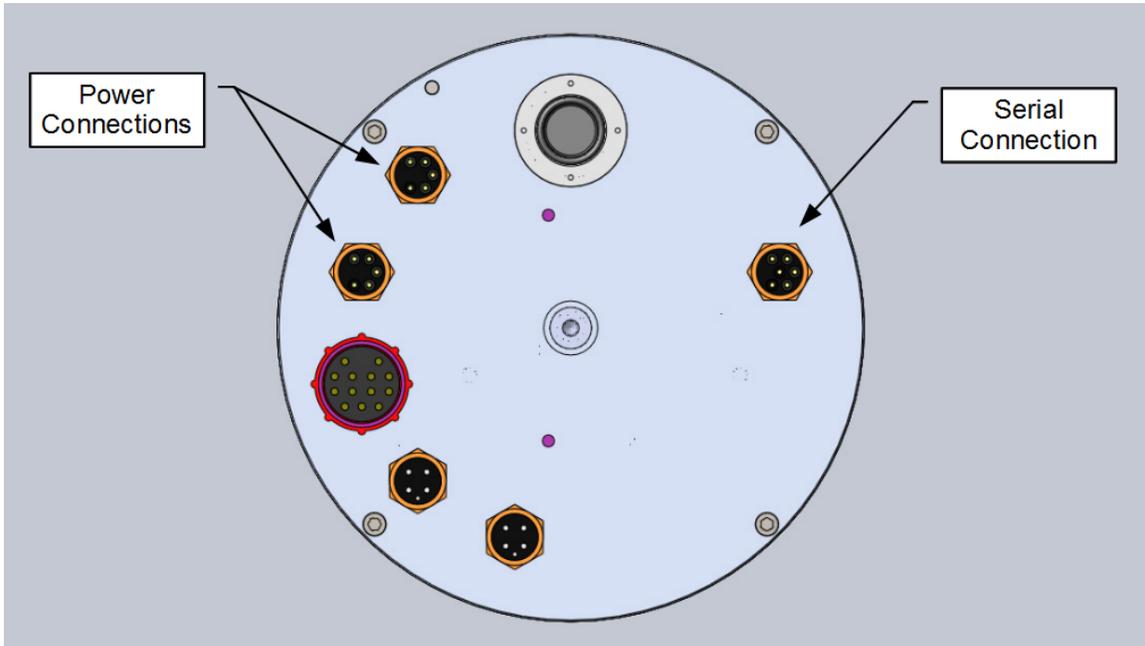


Figure 1 – Power and Serial Connection Locations on Control Can Bottom Flange

3.2.1.1 Serial Port Interface

The serial port interface follows the WET Labs standard serial interface format specified below. The connector on the uCSPP is a Teledyne/Impulse model MCBH (WB)-6-MP. The mating connector is a Teledyne/Impulse model MCIL-6-FS. Materials and specifications for the connectors may be found in the Teledyne/Impulse Technical Bulletin 66 01. See Table 1 for the contact function descriptions and Figure 2 for the physical contact arrangements. This connection is used for communications only and consumes no power and has no inrush current. See Figure 1 for the location of the serial port interface on the uCSPP. The RS-232 serial output on pin 5 of the serial port interface will have nominal voltages of +/- 5.4V when connected to a 3 kΩ load relative to the ground connection on contact 1. If the output is shorted to ground, the typical output current is +/- 35 mA and the maximum output current is +/- 60 mA. Output slew rates are typically 6V/μs. The input voltages to pin 2 can range from -25 to +25 V relative to the ground connection on contact 1. The input threshold for a low input is typically 1.2 V with a minimum of 0.6V. The input threshold for a high input is typically 1.5 V with a maximum of 2.4V. The serial port uses asynchronous communications at 115,200 bits/s with 8 data bits, one stop bit and no parity bits. Details on the communications message format and available commands can be found in the WET Labs AMP Host User's Guide and in section **Error! Reference source not found.** The ground reference on pin 1 is connected directly to the CSPP system ground. This will be the battery return terminal when running from batteries, or the power supply return line when running from external power.

Contact	Description
1	Ground
2	RS-232 RX (to CSPP)
3	Modem RS-232 TX (No connection via serial cable)
4	Unused
5	RS-232 TX (from CSPP)
6	Unused

Table 1 - Serial Port Interface Connections

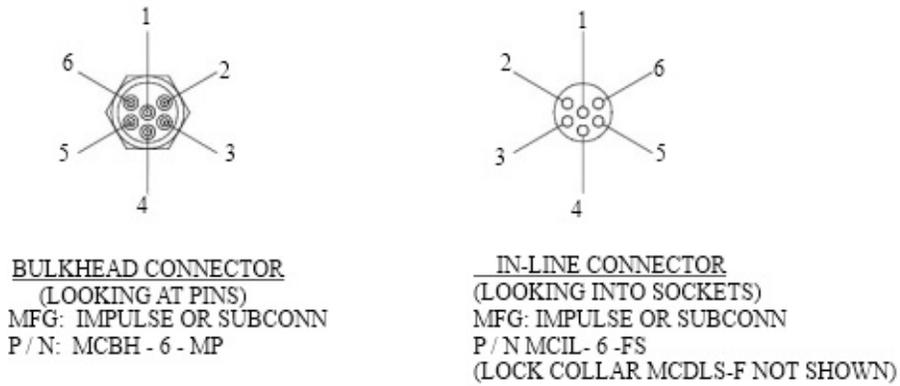


Figure 2 – Serial Port Interface Connector Diagrams

3.2.1.2 Power Port Interface

There are two power port interfaces that connect the uCSPP controller to the batteries during normal operation. These may also be used to supply the uCSPP with external power. The connectors on the uCSPP are Teledyne/Impulse model MCBH (WB)-5-MP. The mating connector is a Teledyne/Impulse model MCIL-5-FS. Materials and specifications for the connectors may be found in the Teledyne/Impulse Technical Bulletin 66 01. See Table 2 for the contact function descriptions and **Figure 3** for the physical contact arrangements. See Figure 1 for the locations of the power port interfaces on the bottom flange of uCSPP control can. If external power is to be supplied to the uCSPP, all batteries should be disconnected, and the unused power port should have a dummy plug installed before power is supplied. This is a required safety precaution to avoid the exposure, of high voltage contacts. Contacts 2, 3 and 5 of both connectors are intended only for use with Bluefin SBM batteries. When used with an external power cable, they should not be connected. The typical input voltage to the CSPP is 34.0 Volts. The minimum voltage to power the controller is 9.0 V. The minimum voltage required to operate the winch is 20.5 V. The maximum allowable input voltage is 36.0 V. The required input current varies widely during profiler operation depending upon whether the instruments, telemetry and/or winch are in operation. The maximum inrush current at power up if all of the instrument, telemetry and winch relays are in the on state is **N.NNN** at 34.0V. The typical inrush current, when all relays are in the off state is **N.NNN**. Typical power consumption for common CSPP states of operation while powered from an external source may be found in Table 3. The ground connection on the power port is a common ground for the entire CSPP system. It is internally connected to the serial port interface ground.

Contact	Description
1	Power Return (Ground)
2	Bat Coms+ (No connection via power cable)
3	Bat Enable (No connection via power cable)
4	Power In
5	Bat Coms- (No connection via power cable)

Table 2 - Power Port Interface Connections

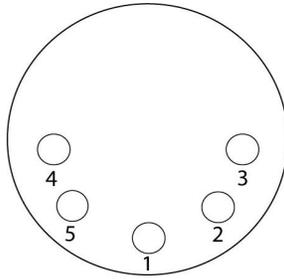


Figure 3 - Power Port Interface Cable Connector Diagram

uCSPP State	Typical Power Consumption (Watts)
Low power sleep state	0.001
Direct serial file offload with telemetry off	0.5
Telemetry only (Iridium)	5.8
Loading rope onto the winch	140

Table 3 - Typical Power Consumption when Externally Powered

3.2.2 Mechanical

Mechanically, the uCSPP is attached via a spectra line to the anchor. A winch within the profiler adjusts the distance between the profiler and the anchor. The anchor is provided by OSU not the profiler vendor.

3.2.2.1 Mechanical: line between profiler and winch

The line connecting the profiler/winch to the bottom anchor is Plasma 12 Strand made by Cortland Cable. The table below gives the specifications of this cable as highlighted in green.

	Nominal Diameter		Size (circ in.)	Approximate Weight		Minimum Tensile Strength	
	Inch	MM		Lbs/100ft	K g/100m	Lbs	Te (tonnes)
12 Strand	0.04	1	0.12	0.05	0.1	270	0.1
	0.05	1.25	0.15	0.07	0.1	390	0.2
	0.06	1.5	0.18	0.1	0.1	475	0.2
	0.07	1.75	0.21	0.14	0.2	750	0.3
	0.1	2.5	0.3	0.27	0.4	1,400	0.6
	1/8	3	3/8	0.54	0.8	2,800	1.3
	3/16	5	9/16	1.12	1.7	5,500	2.5
	1/4	6	3/4	1.6	2.4	8,000	3.6
	5/16	8	15/16	2.5	3.7	11,700	5.3
	3/8	9	1-1/8	3.7	5.5	17,500	7.9

Table 4 – Plasma 12-Strand Specifications

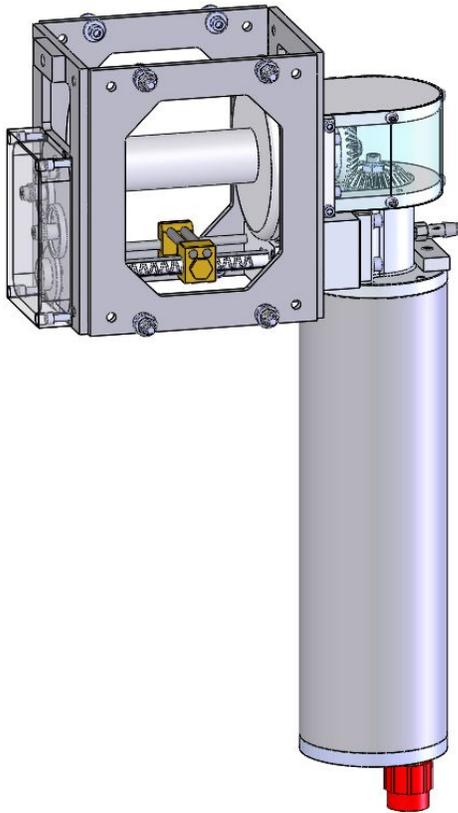
The Plasma 12 strand is the highest strength synthetic rope available. It is manufactured from High Modulus Polyethylene (HMPE) that has been enhanced by Cortland. Their process allows for over 50% higher strength and creep resistance over that of standard Spectra. WET Labs specifies a non-twist structure will makes the rope flatten under tension prevents rope “knifing” when wrapped onto the drum of the winch.

3.2.2.2 Mechanical: winch

The winch executes commands from the control module:

- profile up and down
- mitigate wave motions during profiling for optimal sampling and maintains constant winch line tension
- keep the antenna up while the profiler is at the surface
- stop in different locations near the bottom between profiles to minimize winch line wear

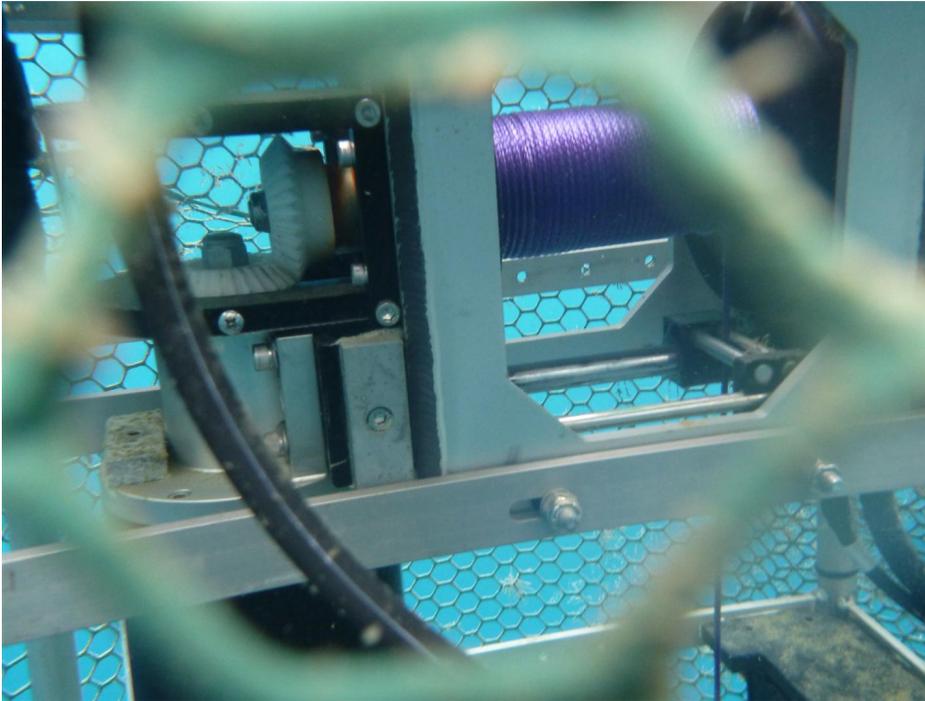
The winch is constructed of an assortment of materials to maximize its endurance while keeping its weight to a reasonable minimum. The primary materials are aluminum (anodized), plastic, stainless steel, and brass. The motor shaft is sealed with a silicon carbide mechanical face seal. The assembly is rated to 100 m. The drum holds 200 m of the rope specified above. A level wind mechanism keeps the rope layers flat to manage motor torque and ensure long-term reliability.



Winch (top) and motor (right), oriented as it is installed in the profiler.

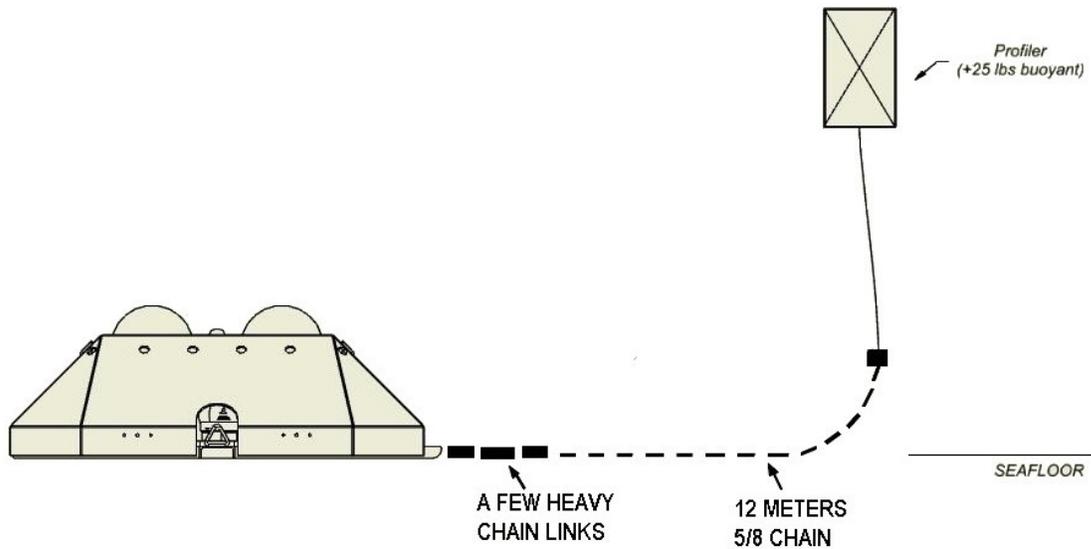


The winch is mounted in the center of the profiler, and the winch rope can be seen exiting at the center of the base of the profiler.



Winch, mounted in profiler. The purple rope is visible on the winch drum. Bevels gears (on the right) connect the motor to the winch drum.

3.2.2.3 Mechanical: Endurance anchor



Anchoring diagram

The Profiler and winch rope are supplied by WET Labs. All other components and rigging connections are supplied by the customer.

WET Labs recommends the anchor chain be 12 m (40 feet) of 16 mm (5/8") galvanized steel chain. Anchor chain damps wave motions to reduce winch line tension spikes.

Details of all the listed components, recommendations, and deployment procedures are detailed in WET Labs document, "AMP Rigging and Deployment (Rev. 1)".

3.2.2.4 Mechanical: Pioneer anchor

TBD

3.2.3 Satellite to Shore System Telemetry

The uCSPP uses Mobile Originated (MO) RUDICS Iridium satellite communications as the primary telemetry path to shore (see Figure 4). On the shore side, one or more computers will serve to provide the automatic and manual controls required for CSPP operation. The following subsections will provide more detailed information on the satellite telemetry system.

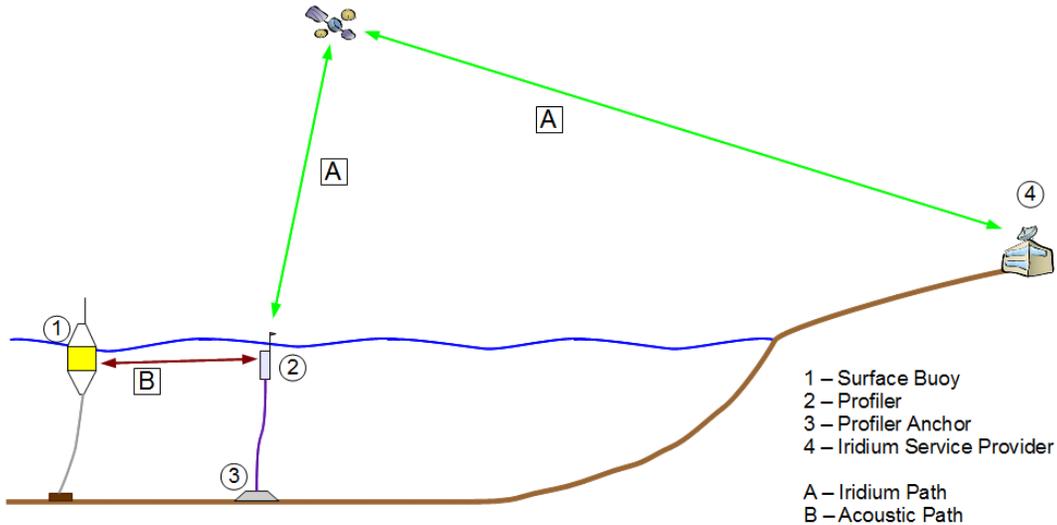


Figure 4 - uCSPP Communications Paths

3.2.3.1 Iridium RUDICS

The CSPP uses Mobile Originated (MO) Iridium RUDICS satellite connection for each primary telemetry session. The Iridium modem on the uCSPP contains a SIM card that uniquely identifies it within the Iridium system. RUDICS service associates each modem with a uniquely named RUDICS group. The group that a modem is provisioned under determines the destination IP address of MO sessions. A large number of modems may be provisioned within the same group. When operating more than one RUDICS modem, it is desirable to establish them within the same group to avoid the significant fees associated with establishing or changing a group. The specified maximum available RUDICS data rate is 2400 bits/s or 300 bytes/s. When an uCSPP originates a call, the Iridium system will establish a connection to the CSPP modem, and then route the connection to the unique, pre-determined IP address and port for the group. If there is no receiving connection available at the destination IP address that time, the call is dropped, and the uCSPP will either re-attempt a connection, or will skip the telemetry session and continue its configured operation.

3.2.3.2 AMPServer Application

The primary shore side reception point for uCSPP Iridium sessions is a Java based application called AMPServer. This application can run on most commercially available Windows or Linux based servers. Because the RUDICS group destination IP address is a publicly visible IP

address, Linux is the preferred operating system for the server, due to its more robust and secure networking services. When running, AMPServer provides the incoming connection point for all MO uCSPP sessions. Due to the server nature of the application, AMPServer is typically run as a background daemon service that automatically starts each time the server computer boots up. When a modem (or test telnet connection) establishes an incoming connection to AMPServer, the application will issue a profiler specific command to request the MSISDN of the SIM in the uCSPP's modem. AMPServer then looks for the number from the uCSPP response in a routing table. This table associates each uCSPP MSISDN to another IP address and port number. When a match is found, AMPServer then starts forwarding data to/from the IP port and address specified in the routing table. If there is no receiving connection to the routing table destination IP address, AMPServer will terminate the connection to the uCSPP. AMPServer is capable of handling an estimated 50 or more uCSPP connections at a time. While forwarding data to/from each uCSPP, AMPServer reassembles incoming IP packets into new IP packets containing complete uCSPP messages (see section 3.2.5.1) before forwarding them on. Changes to the routing table currently require AMPServer to be shut down and restarted. Future versions will provide the option to update the routing table without the need to stop AMPServer.

3.2.3.3 JProfilerHost Application

The primary application for controlling an individual uCSPP is the Java based JProfilerHost program. One, and only one, instance of JProfilerHost is run for each uCSPP in operation. It can run on most commercially available Windows or Linux based computers. JProfilerHost can be run on the same computer as AMPServer, or on a separate computer. Multiple JProfilerHost programs can also be run on the same computer if needed. The only requirement is that the computer(s) running JProfilerHost are network reachable from the AMPServer server.

JProfilerHost is a graphical application requiring a keyboard, and ideally a mouse, for user input. Should it be impractical to physically access the computer that JProfilerHost is running on, UVNC or VPN access can be used to provide remote access to the JProfilerHost computer. WET Labs has also tested an approach for running X11 graphical apps (i.e. JProfilerHost running on Linux) via a Putty SSH connection from a remote Windows machine. This requires the installation of the open source Putty and Xming applications on the Windows computer.

The JProfilerHost application can perform a number of automatic or manual operations required to control CSPP operation and enact data transfers. See the JProfilerHost User's Guide for more detailed information on its operation. JProfilerHost will place offloaded uCSPP data into a user specified directory for follow on data processing and publication. Once a telemetry session is complete, JProfilerHost will direct the uCSPP to continue its mission plan. The Iridium modem will then be turned off, and the connection via AMPServer will be dropped. JProfilerHost will then wait for the next session from the same uCSPP.

3.2.4 Host Buoy to uCSPP Acoustic Communications

In addition to the primary Iridium communications path, the uCSPP is equipped with an acoustic modem that can be used to communicate with the uCSPP when it is not at the surface (figure 4). The primary acoustic communications to the uCSPP will be via a compatible acoustic modem installed on a nearby OOI Coastal Surface Mooring (CSM). A secondary acoustic communications path to the uCSPP would be from a ship based compatible acoustic modem during deployment and recovery operations. The CSMs will have a Teledyne Benthos acoustic modem model 916. The uCSPP is equipped with a compatible acoustic modem, Teledyne Benthos model 916.

There is an opportunity for an acoustic modem session each time the neighboring surface mooring calls in to shore. Normally, one will schedule profiles in the hour before a surface mooring call so that one may communicate with the uCSPP if there is a problem immediately following each profile. Normally, a default set of commands will be sent, including a check of the distance between the acoustic modems on the uCSPP and surface mooring and a request for

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summary status message from the uCSPP. See JProfilerHost manual for details. If problems occur, one may send a different command set.

The default commands are:

```
+++
ATR2                get distance between modems
AT$V2               get modem battery voltages
ATD2                connect to profiler
$PWETC,,,BC,,DATE*48  get date
$PWETC,,,BC,,PFS*19  get profiler state
$PWETC,,,BC,,PST*0B get profiler start time
$PWETC,,,BC,,SUM*17 get summary status
+++
ATH                 close session
```

Use PST to initiate a profile later than the normal profile interval. For example,

```
$PWETC,,,BC,,PST,2,18:00:00,05/31/2014*1C
```

Use WET Labs' checksum calculator, SumCalc, to calculate the value of the last two hex characters. The "checksum is calculated by a bitwise exclusive or of the characters from the \$ up to, but not including, the * character." One may want to initiate a profile later than the normal profile interval to avoid surface waves. To send a non-default command to the uCSPP via the acoustic modem, make a new spp_commands.txt file that has been created using UNIX line endings (no crlf!). Use Notepad++ or the equivalent for this. Name the command file for the dcl it will be sent to, such as instCfg.dcl17.spp_commands.txt. Make a new outboundcmd file that has been created using unix line endings (no crlf!). The outbound file should FGET the file name of the command file, as in FGET instCfg.dcl17.spp_commands.txt. Using a sftp application like FileZilla or SSH, log into the mooring server, such as ooi-cgpps1.osu.ooi-omc.org, using the mooring reference designator as the UID and PWD, such as user ce01issm and password !ce01issm. Put both files in the Cfg2Buoy directory for the active deployment e.g., cd D00001/Cfg2Buoy. Wait until the next telemetry session with the buoy and following acoustic modem session from that buoy. After the file is sent to the buoy, a *.DONE file will replace the command file.

Data from each acoustic modem conversation are located in the OMC under the surface buoy DCL with the acoustic modem that talked with a CSPP. Log data are located on the OMC in a folder associated with the DCL that has the acoustic modem (e.g., /home/ce01issm/D00001/dcl17/ucspp). Here is an example:

```
2014/04/28 12:00:17.116 sent: +++
2014/04/28 12:00:17.684 rcvd: user:1>
2014/04/28 12:00:17.688 sent: ATR2
2014/04/28 12:00:21.443 rcvd: Range 1 to 2 : 175.6 m
2014/04/28 12:00:21.445 sent: AT$V2
2014/04/28 12:00:24.695 rcvd: Remote Battery Voltages
2014/04/28 12:00:24.714 rcvd: DSP Bat = 02.9V
2014/04/28 12:00:24.732 rcvd: Xmit Bat = 19.9V
2014/04/28 12:00:24.735 sent: ATD2
2014/04/28 12:00:27.990 rcvd: CONNECT 00800 bits/sec
2014/04/28 12:00:27.996 sent: $PWETC,,,BC,,DATE*48
2014/04/28 12:00:35.762 rcvd: $PWETA,BC,,PC,P1,DATE,3,4/28/2014,12:00:38,0.0*14
2014/04/28 12:00:35.872 sent: $PWETC,,,BC,,PFS*19
2014/04/28 12:00:43.328 rcvd: $PWETA,BC,,PC,P1,PFS,1,13*5A
2014/04/28 12:00:43.445 sent: $PWETC,,,BC,,PST*0B
2014/04/28 12:00:51.223 rcvd: $PWETA,BC,,PC,P1,PST,3,16:00:03,04/28/2014,14350*76
2014/04/28 12:00:51.338 sent: $PWETC,,,BC,,SUM*17
2014/04/28 12:00:59.920 rcvd: $PWETA,BC,,PC,P1,SUM,14,20.42,0.53,1.15,31.8,-
5308623,11184167.PPB,94179,452689920,184,24,32.04,4.025,-2059.01,2*08
2014/04/28 12:01:00.039 sent: +++
```

2014/04/28 12:01:00.131 rcvd: user:4>
2014/04/28 12:01:00.132 sent: ATH
2014/04/28 12:01:00.225 rcvd: Off Line

3.2.5 Logical/Data

All communication with the profiler occurs via a specific message format detailed below. Software supplied by the vendor will be used for all CSPP interactions. The file messaging information supplied below is not expected to be required by the OOI system, and is included for informational purposes. The message format follows the proprietary extension to the NMEA 0183 standard. Fields are separated by commas. Whitespace (space and tab) characters are ignored, except during checksum calculation and within binary data fields. The optional checksum is calculated by a byte-wise exclusive or of all the characters from the \$ up to, but not including, the * character. Talker and listener types and IDs can be used to implement message routing and to identify the source of messages.

3.2.5.1 Command Message Format

Command messages are issued from a talker to a listener to direct the listener to perform a configuration or operation command or request status information. The command format is detailed below, followed by field descriptions in Table 4.

```
$PWETC,LT,LID,TT,TID,CMD,n,parms*CC<cr><lf>
```

\$PWETC	Command header
LT	Listener Type - listener device type identifier. If this field is blank, the command is for all devices that receive the command.
LID	Listener ID - listener id number that the command is destined for. If the field is blank, the command is for all LT type devices that receive the command.
TT	Talker Type - talker device type identifier. (optional)
TID	Talker ID - talker id number. (optional)
CMD	Device specific command
n	Decimal Number of comma separated fields in parms section
parms	Command specific, comma separated parameters
*	Checksum delimiter char
CC	Hex 2 character checksum (optional)
<cr>	ASCII carriage return
<lf>	ASCII line feed

Table 4 - Command Message Fields

3.2.5.2 ASCII Reply Message Format

ASCII reply messages are issued by a listener to a talker in response to a command, or as an unrequested status or notification message. The ASCII reply format is detailed below, followed by field descriptions in Table 5.

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\$PWETA,LT,LID,TT,TID,CMD,n,parms*CC<cr><lf>

\$PWETA ASCII Reply header
LT Message Recipient (TT from command message)
LID Message Recipient (TID from command message)
TT Message Sender (LT from command message)
TID Message Sender (LID from command message)
CMD CMD from the command that caused this reply.
n Decimal number of comma separated fields in parms section
parms Command specific, comma separated parameters
* Checksum delimiter char
CC Hex 2 character checksum (optional)
<cr> ASCII carriage return
<lf> ASCII line feed

Table 5 - ASCII Reply Message Fields

3.2.5.3 Binary Reply Message

Binary reply messages are issued by a listener to a talker in response to a command when ASCII formatted data is not practical. The binary reply format is detailed below, followed by field descriptions in Table 6.

\$PWETB,TT,TID,LT,LID,CMD,n,data*CC<cr><lf>

\$PWETB Binary Reply header
LT Message Recipient (TT from command message)
LID Message Recipient (TID from command message)
TT Message Sender (LT from command message)
TID Message Sender (LID from command message)
CMD CMD from the command that caused this reply
n Decimal number of bytes in parms section
data Command specific binary data
* Checksum delimiter char
CC Hex 2 character checksum (optional)
<cr> ASCII carriage return
<lf> ASCII line feed

Table 6 - Binary Reply Message Fields

3.2.5.4 uCSPP Common Commands

The commands in the following table are common to both the uCSPP package controller, which serves as the main interface, and the embedded winch controller. Commands to the winch controller are forwarded by the package controller based upon the LT and LID fields within a command message. All winch controllers are configured to respond to an LT of WC and an LID of W0.

Command Function

Command	Function
BREAK	send a break command to terminate a file offload (will also abort deployment by the package controller or cancel breakaway state)
CD	change to the specified directory on the controller's disk drive
DATE	get/set the controller date & time

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Command	Function
e	delete the specified file(s) from the controller's disk drive
DIR	change to the specified directory on the controller's disk drive
FREE	show the amount of free space on the controller's disk drive
GET	offload the specified file(s) from the controller's disk drive
LOG	get/set package controller data logging
LRS	start generating a linear recursive byte pattern for coms testing
MKD	create a directory on the controller's disk drive
PAS	pass thru to communications to the specified controller port
PING	get an acknowledge message from the controller
PUT	send the specified file to the controller.
PWD	show the current working directory path
Q	quit the controller application to PicoDOS
RMD	remove a directory from the controller's disk drive
S	get the current profiler status
e	get/set the controller time
TOTAL	show the total file space (used and unused) on the controller's disk drive
TYPE	echo the specified file(s) from the controller's disk drive
VER	get the current firmware version information

Table 7 - CSPP Common Commands

3.2.5.5 uCSPP Package Controller Commands

The commands in the table below are specific to the uCSPP package controller.

Command	Function
ACSP	get/set the ACS power status (X10)
ADVL	get/set the ADV logging status (X10)
ADVC	put the ADV in command mode (X10)
ADVP	get/set the ADV power status (X10)
AIPA	get/set the auxiliary host IP address for use with CDMA telemetry
AIPP	get/set the auxiliary host IP port for use with CDMA telemetry
ANAM	get the current APNA mode message (ORCAS- IOPC)
ANAP	get/set the APNA power status and operation (ORCAS- IOPC)
ANAS	issue an APNA stop message (ORCAS- IOPC)
AUXP	get/set the Auxiliary port power status
AWU	get/set the auxiliary instrument warm up time in seconds
BD	get/set the breakaway depth (volatile value, default 0.5)
BFS	Get the Bluefin battery status
BOK	Get batch operation availability (OK or NO)
BT	run a breakaway test (winch must be on and not profiling and shallower than the breakaway depth)
CAL	get/set the APNA pre-calibration time in seconds (ORCAS- IOPC)
CCM	Get/set the constant torque mode. 0 = off, 1 = const torque on ascent and descent, 2 = all motion
CTDP	get/set the CTD power status
CTS	enable or disable clear to send handshaking
CWD	Get/set the Cell modem WatchDog operation. 0 = off 1 = on
D	get the current depth as reported by the CTD
DEP	deploy the profiler – obsolete
DL	get/set package controller debug logging (volatile setting, defaults to on at reset)
GPS	get the last GPS position fix
GPSP	get/set the GPS power status
GRF	get the names of the most recent profile data and winch files
GWF	transfer the specified file from the winch controller to the package controller
HLD	Get/set the surface hold mode. 0=winch off, 1 = winch on

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Command	Function
HOLD	hold the profiler at the surface for the specified time in seconds
IBT	Get/set the delay time in seconds between position reporting and acquisition during breakaway for Iridium based systems. Default is 30 seconds, max is 4924.
IGT	Get/set the on time in seconds for the GPS during a breakaway for Iridium based systems. Default is 60 seconds, max is 4924.
IME	get/set the WiFi coms status 1= on, 0 = off, reports connection attempt number when on (X10)
INSP	get/set the instrument power status
IWU	get/set the instrument warm up time in seconds
LOG	get/start/stop file logging
PAS	pass thru to the specified port
PRO	start profiling
PT	get/set the profiler type
RD	get/set the profiler radio depth
REL	release the profiler from holding at the surface
RHT	remaining hold time in seconds
RUN	Run a specified batch file
SCS	Get/set the profiler scooch settings (interval in minutes, max delta counts, max travel, min delta)
SUM	get summary for the most recent profile.
VER	get the current firmware version and date
SS	Get/set the surface seconds time (default is 180)
WD	get the last deploy wakeup depth – obsolete
WL	start/stop winch controller logging (if it's on)
WP	get/set the winch power status
XCD	set the charger status to done (X10)
XCS	get the charger status (X10)

Table 8 - Package Controller Commands

3.2.5.6 Winch Controller Commands

The commands in the table below are specific to the uCSPP winch controller.

Command	Function
D	get the current depth as reported by the SBE-50 pressure sensor
STP	stop winch motion
B	get/set the brake state
AMP	get the on/off state of the embedded motor controller
V	run the motor at a constant velocity – for development use
GO	run to a specified depth at a specified rate
GC	run the motor in continuous mode – for development use
GP	run the motor to the specified encoder position at the specified rate
P	get the current motor encoder position
POS	get the current motor encoder position
AP	get the current anchor position
AD	get the current anchor depth – obsolete
DO	get/set the depth offset to be applied to the pressure sensor output
CMD	clear the move done status flag
LOG	start/stop logging of winch data
MS	get the status from the embedded motor controller
HMR	get the current readings from the compass
RBQ	reset the gas gauge counters
BQ	get the current gas gauge counts
ZP	zero the compass pitch

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Command	Function
ZR	zero the compass roll
CAC	send a message to the embedded motor controller – for development use
CC	run the winch in constant torque mode to the specified depth – under development
CPM	get the counts per meter setting
MBR	get the current motor controller baud rate – for development use
STA	Get/set the stop amps used in the surface hold mode of the package controller

3.2.5.7 Data File Formats

Instrument and other operational data collected during profiles is collected and stored on the uCSPP controller. These files are optimized to minimize the storage space and transmission requirements. Vendor supplied software will be provided to extract time stamped individual data sources into separate files. The file formatting supplied below is not expected to be required by the OOI system, and is included for informational purposes. Further details will be provided in the uCSPP DPS and IOS. The uCSPP file naming convention follows the format of PDDDDFFFF, where:

- P is the last digit of the controller's ID.
- DDD is the day of the year number. January first is 000, February first is 32, etc.
- FFFF is the start time of the profile as a fraction of the day to four digits. For example, Midnight, is 0000, noon is $12/24 * 10000 = 5000$, 0600 is $6/24 * 10000 = 2500$, 13:30 = $13.5/24 * 1000 = 5625$.

The file names will end with a period followed by a unique two or three character code to identify the source of the file. See Table 9 for the list of the file extensions

Extension	File Type
.PPB	Instrument (less SUNA and ACS data) and engineering data collected by the package controller
.WC	Winch controller data
.SNA	SUNA data
.ACS	AC-S data
.DBG	Engineering data (if not stored within .PPB files)

Table 9 - Data File Types

3.2.5.7.1 Package Controller File Format

The package controller files start with three lines of ASCII data. The first line contains the profiler ID (i.e. P1) followed by a space character and then the package controller firmware version that was installed when the file was recorded. The second line is followed by the start time of the profile, encoded first as the day of the year and time of day as DDD.FFFF using the same conversions as the file naming convention. The “decimal” start time is followed by a command and a space and then the start time as MM/DD/YYYY HH:MM:SS. The third line will be the most recent position fix by the CSPP’s GPS receiver. It is reported as DDDMM.FFFFF A, DDDMM.FFFFF O, where DDD is degrees latitude/longitude, MM is minutes of latitude/longitude and FFFFF is a decimal fraction of a minute of latitude/longitude. A will be N or S to indicate which hemisphere the latitude is in, O will be W or E to indicate which hemisphere the longitude is in. If the GPS has not yet received a position fix since power was last applied to the CSPP, the reported position will be 4432.33100 N, 12322.63100 W. Following the header line, will be the time stamped data collected by the package controller during a profile sequence. All data records start with a single byte indicating the data source, followed by 4 bytes to represent the date and time of the first byte of data from the source in seconds since 1 Jan 1970. This is followed by two bytes to indicate the fraction of seconds of the time stamp. Each individual data source then has its own specific data record. Where practical, sensor data is recorded in binary format to reduce storage and transmission requirements. The starting data source indicator byte also indicates whether the record’s time stamp occurred following a data buffer write to persistent storage. That

is because the time stamps for these records can be in error by as much as 50 ms, and may deserve special treatment in post processing.

3.2.5.7.2 Winch Controller File Format

The winch controller files start with two lines of ASCII data. The first line contains the winch controller ID (W1) followed by a space character and then the winch controller firmware version that was installed when the file was recorded. The second line contains the winch controller's depth offset setting at the time that the file was recorded. The offset is in meters to three decimal places. The offset is added to the winch controller's integral depth reading to adjust it to report a depth consistent with the depth reading of the CTD. This offset is only applied to the depth reported by the D command and is not applied to the depth recorded within the WC files. As with the package controller, the remainder of the file is made up of time stamped data records. These records follow the same one byte source indicator, four byte date and time field, and two byte fractional seconds field.

3.2.5.8 SUNA and ACS File Formats

These two files include the same header as the package controller files, but the following data records consist only of time stamped data from a single instrument (SUNA or AC-S). Time stamps are assigned at the start of output records from the specific instrument and follow the same format as the package controller files.

3.2.5.9 Iridium Beacon Communications

The communication protocol used by the Iridium beacon can be obtained from the beacon manufacturer, MetOcean. They are MetOcean CABO beacons. CGSN is using Joubeh as the Iridium provider for these beacons, so they can be accessed when deployed through Joubeh's website.

3.2.6 Error Handling and Recovery

The underlying communications interface to the uCSPP, regardless of which telemetry method is being employed, is based upon a messaging scheme described in section 3.2.3. Each message employs a basic 8 bit checksum to help ensure the integrity of each received message. Each message must also adhere to the message format described in section 3.2.3. The uCSPP will respond to all commands with an appropriate reply message, or a NAK message, also specified in section 3.2.3, should the command message not adhere to the required message format, or if the received checksum for the message does not match the calculated checksum. The CSPP will also reply with a NAK to invalid command messages that still meet the format and checksum requirements. The recovery approach to a failed command message to the uCSPP is to have the sending unit retransmit the command until it is successfully received by the uCSPP. The various modems that are used on the uCSPP also employ modem specific Forward Error Correction (FEC) schemes to ensure the integrity of the transmitted data.

3.2.7 Privacy and Security

The main security issue for the uCSPP is that an unauthorized party could supersede authorized uCSPP communications, resulting in unintended operation or possibly halted operation. Due to the infrequent nature of uCSPP communications, as well as the inherent inaccessibility to the uCSPP, unauthorized access is unlikely. When the uCSPP is operating via FreeWave modem, the on-board modem is pre-programmed with a list of up to 10 serial numbers of compatible modems that it will communicate with. It is not known whether one of these modems could be spoofed, but it seems unlikely. The unauthorized party would also need to know which numbers the uCSPP is configured for spoofing to be successful. The Iridium modems used by the uCSPP each have International Mobile Station Equipment Identity (IMEI) numbers and Subscriber

Identity Modules (SIM), which uniquely identify them and allow them access to the Iridium system. Each is also assigned to a specific RUDICS group within the Iridium system, which identifies a single, fixed IP address for the shore side communications end point. To gain unauthorized control of the CSPP would require that the perpetrator find a way to connect to the uCSPP via a mobile terminated call, or to somehow spoof the Iridium system into believing that it was connecting from the authorized IP address, or that they somehow gain control of the true IP address. The likelihood of any of these scenarios occurring is very small.

4 Notes

There are no additional notes at this time

5 Appendices

There are no appendices at this time.