ROV Doc Ricketts
Telemetry Replacement

1.1 Purpose

The ROV Doc Ricketts as purchased from SMD relies on the QNX 4 operating system and several proprietary control boards. This system has been both reliable and highly user configurable. Due to the age of these components they are no longer available. We are seeking a replacement of these obsolete systems that will extend the life of this ROV system and maintain the user configurable nature of its architecture.

SMD's Comments QNX4 is not officially obsolete but it is becoming increasing difficult. SMD will propose the current PLC / SCADA system as a replacement.

1.2 Obsolete Components

The specific parts that are no longer available and will need to be replaced by SMD include:

- Topside QNX computers
- Control Room Touchscreens
- Thruster Valve Pack Control Board
- Hydraulic and Toolsled valve pack control boards
- Lamp Dimmer Board

The topside computers and touchscreen will be replaced as part of this upgrade. This will be transferred to the new PLC architecture. This still communicated with the cabin and subsea wago.

SMD have developed a like for like replacement for the Thruster control board, SMD will propose to use this board for this proposal.

SMD have developed a new valve tank control board with increased functionality, this also has a backward compatibility mode so this can be used in the existing valve tanks. This will come with the benefits of using the greater resolution and additional functionality at a later date. The initial scope

SMD have developed a new lamp dimming board to replace the old one and remove the obsolescence issues. SMD will include two options for the lamps in this proposal, fist with the new lamp dimmer and existing implementation, second using the RS485 deep sea lights which was requested later in this document.

2.1 Mechanical Changes

It is our understanding that the new SMD systems have switched their thruster valves from servo to proportional valves. We would be amenable to this change to maintain support and some level of similarity to other SMD vehicles, however we are concerned about the scope of this change. Would the upgrade attach to our current hard piping? Could an adapter plate be made for the current backplane? Access to the current hard piping is difficult so minimizing changes to those pieces would be preferred.

SMD have not implemented the proportional valves on any ROV systems at this time, this is still in its development stage. Due the thruster resolution stated later in this requirement SMD would recommend this system stays with the servo implementation with the latest SMD thruster control board.

3.1 Software

The new software system will need to maintain the features of the QNX4 system. We change vehicle configurations often so the ability to change button labels as well as change and save GUI loadouts is essential. The ability to add additional WAGO nodes and IO cards to existing nodes is also necessary. This would include a significant number of additional holding registers for these data. The option to set alarm levels on numerical data items as we do in the current system is also required.

The new control system allows changes on buttons for HCU's, cameras and spare outputs etc. Core functions for example auto head can not be changed.

The PLC system is configured to add additional valve tanks and JB etc. Changes to the core system would be needed to allow the ability of end user and further discussions would be needed between the two parties. SMD have provisionally costed the time in for these changes in the bid.

The ability to set multiple and high and low alarms is standard on the system. We also have the ability to set a launch mark and trend function to show deviations from launch position.

3.2 Auto Functions

These features include auto control systems such as: Auto-Head, Auto-Depth, Auto-Altitude, Joystick lock, and Auto-Hold. We would like these to function as they do in the current system. Joystick scaling and the selective thruster (MBARI-Mode) would also need to be maintained as they currently operate.

All auto functions will be included in the deliverable, it would be beneficial for both parties to have meeting on this to discuss the operation of the auto functions to implement the required solution.

3.2.1 Auto Survey

MBARI science groups have specific vehicle control automation systems that will need to maintain their current interface or have modification agreed upon. Please refer to this excerpt from the original RFQ.

Tiburon currently supports an interface that allows an external controller to receive real-time ROV telemetry. The interface also executes ROV thrust commands sent by the external controller. The ROV telemetry data and thrust commands are sent and received by the Tiburon control system over a serial port. The Tiburon control system sums the received thrust commands with the pilot joystick commands to allow the pilot to assist or disturb the external controller. The Tiburon control system also monitors a digital input, the closure of which disables the external controller interface. An emergency cutoff button is attached to this digital input to allow the pilot to immediately disable external control.

Tiburon II shall support a similar advanced controls interface to allow for the control of the ROV by an external controller. The data in table 11 shall be sent to the advanced controls interface from the Main Control Computer via a serial connection. The data is required to have a latency of no more than 20 ms. The data string shall be sufficiently flexible as to allow for the addition of future data items with minimal configuration changes. The format of the data string as well as the serial port configuration shall be agreed upon by MBARI and SMDH.

The Main Control Computer shall also receive thrust commands as shown in table 12 from the advanced controls interface and sum those commands with the pilot commands in real-time. The format of the command string shall be agreed upon by MBARI and SMD.

Table 11

Data	*type*	*units*
Heading	float	degrees
Pitch	float	degrees
Roll	float	degrees
Depth	float	meters
Altitude	float	meters
AutoHead state	boolean	N/A
Emergency Cutoff state	boolean	N/A
Observation Mode state	boolean	N/A
Bypass Mode state	boolean	N/A
Heading Thrust	float	TBD
Lateral Thrust	float	TBD
Axial Thrust	float	TBD
Vertical Thrust	float	TBD

Table 12

data	*type*	*units*
Heading Thrust	float	TBD
Lateral Thrust	float	TBD
Axial Thrust	float	TBD
Vertical Thurst	float	TBD

SMD do not have an issue with this and can be implemented on the new system.

3.2.2 SMD Auto-Control

In addition to the basic auto hold functions we would also like to maintain Auto-Step, Auto-Nudge, Auto-Home and Auto Track functions from the current software. There are a couple of modifications to these systems we would like to implement as well.

The current system has some redundant sensors. In the current system we can select the Octans or the IFG as our heading sensor. We can also switch between DVL or altimeter for altitude reference. We have added a SPRINT INS to Doc Ricketts. We would like to integrate this sensor into the control system as well. The new software will need the ability to read in the sprint string and then select this sensor for heading and position references.

The Doc Ricketts system often moves in a very slow controlled manner. As such these auto functions would need to be able to maintain lower speeds and thrust levels than the current system as well as function with MBARI Mode thruster configuration engaged. The ability to move at rates of 0.01 m/s to 1 m/s and rotate at speeds of 1 – 72 degrees per second is preferred.

Auto hold, auto nudge and auto step will be included as standard, Auto home and Auto follow will be included but will need further discussion with client.

The new control system is compatible with multiple sensors including all the devices mentioned above. The new control system is capable of hot swapping between devices while in operation.

With respect to the slow operation using the servo valves SMD do not see this as a problem. SMD believe this would be hard to achieve with proportional valves.

3.3 MBARI Nav Processor

We would like to maintain the current interface strings that pass data between the SMD system and MBARI's Nav Processor computer. Please see the below excerpt for the original RFQ:

The MBARI Navigation Processor or NavProc is a computer that interfaces various ship and ROV navigations systems together. NavProc can send and receive data over serial ports or via a proprietary publish/subscribe data distribution system know as Datamanager. Once data has been published to Datamanager any other Datamanager node on the network can subscribe to that piece of data.
The data in Table 13 shall be sent to the NavProc computer from the Main Control Computer via a serial connection. The data is required to have a latency of no more than 100 ms. The data string shall be sufficiently flexible as to allow for the addition of future data items with minimal configuration changes. The format of the data string as well as the serial port configuration shall be agreed upon by MBARI and SMD.
The Main Control Computer shall also receive MBARI system variables as shown in

table 14 to be displayed on the GUI. The format of the data string shall be agreed upon by MBARI and SMD.

Table 13
SMD control system data to be sent to NavProc

data	*type*	*units*
Vehicle in water	boolean	N/A
Heading	float	degrees
Pitch	float	degrees
Roll	float	degrees
Altitude	float	meters
Depth	float	meters

Table 14
NavProc System Data sent to SMD control system

data	*type*	*units*
Umbilical payout	float	meters
Umbilical delta	float	meters
HDTV humidity	float	percentage
HDTV leak detect	boolean	N/A
HDTV zoom position	float	TBD
HDTV focus position	float	TBD
HDTV iris position	float	TBD

The new control system has the hardware available for this functionality. A software driver for this is included in the costing.

Video Overlay

Tiburon II will use the Options VIGRA video overlay to display vehicle information on the pilots video display. The VIGRA overlay system can receive this data via a serial or TCP connection.

The data in table 15 shall be sent to the VIGRA overlay unit from the Main Control Computer via a serial or TCP connection. The data is required to have a latency of no more than 100 ms. The data string shall be sufficiently flexible as to allow for the addition of future data items with minimal configuration changes. The format of the data string as well as the serial port configuration shall be agreed upon by MBARI and SMD.

Table 15
SMD control system data to be sent to VIGRA overlay Unit

data	*type*	*units*
Heading	float	degrees
Hydraulic Pressure	float	PSI
Depth	float	meters
AutoHead state	boolean	N/A
Altitude	float	meters
Divenumber	integer	N/A
Date string	date	string

The new control system has the hardware available for this functionality. A software driver for this is included in the costing.

Integrated Viewing System

Tiburon currently uses an integrated viewing system or IView to control the camera and light pan and tilts. This system allows the control of the cameras to be shared between the pilots and scientists. The IView system also supports special viewing modes that have proven useful in different observation scenarios.

Though the pan and tilts will be controlled via the IView controller it is necessary to have the pan and tilt positions displayed both graphically and numerically on the pilot GUI for diagnostic purposes. In order to display the pan and tilt positions on the pilot GUI the Main Control Computer shall receive pan and tilt data as shown in table 16 via a serial string. The format of the serial string shall be agreed upon by MBARI and SMD. The data shall be displayed on the pilot GUI both graphically and numerically in a similar fashion as shown in figure to the right. The layout of the pan and tilt portion of the GUI shall be agreed upon by MBARI and SMD.

Table 16
IView pan and tilt data sent to SMD control system

data	*type*	*units*
Port light pan	float	degrees
Port light tilt	float	degrees
Starboard light pan	float	degrees
Starboard light tilt	float	degrees
Port camera pan	float	degrees
Port camera tilt	float	degrees
Starboard camera pan	float	degrees
Starboard camera tilt	float	degrees

The new control system has the hardware available for this functionality. A software driver for this is included in the costing.

3.4 Lamp Dimming

Rather than replace the existing 6 channel lamp dimming board, we would like SMD to integrate the Deep Sea Power and Light “SeaSence RS-485 protocol” for light dimming. We will be running (12) LSL-1000 lights on the current 110 VAC lighting circuits, this includes the main lights as well as the previously dimmed circuits. MBARI will implement the wiring changes, which have been implemented and partially completed already. SMD shall be responsible for creating a page on the new touch screen system to select a light, a dimming setting, and create and send the correct string via shared RS-485 to the light.

The hardware is available for this, the software development is included in the costing. SMD would need a lamp to prove the protocol.

4.0 Summary

As this request is an update to the current system, the current QNX 4 system should be used as a template except for the specific exceptions noted above. Should the new architecture require other changes or a loss of features these shall be agreed upon in advance by SMD and MBARI.

Comment noted and agreed.