Wave Glider™ Management System

Payload Development Kit Quick Start Guide

Version 1.4

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REVISION HISTORY

Rev	Changes	Author(s)
1.0	Initial Release	RO
1.1	Minor Edits	GH
1.2	Minor Edits	RO
1.3	Edited component descriptions and some procedural steps. No structural changes	GH
1.4	Added Xbee Configuration Info, default configuration info	CW

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Figures and Tables

1. Introduction

The Liquid Robotics Inc. (LRI) Wave Glider™ is a platform for long-duration deployment of ocean surface sensor systems. The Wave Glider Management System (WGMS) provides browser and programmatic interfaces to allow users and applications to send commands to the Wave Glider™, including its payloads, and to receive data from the Wave Glider™ and its payloads. WGMS is easily configured to support a variety of deployment scenarios.

The Liquid Robotics Wave Glider Payload Development Kit (PDK) facilitates mechanical, electrical and software integration of one or more sensors with the Wave Glider platform. For the purposes of payload integration, the components supplied with a Wave Glider PDK are functionally the same as those from a production Wave Glider. However, the PDK is not tested nor intended for field operations and the components are not interchangeable with production components. Unless specifically stated, information in other manuals, such as the User Manual and the Wave Glider API, also applies to the Payload Development Kit.

This document, the Payload Development Kit Quick Start Guide, takes you from opening the shipment to being able to send simple commands to the PDK via WGMS. In most cases you are referred to the relevant LRI document for detailed instructions.

1.1 Wave Glider Documents

There are three primary documents for the Wave Glider:

- **User Manual** – The User Manual, LRI part number 030-00025, focuses on operational issues, such as provisioning, launch, retrieval and mission planning.
- **Interface Control Description** – The ICD, LRI part number 030-00026, describes in detail the mechanical, electrical, electronic and software configuration of the Wave Glider components. The ICD is a primary source document for payload developers.
- **System Administration Manual** – The System Administration Manual, LRI part number 030-00481, is intended for users who need to administer the LRI Wave Glider Management System (WGMS). It is common, but not required, for payload developers to communicate with a PDK via an “XBee Relay”. A quick configuration guide is included in Chapter 3 below, and a detailed installation and configuration guide can be found in the System Administration Manual.

1.2 The Wave Glider™

The Wave Glider™ is composed of two main parts, connected by a flexible umbilical. The figure below shows the Wave Glider™ on the surface and calls out the basic components.

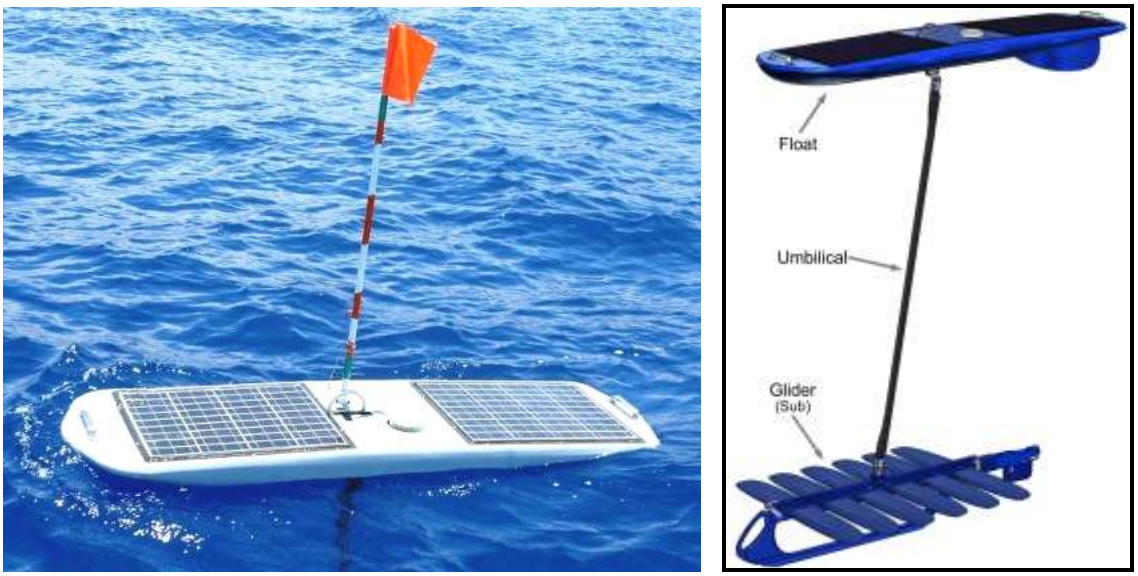

Figure 1-1: Wave Glider™

The float rides on the surface of the water. The middle section of the float contains a command and control (C&C) dry box. That dry box contains the central command and control processor, batteries, power control and antennas for Iridium satellite and XBee communications. In general the C&C dry box contains no customer modifiable components.

The glider provides propulsion by harnessing power from wave action. Steering is provided by an electronically controlled rudder on the glider. The glider is connected to the float via a flexible, high-strength umbilical.

Power and communications interfaces are provided to the fore and aft payload boxes (underneath the solar panels) and to the glider. Additional interfaces are provided through connectors on the top of the C&C dry box.

The payload flexibility, long mission capability and the fact that data and commands may be exchanged with shore-based applications in near real-time makes the Wave Glider™ suitable for a wide variety of missions.

The components of a Payload Development Kit provide exact models of the interfaces between Wave Glider and payload. Mechanical mounting positions, electrical connections, and software protocols are all identical to a production Wave Glider. Indeed, most of the components are identical to production components apart from their ocean-readiness. The only substantial component distinctions are lack of a sub body, only the rudder module is supplied with a stand, and the lack of a molded umbilical, instead an electrically-identical cable is provided.

1.3 Wave Glider™ Instrumentation and Communications

The figure below shows the general configuration of the payload and communications on the Wave Glider™. Payload developers wishing to take advantage of the communications facilities offered by the Command and Control should understand this architecture.

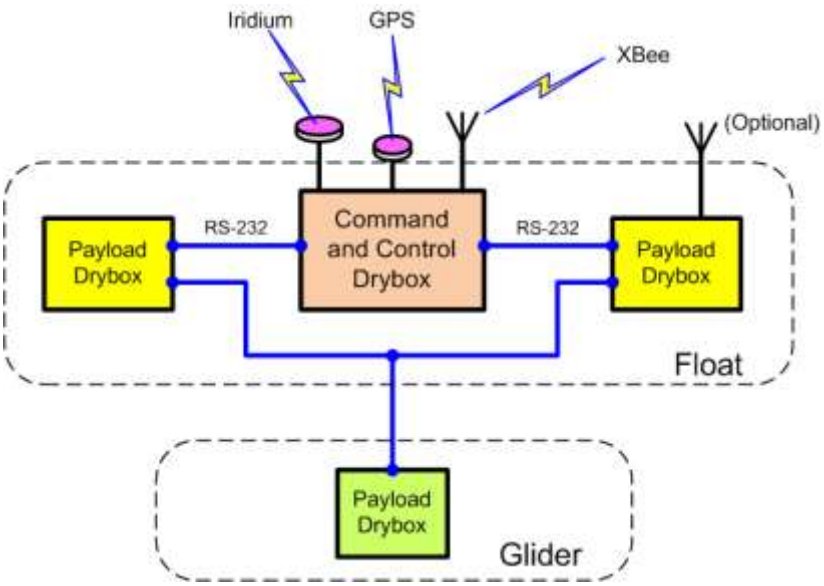

Figure 1-2: Communications Architecture

Note the following in the figure:

- The Command and Control Computer communicates directly with the external world via either Iridium Communications, Inc. satellite Short Burst Data (SBD) or via XBee (IEEE 802.15.4).
- The Command and Control Computer can communicate indirectly through payload-based communications equipment.
- The Command and Control (C&C) Computer communicates with the payloads via RS232 links.

1.4 Payload Development Kit Components

The Payload Development Kit is delivered in one container. It includes:

- Float hull with associated tail fin, handles, turtle deck, mast plate, foam and test stand
- Standard aft payload box, including a payload Interface Board (PIB) with one PCOMM (power and communications) Personality Board (pre-installed in the float) and one spare PIB with PCOMM board set.
- Two solar panels
- Wall power supply to power the system in place of the solar panels
- PDK-specific umbilical
- Rudder module with bench stand
- Serial (USB) XBee Pro transceiver, intended for use with a nearby computer
- User's Manual, Interface Control Document (ICD) Manual, and this Quick Start Guide (provided electronically)

2. Basic WGMS Configuration

2.1 Background Information

Wave Gliders are commanded through a browser-based user interface. The Wave Glider Management System software manages the associated database and supervises the messaging flow between the browser UI and the Wave Glider. Doing end-to-end testing of your Wave Glider PDK requires

- that the PDK be registered with the copy of WGMS you will be using,
- that there be communications connectivity between the PDK and that copy of WGMS,
- that the tester be authorized to control the PDK through that copy of WGMS.

The System Administration Manual provides detailed descriptions of the various scenarios and associated configuration steps. In particular, it describes the payload development scenario in depth. We recommend that prior to using your Wave Glider PDK you should confirm arrangements with the system administrator for the copy of WGMS that you expect to use. At a minimum, the tester needs to have the permissions associated with the WGMS Master role, which allows him to configure a Wave Glider in that copy of WGMS.

At a high level, the sequence of steps performed is:

- If necessary, perform the basic configuration of the WGMS instance that will host the PDK Wave Glider.
- Move the shipping container to a location adjacent to the developer's work table. The table must be at least two meters or six feet in length – 2.5 meters or eight feet is preferable. The table must be able to support at least 60kg (130lbs).
- Open the container and inspect the system for shipping damage.
- Put the float test stand on the work table.
- Put the float on the float test stand.
- Put the rudder test stand on the work table.
- Assemble the PDK umbilical to the rudder module.
- Assemble the rudder module to the rudder test stand.
- Attach the PDK umbilical to the float.
- Insert the shorting plug to provide power to the float and initiate startup.
- Install and configure the XBee Relay.
- Configure the PDK Wave Glider in WGMS.
- Confirm that the rudder can be commanded from WGMS. This confirms the basic electrical and mechanical operation of the PDK.

2.2 Description of Work

To configure WGMS:

1. Open the container and inspect the system for shipping damage. As shipped, the opened container should be similar to that in the image below. In that image the C&C Dry Box cover has been removed for illustration purposes, whereas it will be installed in a normal shipment. In addition, the container will

contain manuals and other materials not shown in the image. The Wave Glider has two C&C Dry Box configurations; the image shown is of a Model 08 Dry Box 2, PDK's typically ship with Dry Box 3.

Figure 2-1: Wave Glider in Shipping Container

2. Put the float test stand on the work table. The float test stand is stored in one of the small compartments in the shipping container. In the figure above it is in the bottom left corner of the picture.

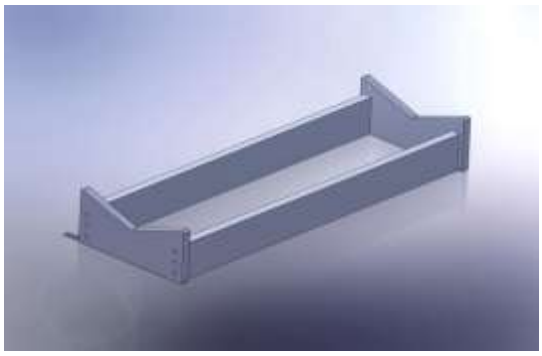

Figure 2-2: Float Test Stand

3. Using the handles on the bow and stern of the float, lift the float out of the container and position it on the float test stand. Note that the weight of the float in a PDK is approximately 45 kilograms (100 pounds). Positioned on a test stand, the float will look approximately like the figure below.

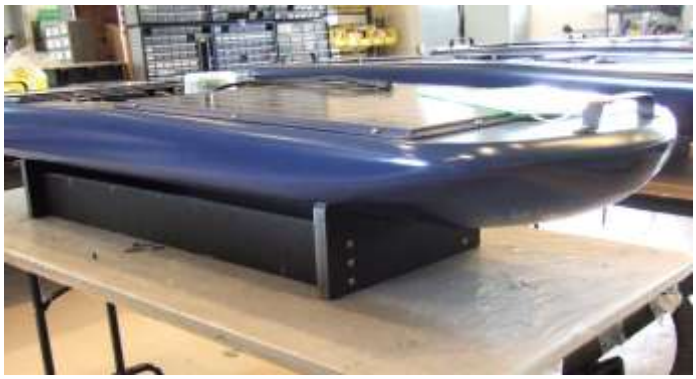

Figure 2-3: Float on Test Stand

4. Assemble the rudder system.

- Remove the rudder test stand from the packing container and place it on a table near the float.
- Remove the umbilical from the packing container and feed the female end through the hole in the rudder test stand.
- Remove the rudder module from the packing container and attach the female end of the umbilical to the rudder module.
- Remove the C&C Dry Box cover from the float, exposing the connectors on the top of the C&C Dry Box.
- Attach the male end of the umbilical to the connector on the C&C Dry Box labeled “tether”. At this point, you have completed the physical assembly of the PDK with the exception of power connections.

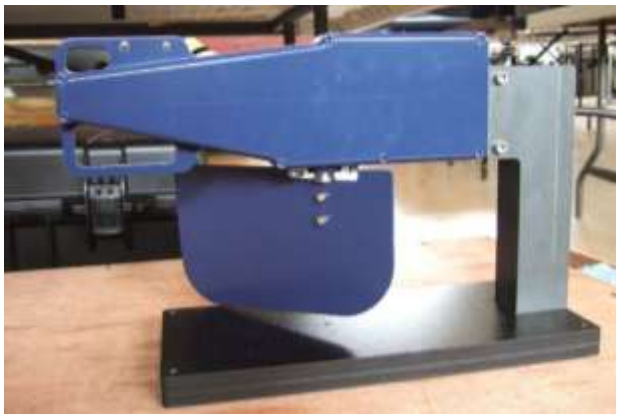

Figure 2-4: Assembled rudder module on test stand

5. Provide power to the float. The Wave Glider PDK is shipped with the batteries charged, so initial testing can be completed without attaching the Wave Glider PDK to a power source. To energize the system, push the shorting plug into the seated position, as shown in the figure. The LED in the lid should turn on and the rudder should actuate within 30 seconds. The LED will transition from red to green when it has completed its self test and verified that there are no errors. It can take several minutes as the Wave Glider attempts to verify Iridium modem functions, and indoors a red LED should not be a concern.

Figure 2-5: Inserting the on switch

6. Install and configure the XBee Relay. The Wave Glider can communicate via both Iridium and XBee (IEEE 802.15.4). For most development activities it will be more convenient to use XBee, which is higher bandwidth and less expensive than Iridium. A quick configuration guide is included in Chapter 3 below, and a detailed installation and configuration guide can be found in the System Administration Manual.

7. Provision the Wave Glider PDK in WGMS. Provisioning is the process of configuring a Wave Glider and an instance of WGMS to talk to each other. Provisioning a Wave Glider PDK is identical to the process of provisioning a regular Wave Glider. The provisioning process is described in detail in the User Manual.
8. Confirm that the rudder can be commanded from WGMS. The final step is to confirm that you have end-to-end control of the Wave Glider PDK elements. This is accomplished by using the WGMS browser UI to send rudder commands to the Wave Glider PDK. Successfully moving the rudder provides visual confirmation that all electrical, communications and WGMS elements are operational.
    - Log in to WGMS and select the Wave Glider PDK provisioned in the previous step.
    - Click on the “More Commands…” link on the dashboard page. This brings up a dialog window.
    - In the dialog window, confirm that the Vehicle is the one you provisioned.
    - Enter a command reason, such as Test. As the command type, choose Rudder Center. As the Com Channel choose XBee Relay. If that option is not available on the command, you either have a WGMS configuration error, a hardware problem or the transceiver is out of range.
    - Click Send.
    - Watch the rudder. If it moves you have completed the initial setup of your Wave Glider PDK. If you are using Iridium, the command might take several minutes to execute, depending on the configurable telemetry rate.

This completes the WGMS configuration.

3. Xbee Relay Configuration

3.1 Background Information

The Xbee relay should already be configured to work correctly with your system. The information in this section is provided to assist you if you are experiencing problems with the relay.
The figure below shows the Xbee Relay window.

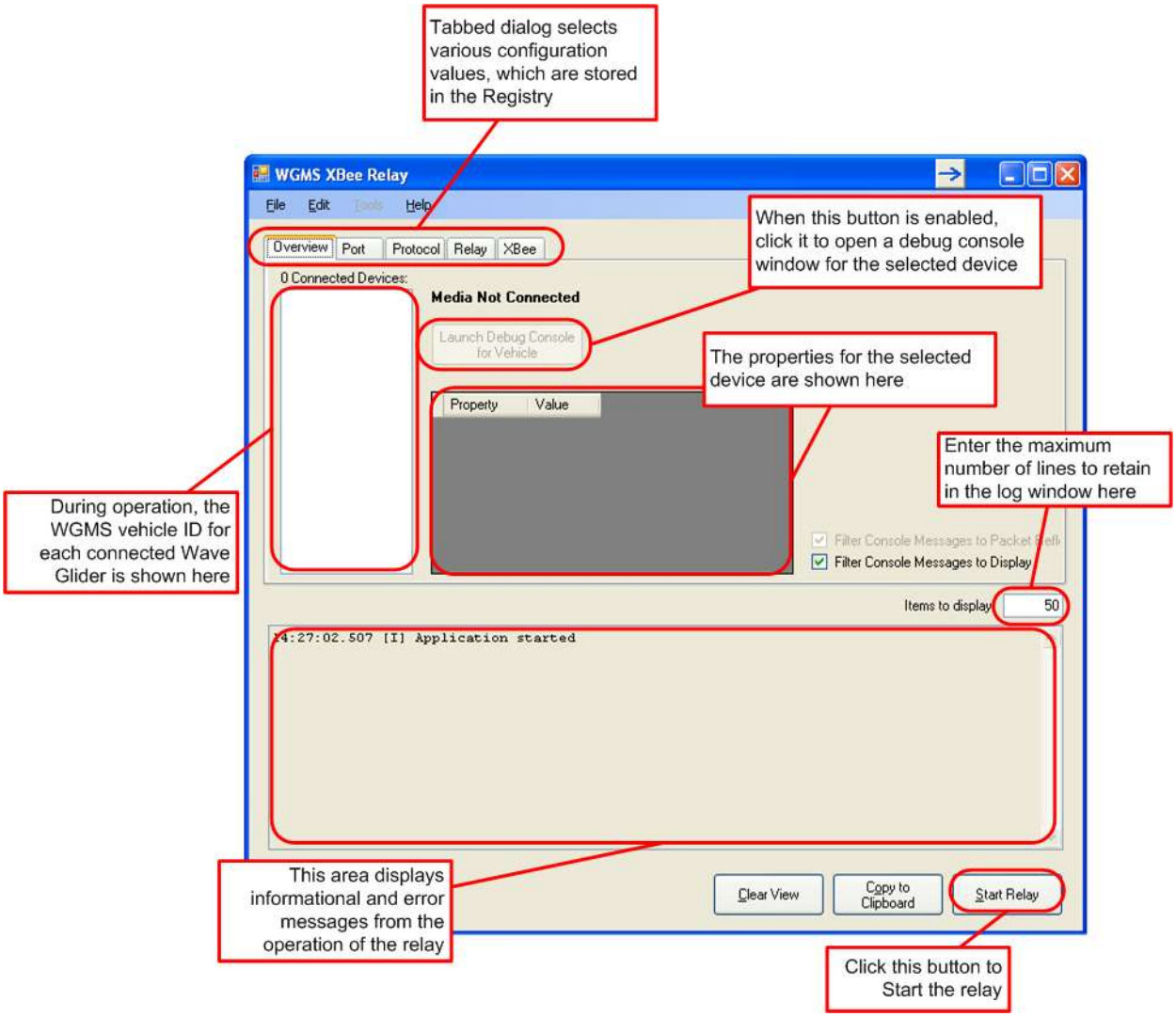

Figure 3-1: XBee Startup Screen

3.2 Description of Work

To configure the relay:

1. Start the relay either from the Start Menu, the desktop shortcut, or an icon in the system tray.
2. Ensure that the XBee modem (Digi XBee USB Adapter S1 Pro) has been connected.
   If the modem is not connected, the message “Media Not Connected” will be displayed in the Overview page of the Xbee Relay window.

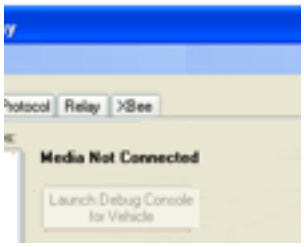

Figure 3-2 Media Not Connected Message

If this is the case, use Device Manager to check which serial port the Xbee Relay is connected to. Then restart the Xbee application and click the Port tab. Select the correct port from the pull-down menu in the Port window. The application should now discover the relay and the message “Media Connected” will display in the main window. You can now configure the relay.

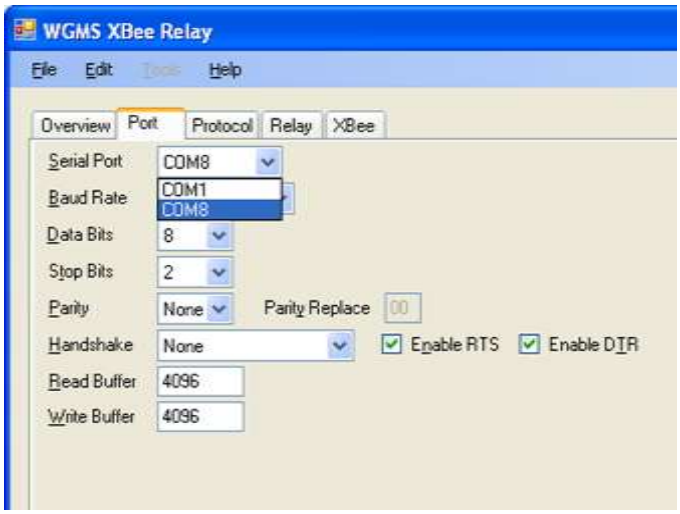

Figure 3-3: Selecting the Serial Port for the XBee Relay

Note: If necessary, you can use Digi diagnostics software X-CTU to detect and configure the modem (available from Digi at http://www.digi.com)

3. Click the Port tab and verify the following settings (for PDK systems):
   - Correct serial Port is selected
   - Baud Rate is set to 111111
   - Data Bits is set to 8
   - Stop Bits is set to 2
   - Parity is set to None.
4. Click the Apply button to save any changes.

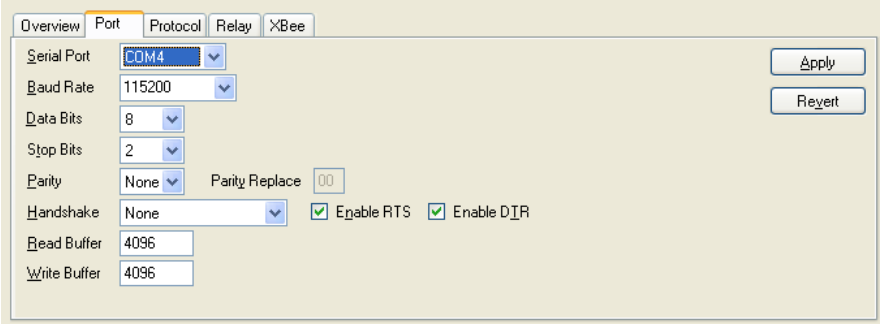

Figure 3-4: Port Settings

5. Click the Apply button to save any changes.
6. Click the XBee tab and verify that the PAN ID is correct (The appropriate PAN ID should be included in your documentation and is vehicle specific). PDK systems are typically set up on a fixed channel, so the Scan for Clear Channel box will be unchecked. Checking that box will have the application automatically scan and then select the channel that has the best tested results.

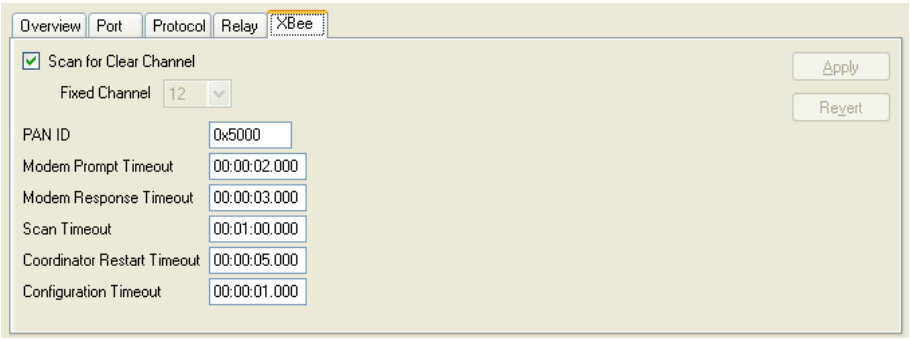

Figure 3-5: Xbee Settings

7. Click the Apply button to save any changes.
8. Click the Relay tab to enter the correct address and port for the Packet Reflector and for the Relay. Since this is a PDK, the packet reflector address and the relay address are both 127.0.0.1. The Packet Reflector's port on a PDK is 5665, and the Relay's port is 5667.

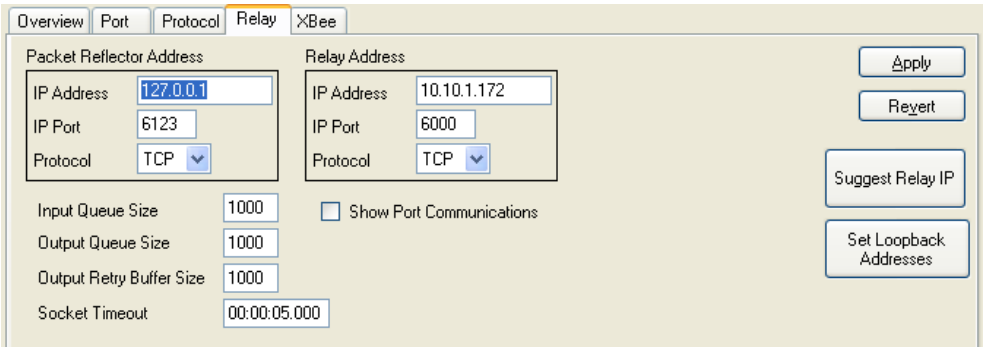

Figure 3-6: Relay Settings

9. Click the Apply button to save any changes.
10. When the changes have been saved, click the Start Relay button. Some configuration values are grayed out during execution. The log display shows events as they occur, along with a time stamp. When

communication is established with the modem, the bold indicator field changes to **Media Connected** and the log shows **XBee modem communication established**.

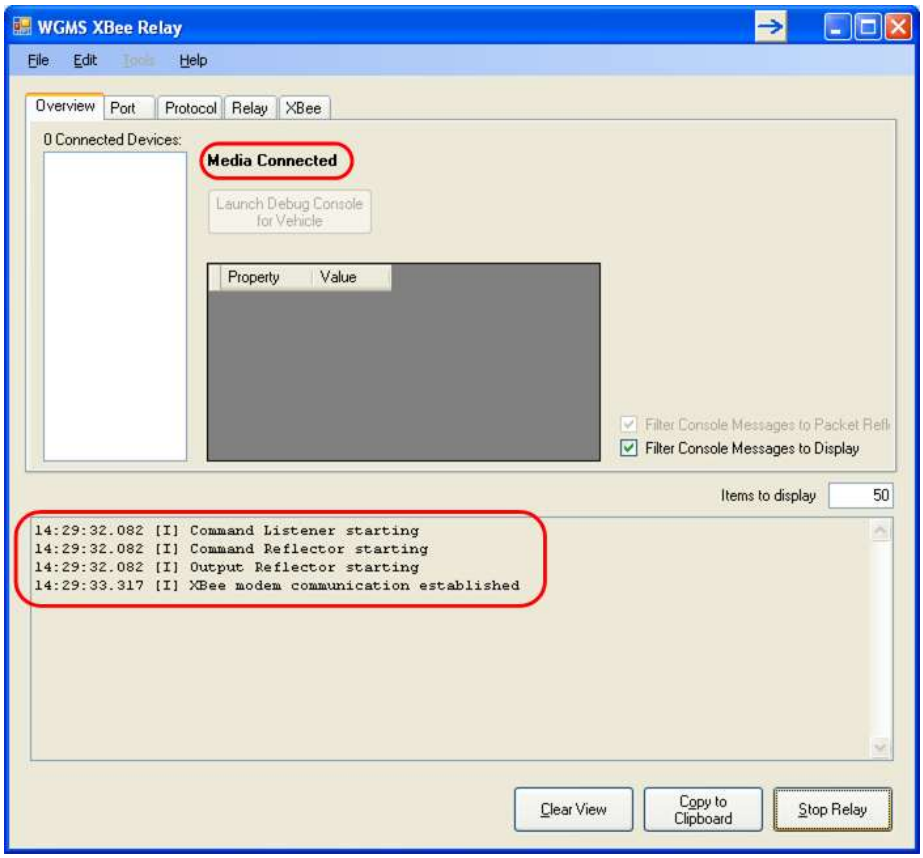

Figure 3-7: Xbee Overview

Any Wave Gliders with active XBee modems and that are in range connect automatically; details of the selected device are shown in the adjacent control (next figure).

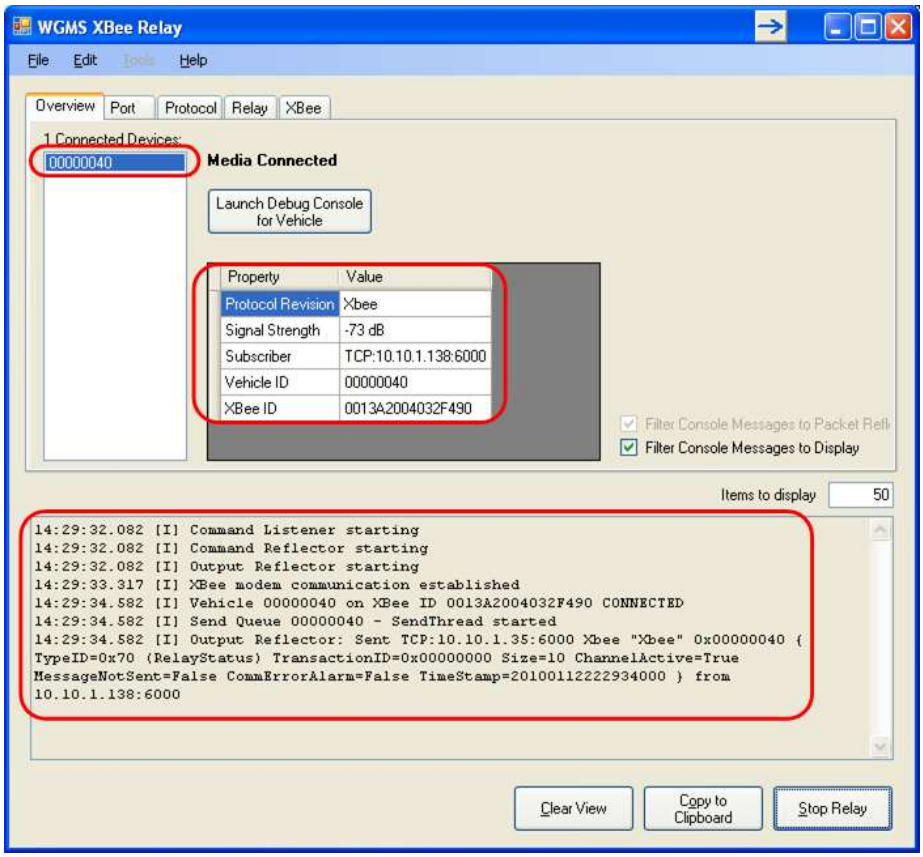

Figure 3-8: XBee Connected

The “Output Reflector: Sent” notification indicates transmission to the Packet Reflector. If the notification is “Added” instead of “Sent”, the relay is not able to successfully send to the Packet Reflector. A Set Default Comm Channel command then needs to be executed in order to get Telemetry packets over Xbee. This command can be sent in WGMS.

This completes the configuration of the Xbee relay.

4. Contacting Liquid Robotics

If you cannot determine or correct the cause of a problem, contact LRI.

To expedite resolving the problem, make a brief list beforehand with the following information.

- Time/date when problem occurred.
- Location of Vehicle when problem occurred.
- Initial indication of problem.
- Any other indications or unusual readings.
- Attempts at corrective actions and their results.

For time-critical problems, call LRI at:
(888) 574-4574 (toll free in the US)
or
+1 (650) 240-4603

For non-critical problems, please send the above information via email to:
support@liquidr.com

A. APPENDIX A – DEFAULT WGMS SETTINGS

A.1. Packet Reflector Settings

IP	Port	Protocol	Channel
Output Sinks			
127.0.0.1	10015	TCP	Packet Reflector/Comm Server
Output Sources			
directip.sbd.iridium.com	10010	TCP	Iridium
127.0.0.1	5665	TCP	XBee Relay
Command Sinks			
directip.sbd.iridium.com	10800	TCP	Iridium
127.0.0.1	5667	TCP	XBee Relay
Command Sources			
127.0.0.1	10020	TCP	Packet Reflector/Comm Server

A.2. Comm Server Settings

Field	Value
Server URL	http://localhost/webservices/EntityAPI.asmx
Email	webadmin@liquidr.com
Password	PDKlog!n
Org Internal Name	liquidr
Reflector	localhost

A.3. Computer Accounts

Username	Password
WGMS Accounts	
webadmin@liquidr.com	PDKlog!n
login@liquidr.com	Pass0124
Computer Accounts	
PDK	PDKlog!n

A.4. XBee Relay Settings

Field	Value
Port	
Serial Port	<user defined>
Baud Rate	111111
Data Bits	8
Stop Bits	2
Parity	None
Handshake	None
Enable RTS	True
Enable DTS	True
Read Buffer	4096
Write Buffer	4096
Protocol	
Message Ack Timeout	00:00:05.000
Message Receive Timeout	00:00:00.100
Remote Connection Timeout	00:01:30.000
Message Send Retries	3
Max Message Size	400
Relay	
Packet Reflector IP	127.0.0.1
Packet Reflector Port	5665
Packet Reflector Protocol	TCP
Relay IP	127.0.0.1
Relay Port	5667
Relay Protocol	TCP
Input Queue Size	1000
Output Queue Size	1000
Output Retry Buffer Size	1000
Socket Timeout	00:00:05.000
Show Port Communications	False
XBee	
Scan For Clear Channel	False
Fixed Channel	<user defined>
PAN ID	<user defined>
Modem Prompt Timeout	00:00:02.000
Modem Response Timeout	00:00:03.000
Scan Timeout	00:01:00.000
Coordinator Restart Timeout	00:00:05.000
Configuration Timeout	00:00:01.000