White Rabbit Switch Management Framework
Collaboration proposal from University of Granada

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1. Introduction

It makes sense to bet for new configuration tools for White Rabbit switches (WRS) since not only technicians are buying/dealing with them and, nowadays, their management is not that easy. In addition to this, there isn't any remote management framework due to the Integrasys CLI tool has become abandon-ware since last WRS software v2.0.

The first part of our work starts with a little bit of research related to the state-of-the-art of actual open source network management tools considering that we do not pretend to reinvent the wheel, the ideal scenario comes from an integration effort of WRS management features in an already working network management tool-suite.

After Googling for a while, some open source solutions appear on the Internet, The Cisco-centric Open Source Community (COSI), FreeNAC, Floodlight Project, Zynx OpenArchitect, Open vSwitch, NETDISCO, Zynx Open Source Monitoring and Systems Management, and an big amount of purchasable solutions that are not worth to mention. However, some of these open source tools are not maintained anymore, or quite big for our scope, etc. The following table describes the summary of the main features and the advantages and disadvantages of using them:

<table>
<thead>
<tr>
<th>Application Framework</th>
<th>Main Features</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>OpenSource? Freeware? Notes?</th>
</tr>
</thead>
<tbody>
<tr>
<td>COSI</td>
<td>• ARP manager • SNMP manager • Command tool • Configuration files Manager • SSH/Telnet • PPP tools • It's a very complete tool-set for CISCO systems. • Local &amp; remote</td>
<td>• Totally oriented to CISCO systems • Maybe too much?</td>
<td>Open Source</td>
<td></td>
</tr>
<tr>
<td>FreeNAC</td>
<td>• Includes OpenVMPS for switches • Database management • VLAN management • SNMP scanning for larger networks • Only remote.</td>
<td></td>
<td>Development stopped in 2010. The status of the project is unknown (link down at the moment of writing (<a href="http://www">www</a>. <a href="http://freenac.net/">http://freenac.net/</a>))</td>
<td>Open Source</td>
</tr>
<tr>
<td>OpenVMPS</td>
<td>• Assignment of switch ports to specific VLANs based on MAC address of connecting device</td>
<td>• Insufficient (only for VLANS) • This can be done by using WRS tools easily.</td>
<td></td>
<td>Open Source</td>
</tr>
<tr>
<td>Tool</td>
<td>Features</td>
<td>Notes</td>
<td>Status</td>
<td></td>
</tr>
<tr>
<td>----------------------</td>
<td>--------------------------------------------------------------------------</td>
<td>--------------------------------------------</td>
<td>----------</td>
<td></td>
</tr>
<tr>
<td><strong>Floodlight</strong></td>
<td>Works with both virtual and real switches</td>
<td>Perhaps too much complex for our purposes.</td>
<td>Open Source</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Control layer for network systems</td>
<td>It's a layer above our target system</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Focuses on data distribution and control</td>
<td>It controls everything, but we should</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>It abstracts from Ethernet TCP/IP protocols.</td>
<td>develop another WRS interface for the</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Runs on top of FreeBSD</td>
<td>communication.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Zynx OpenArchitect</strong></td>
<td>Routing, control and management of embedded Ethernet switches</td>
<td>It's not open source</td>
<td>$$$$$$$</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>It's not open source</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Only remote</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Open vSwitch</strong></td>
<td>Protocols: NetFlow, sFlow, SPAN, RSPAN, CLI, LACP, 802.1ag</td>
<td>It's for virtual switches.</td>
<td>Open Source</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Developed for virtual switches or Cisco's Nexus 1000V</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>NETDISCO</strong></td>
<td>Discovering tool</td>
<td>It's just a monitoring tool.</td>
<td>Open Source</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Endpoints discovery</td>
<td>Could it be a point of departure of a</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Network topology</td>
<td>remote app?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Monitoring network tool</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>It uses SNMP and ARP protocols to discover devices (MAC)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Postgres BD per switch</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>OpenWRT</strong></td>
<td>Complete local management tool for routers</td>
<td>Quite heavy for WRS</td>
<td>Open Source</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Network tools</td>
<td>Developed for routers and not for switches</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Customization</td>
<td>Only local to switch</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Zenoss OSMMS</strong></td>
<td>Web server (python)</td>
<td>Only remote</td>
<td>Open Source</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HTTP, POP3, NNTP, SNMP, FTP</td>
<td>Mainly for monitoring</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>RRDtool for data monitoring</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MySQL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Events capture</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Multiplatform</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 1 - Actual tools for network management.**

Note extra information color-coded (red ➔ bad, orange ➔ bearable, green ➔ good).
After analyzing the previous tools, we present two solutions to perform an easy and functional management framework for WRS V3.3 and V3.4. It consists of two applications: a local HTML setup environment and a remote Java-Desktop application.

This document presents the technology, implementation ideas and mockups for the two possible solutions. It goes without saying, that any suggestion is welcome and of course, any help ;-) 

2. Management Framework

The proposal for the management framework consists in two applications. The first one is a web setup tool allocated in WRS itself and accessible from the HTTP:80 port that is born to configure and monitor the WRS locally. The second one is a Java application (multiplatform) that provides remote control, management and monitoring of WR networks.

Next sections describes each tool.

2.1. Switch Setup Web Tool

The White Rabbit Switch Web Interface (WRSWI) is an HTML-based application inside the WRS that runs on the ARM processor of the RSB board over a web server: apache or lighthttpd. This two webservers are included in the BuildRoot project, it must just be added during the make --config procedure and then flashed to the WRS.

Despite the adaptation of CLI to new WRS versions could be very useful, since WRSWI is already on the WRS it is possible to run directly the native WRS scripts and commands from /wr/bin, such as:

- com
- mapper
- rtu_stat
- wmapper
- wrsw_hal
- load-lm32
- ping
- shw_ver
- wr_mon
- wrsw_pstats
- load-virtex
- ptpd
- spll_dbg_proxy
- wr_phytool
- wrsw_rtud

2.1.1. Main features & Mockups:

The layout is composed by three sublayouts: header, menu and main-display layout:

- **Header**: The main important element displays a WRS-like image that displays in every moment the status of each end-point. An icon displays whether an endpoint is master or slave and if it is transmitting/receiving information.
- **Menu**: Displays the menu elements. Dashboard, Monitoring, Configuration and WRS tools.
- **Main**: main screen... no more words needed.

The mockups are as it follows:
### Description

#### Dashboard

Displays:
- Switch DHCP info
- Status (status LED, temperature, bandwidth and packet errors)
- PTP status
- Clock locking

#### Configuration

Displays:
- Adding a name to this switch
- VLAN actual configuration
- PTP & DHCP status
- Endpoints status (wr_mon)
Endpoint manager
Endpoints tool linked to **wrsw_r tud** tool

Flashing tool
If flashes the firmware with a local binary or check or a remote internet address for updates. It also displays the running version number.

LM32 & FPGA binary load
It runs binaries on LM32 and on the FPGA.

Console
2.1.2. DISCUSSION

OpenWRT (https://openwrt.org/) is an Open Source framework to build an application without having to build a complete firmware around it that means the ability for full customization.

We have considered it as a possible solution to implement the website management tool for the WRS. The problem is that it is actually oriented to Router management and it seems to be a little bit heavy for running on the ARM in conjunction to the WRS ARM system.

![Figure 1 - OpenWRT LuCI web interface for DHCP & DNS configuration](image)

However, we are integrating and testing it on the WRS in order to clarify whether it is a cool reusable and useful thing or not. Maybe we'd rather used it, or maybe just do the HTML development from the crash.
Once again, if you have something to say, it's welcome!

2.2. Remote White Rabbit Network Application

The remote application appears from the managing/monitoring necessities of large WR networks. The idea is to build the application in Java due to its portable capabilities and the development frameworks available for networking.

Main concepts:

- The application can do a discovery procedure in which it finds all WRSs that are connected to its LAN.
- In addition, WAN WRSs can be added manually. From that moment, the administrator is able to manage, configure and monitor each WRS itself and the status of the whole network.
- The connection between the application and each WRS follows the P2P protocol with a White Rabbit Remote Manager (WRRM) daemon which is in charge of executing external commands received from its Ethernet socket.
- The WRRM could perform the actions by using CLI (when finished) or not. This is something to discuss.
The framework would include several Open Source network tools, such as *ping*, *traceroute*, *nslookup*, *whois*, *dig*, *TFTP*, *WireShark*, *EtherApe*, etc. (there is no need to implement those ones). The application could use them whenever it is necessary.

![Diagram of Remote Management with WRRM Daemon](image)

Figure 3 - Remote Management with WRRM Daemon

As said for the local application, this is just a concept, any idea and suggestion is very welcome and helpful!! The main thing is... shall we integrate it using open source applications? any? Shall we do everything from the crash too?

The mockups are as it follows:

<table>
<thead>
<tr>
<th>Description</th>
<th>Mockup</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switch Management</td>
<td></td>
</tr>
<tr>
<td>Features:</td>
<td></td>
</tr>
<tr>
<td>- WRS Discovery over the LAN (opens a list of LAN WRS)</td>
<td></td>
</tr>
<tr>
<td>- WRS info display</td>
<td></td>
</tr>
<tr>
<td>- Switch DHCP info</td>
<td></td>
</tr>
<tr>
<td>- Status (fan, bandwidth and packet errors)</td>
<td></td>
</tr>
<tr>
<td>- Endpoint utilization &amp; status</td>
<td></td>
</tr>
</tbody>
</table>
Right Click

When right click on a WRS, it displays a network toolset (ping, traceroute, etc).

Flashing from local machine.

After WRS selected, you can flash firmware with a local file.

Flashing using a TFTP server.

Same as before but using a TFTP server to do so.

Network Topology

- Describes the network topology graphically.
- When clicking on one of those, it shows the Switch manager for that one.

Table 3 - Remote White Rabbit Network Manager Mockups
3. Final Remarks

This document presents a management tools proposal for the White-Rabbit switch. The role that UGR proposes to play is to develop the high level (local and remote) management software applications at first stage, by integrating low level tools developed by different partners. This could help newcomers without enough experience on low level programming tools to enroll the White-Rabbit initiative, but not only newcomers could take profit of it since these tools would simplify configuration and management tasks in White Rabbit networks for everyone involved in White-Rabbit. In addition to this, these tools would provide White-Rabbit with a more professional shape to the wider world.

We will try to minimize the workload for WR developers but a minimum of coordination overhead might be required (taking special care of your software interfaces). A development plan (in case you agree with this proposal) should also be considered.

A good point of departure for this work would start with:

- Deciding whether we should use open source tools and adapt them to WRSs or develop everything from the crash.
- If Integrasys-CLI is finally being adapted to new WRS firmware versions, we could define a software interface between CLI and the external applications.
- The utilization of a WRS daemon for the remote solution dealing with incoming management requests.
- Is it worth to develop a complex framework by including other open source tools? In case, which ones could be useful? (monitoring, discovery, etc.)

We appreciate your feedback on this proposal and we would be really pleased if you can confirm this is on the right path to keep on working!
Appendix

Local Application Mockups

White Rabbit Switch Web Interface

This figure displays whether an endpoint is connected and its mode.
White Rabbit Switch Web Interface

Dashboard
Monitor
Configuration
Tools
  → LM32 & FPGA
  → Endpoint tools
→ Flashing
→ Console

Flashing

Local Flashing

Firmware
Load file... Browse

Remote Flashing

Firmware
http://www.ohwr.org/projects/

Firmware Version
WRS firmware version 3.3
Updated on: 25/03/2013

White Rabbit Project - Open Hardware and Source Project

http://www.ohwr.org/projects/white-rabbit
White Rabbit Switch Web Interface

Endpoint Tools

<table>
<thead>
<tr>
<th>Endpoint #</th>
<th>Command</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endpoint wr0</td>
<td>PPS Adjustment</td>
<td></td>
</tr>
</tbody>
</table>

Console

TX timestamp: correct 0 -4685224568728584192: 0
RX timestamp: correct 1074685572 395995984726714: 0
TX timestamp: correct 0 -4685224568728584192: 0
RX timestamp: correct 1074685572 395995984726714: 0
TX timestamp: correct 0 -4685224568728584192: 0
RX timestamp: correct 1074685572 395995984726714: 0
TX timestamp: correct 0 -4685224568728584192: 0
RX timestamp: correct 1074685572 395995984726714: 0
TX timestamp: correct 0 -4685224568728584192: 0
RX timestamp: correct 1074685572 395995984726714: 0

White Rabbit Project - Open Hardware and Source Project [http://www.ohwr.org/projects/white-rabbit](http://www.ohwr.org/projects/white-rabbit)
White Rabbit Switch Web Interface

Dashboard
Monitor
Configuration
Tools
--> LM32 & FPGA
--> Endpoint tools
--> Flashing
--> Console

Console

wrs-192.168.1.53#wr_phytool wr0 rt show
RTS State Dump [18 physical ports];
CurrentRef: 0 Mode: 2 Flags: 3
wr0: setpoint: 0 ps current: 0 ps loopback: 0 ps flags: 0
wr1: setpoint: 0 ps current: 0 ps loopback: 0 ps flags: 0
wr2: setpoint: 0 ps current: 0 ps loopback: 0 ps flags: 0
wr3: setpoint: 0 ps current: 0 ps loopback: 0 ps flags: 0
wr4: setpoint: 0 ps current: 0 ps loopback: 0 ps flags: 0
wr5: setpoint: 0 ps current: 0 ps loopback: 0 ps flags: 0
wr6: setpoint: 0 ps current: 0 ps loopback: 0 ps flags: 0
wr7: setpoint: 0 ps current: 0 ps loopback: 0 ps flags: 0
wr8: setpoint: 0 ps current: 0 ps loopback: 0 ps flags: 0
wr9: setpoint: 0 ps current: 0 ps loopback: 967B ps flags: 48
wr10: setpoint: 0 ps current: 0 ps loopback: 0 ps flags: 0
wr11: setpoint: 0 ps current: 0 ps loopback: 0 ps flags: 0
wr12: setpoint: 0 ps current: 0 ps loopback: 0 ps flags: 0
wr13: setpoint: 0 ps current: 0 ps loopback: 0 ps flags: 0
wr14: setpoint: 0 ps current: 0 ps loopback: 0 ps flags: 0
wr15: setpoint: 0 ps current: 0 ps loopback: 0 ps flags: 0

White Rabbit Project - Open Hardware and Source Project  http://www.ohwr.org/projects/white-rabbit
White Rabbit Switch Web Interface

Dashboard
Monitor
Configuration
- VLAN
- DHCP
- PTP
- SNMP
- Tools

VLAN Configuration
- WR ... VLAN Associated
- wr0 VLAN 1
- wr1 VLAN 2
- wr2 Not Associated
- wr3 Not Associated
- wr4 Not Associated
- wr5 VLAN 2

Protocol Status
- PTP
- PTP v2.0
- DHCP

Endpoints Status
<table>
<thead>
<tr>
<th>Endpoint</th>
<th>Status</th>
<th>Mode</th>
<th>Lock State</th>
<th>Calibration</th>
</tr>
</thead>
<tbody>
<tr>
<td>wr0</td>
<td>Link Up</td>
<td>Slave</td>
<td>Locked</td>
<td>Calibrated</td>
</tr>
<tr>
<td>wr1</td>
<td>Link Down</td>
<td>Master</td>
<td>No Locked</td>
<td>Uncalibrated</td>
</tr>
<tr>
<td>wr2</td>
<td>Link Up</td>
<td>Master</td>
<td>No Locked</td>
<td>Calibrated</td>
</tr>
<tr>
<td>wr3</td>
<td>Link Up</td>
<td>Slave</td>
<td>No Locked</td>
<td>Calibrated</td>
</tr>
<tr>
<td>wr4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

White Rabbit Project - Open Hardware and Source Project [http://www.ohwr.org/projects/white-rabbit]
**White Rabbit Switch Web Interface**

### VLAN Configuration

<table>
<thead>
<tr>
<th>Port</th>
<th>VLAN</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>wr0</td>
<td>VLAN 1</td>
<td></td>
</tr>
<tr>
<td>wr1</td>
<td>Not Associated</td>
<td></td>
</tr>
<tr>
<td>wr2</td>
<td>VLAN 2</td>
<td></td>
</tr>
<tr>
<td>wr3</td>
<td>Not Associated</td>
<td></td>
</tr>
<tr>
<td>wr4</td>
<td>Not Associated</td>
<td></td>
</tr>
<tr>
<td>wr5</td>
<td>VLAN 2</td>
<td></td>
</tr>
<tr>
<td>wr6</td>
<td>Not Associated</td>
<td></td>
</tr>
<tr>
<td>wr7</td>
<td>Not Associated</td>
<td></td>
</tr>
<tr>
<td>wr8</td>
<td>VLAN 1</td>
<td></td>
</tr>
<tr>
<td>wr9</td>
<td>Not Associated</td>
<td></td>
</tr>
<tr>
<td>wr10</td>
<td>VLAN 1</td>
<td></td>
</tr>
<tr>
<td>wr11</td>
<td>Not Associated</td>
<td></td>
</tr>
<tr>
<td>wr12</td>
<td>VLAN 2</td>
<td></td>
</tr>
<tr>
<td>wr13</td>
<td>Not Associated</td>
<td></td>
</tr>
<tr>
<td>wr14</td>
<td>Not Associated</td>
<td></td>
</tr>
<tr>
<td>wr15</td>
<td>Not Associated</td>
<td></td>
</tr>
<tr>
<td>wr16</td>
<td>Not Associated</td>
<td></td>
</tr>
<tr>
<td>wr17</td>
<td>VLAN 1</td>
<td></td>
</tr>
</tbody>
</table>

[Save & Apply]

---

**White Rabbit Project - Open Hardware and Source Project**

[http://www.ohwr.org/projects/white-rabbit](http://www.ohwr.org/projects/white-rabbit)
Remote Application Mockups

White Rabbit Remote Manager

Switch Management | Network Architecture | Network Tools | Help

WR Switches List | Network Discovery

+ White Rabbit A (192.168.1.54)
+ White Rabbit B (192.168.8.11)
- White Rabbit C (192.168.1.240)

<table>
<thead>
<tr>
<th>Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statistics</td>
</tr>
<tr>
<td>Remote Management</td>
</tr>
<tr>
<td>Flashing</td>
</tr>
</tbody>
</table>

Switch Information

Name: WR Switch
IP: 192.168.1.240
Gateway: 192.168.1.1
Mask: 255.255.255.0
HWAddr: 34:63:b7:01:aa:44
SW Version: 3.30
HW Version: 3.30

Status

Bandwidth %
Packet Error %

ON

<table>
<thead>
<tr>
<th>wr1</th>
<th>wr2</th>
<th>wr3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tx</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Rx</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>M/S</td>
<td>Slave</td>
<td>Master</td>
</tr>
</tbody>
</table>

...
White Rabbit Remote Manager

Switch Management | Network Architecture | Network Tools | Help

WR Switches List | Network Discovery

- White Rabbit A (192.168.1.54)
- White Rabbit B (150.240.8.11)
- White Rabbit C (192.168.1.240)
- Configuration
- Statistics
- Remote Management
- Flashing

Local Flashing | Remote Flashing

File Load

Firmware

Firmware Version

WRS firmware version 3.3
Updated on: 25/03/2013

Flash