CPE Power Management User Guide for DSL Linux®

CPE-AN900-R

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Revision History

Revision	*Date*	*Change Description*
CPE-AN900-R	02/04/14	Initial release

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About This Document

Purpose and Audience

This document provides solutions to automatically reduce power consumption in PON/DSL CPE reference designs by configuring each of the CPE interfaces to their lowest power state based on usage.

This document is intended for software and system engineers.

Acronyms and Abbreviations

In most cases, acronyms and abbreviations are defined on first use.

For a comprehensive list of acronyms and other terms used in Broadcom documents, go to: http://www.broadcom.com/press/glossary.php.

Document Conventions

The following conventions may be used in this document:

Convention	*Description*
Bold	User input and actions: for example, type **exit**, click **OK,** press **Alt+C**
`Monospace`	Code: `#include <iostream>` HTML: `<td rowspan = 3>` Command line commands and parameters: `wl [-l] <command>`
< >	Placeholders for *required* elements: enter your <username> or `wl <command>`
[ ]	Indicates *optional* command-line parameters: `wl [-l]` Indicates bit and byte ranges (inclusive): [0:3] or [7:0]

References

The references in this section may be used in conjunction with this document.

Note: Broadcom provides customer access to technical documentation and software through its Customer Support Portal (CSP) and Downloads and Support site (see Technical Support).

For Broadcom documents, replace the "xx" in the document number with the largest number available in the repository to ensure that you have the most current version of the document.

Document Name		*Number*	*Source*
Broadcom Documents			
[1]	*Power Management White Paper*	63XX_68XX-WP1xx-R	DocSAFE
[2]	Code of Conduct on Energy Consumption of Broadband Equipment, Draft Version 3 by European Commission	http://re.jrc.ec.europa.eu/energyefficiency/pdf/CoC%20Brodband%20Equipment/Code%20of%20Conduct%20Broadband%20Equipment%20V3%20final.pdf	Web

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Introduction

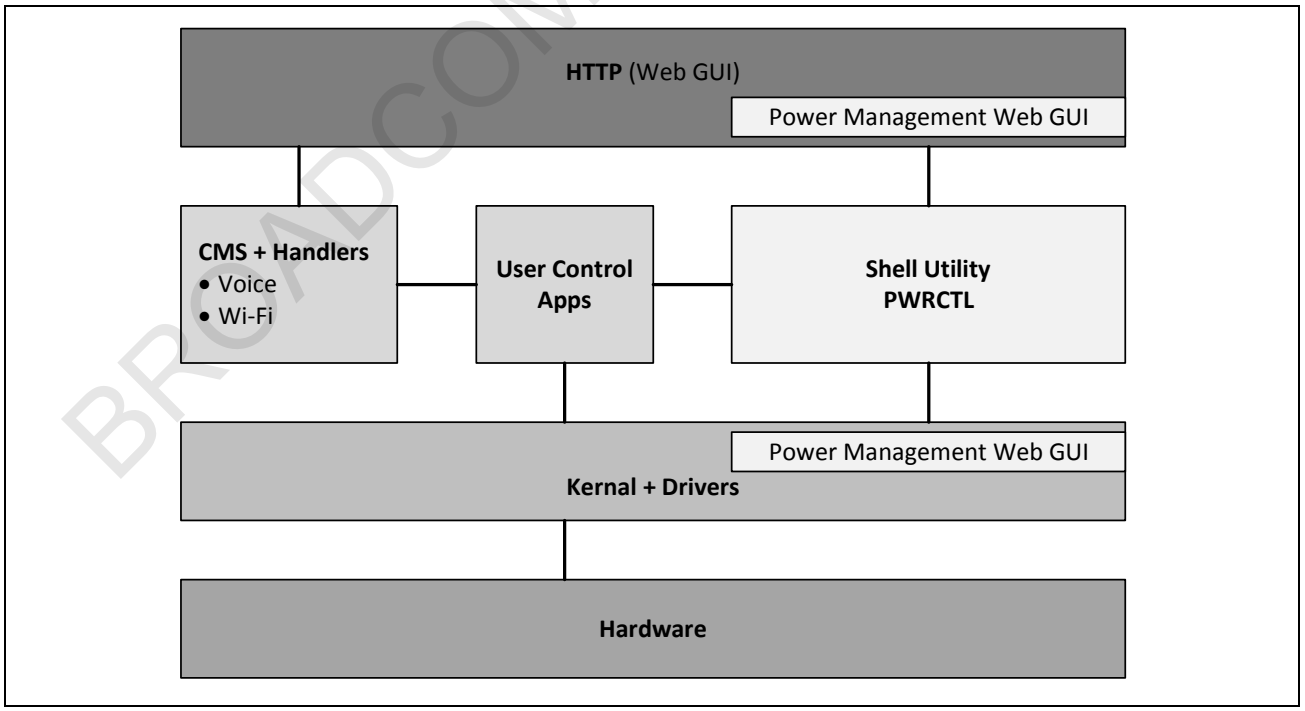
The CPE Power Management User Guide provides solutions to automatically reduce power consumption in PON/DSL CPE reference designs by configuring each of the CPE interfaces to their lowest power state based on usage. A white paper is available in DocSAFE that discusses the options available, see Reference [1] on page 6. The reader of this document should first become familiar with the content of the white paper before consulting this design document.

Architecture

The Power Management driver provides mechanisms to enable or disable the low-power mode of different interfaces on the PON/DSL CPE. In the past, this driver enabled complete shut down of various interfaces of the CPE in order to save power. Thus saving power required human intervention, which was not desirable. An automated power-saving mode for the different interfaces has been implemented instead, and the power management driver now only allows disabling or enabling this power-saving mode. In general, it is not necessary to disable a power-saving mode for a given interface, but there may be cases where it could prove to be useful for troubleshooting purposes.

The Power Management driver manages the power-saving state of these hardware blocks in the kernel. A shell utility, pwrctl interfaces this driver to the user through the ioctl interface. CMS integration has been done to store the power management configuration. The status of the power-saving configuration for the different hardware blocks can be seen through the Web GUI. The functional blocks involved in the power management architecture are shown in Figure 1.

Figure 1: Power Management Functional Block Diagram



API Interface

Customers are encouraged to use the pwrctl utility to manage and check the status of different functional blocks of the CPE. Although, if they want the API interface, they can use the following interface to directly interact with the power management driver.

The following two APIs are used for getting/setting power management configuration from/to the driver:

```
/***************************************************************************
 * Function Name: PwrMngtCtl_GetConfig
 * Description  : Returns the PwrMngt configuration parameters.
 * Returns      : CmsRet return code
 ***************************************************************************/
CmsRet PwrMngtCtl_GetConfig(PPWRMNGT_CONFIG_PARAMS pCfgParams, UINT32 configMask)


/***************************************************************************
 * Function Name: PwrMngtCtl_SetConfig
 * Description  : calls the set global configuration API to effect the new
 *                configuration.
 * Returns      : CmsRet return code
 ***************************************************************************/
CmsRet PwrMngtCtl_SetConfig( PPWRMNGT_CONFIG_PARAMS pCfgParams, UINT32 configMask)
```

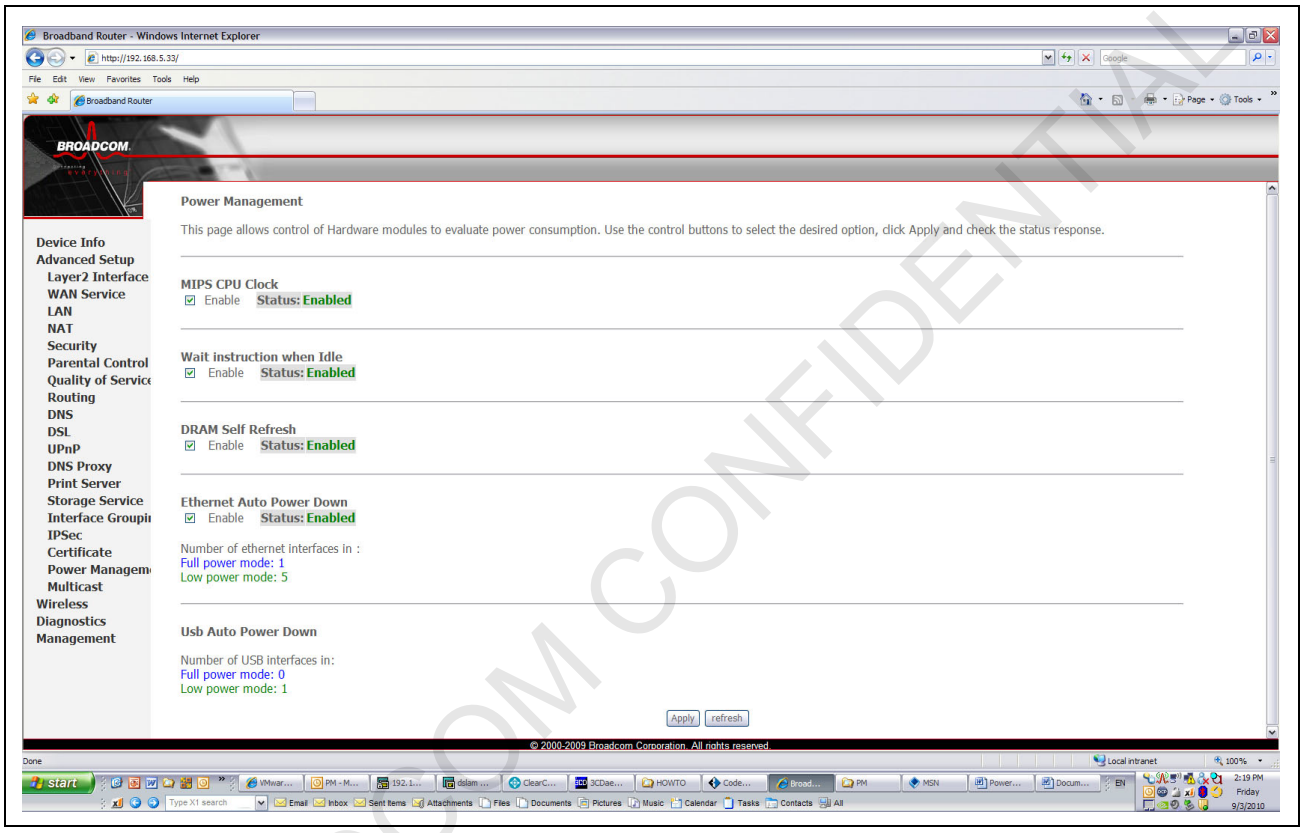
Power management configuration structure is defined as follows:

```
typedef struct _PwrMngtConfigParams {

#define PWRMNGT_CFG_PARAM_CPUSPEED_MASK           0x00000001
   ui32                   cpuspeed;
#define PWRMNGT_CFG_PARAM_CPU_R4K_WAIT_MASK       0x00000002
   ui32                   cpur4kwait;
#define PWRMNGT_CFG_PARAM_MEM_SELF_REFRESH_MASK   0x00000004
   ui32                   dramSelfRefresh;
#define PWRMNGT_CFG_PARAM_MEM_ETH_APD_MASK        0x00000008
   ui32                   ethAutoPwrDwn;

}  PWRMNGT_CONFIG_PARAMS, *PPWRMNGT_CONFIG_PARAMS ;
```

Web GUI

A Web GUI option, Power Management, has been added under **Advanced Setup** as shown in Figure 2. To change the state of any hardware block, select the new status and click the **Apply** button. The driver configuration updates and displays the new state of the CPE.

Figure 2: Power Management GUI



Shell Utility

A shell utility, pwrctl, has been added so users can manage the power management configuration of different hardware subblocks. Note that for certain platforms, such as the BCM96362, you can only select 0 or 256 to run the MIPS at full speed in synchronous or asynchronous modes.

The syntax of pwrctl utility is shown below:

```
# pwrctl
Usage: pwrctl start
       pwrctl stop
       pwrctl config [--cpuspeed <0|1|2|4|8|256>] : 0  -> sets speed @ 1/1 in SYNC mode
                      1-8 -> sets speed @ 1/1, 1/2, 1/4 or 1/8th of fullspeed in ASYNC mode.
                      256 -> 1/8 ASYNC when entering wait, 1/1 SYNC otherwise.
              [--cpur4kwait on|off] :          keeps CPU in sleep state without spinning
              [--sr on|off]         :          DRAM Self Refresh Mode (requires Wait enabled)
              [--ethapd on|off]     :          Ethernet auto power down
       pwrctl show
       pwrctl help
#
```

The configuration of the current power management status is shown below:

```
# pwrctl show
```

Note: Each platform may have a different set of features listed, depending on what is supported and what is compiled.

The settings for the Power Management Configuration are listed below:

Functional Block	Status
CPU Speed	1
CPU r4k Wait	ENABLED
DRAM Self-Refresh	ENABLED
Ethernet Auto Power-Down	ENABLED

The Ethernet interfaces are set as follows:

Full-power mode:	1
Low-power mode:	5

The USB interfaces are set as follows:

Full power mode:	0
Low power mode:	1

To configure the MIPS to always run at full speed, use the following command and syntax:

```
#
# pwrctl config -cpuspeed 0
```

The new state can be obtained by running the following command. In this case, it shows PHY0 in disabled state.

```
#
# pwrctl show
```

The settings for the Power Management Configuration are listed below:

Functional Block	Status
CPU Speed	0
CPU r4k Wait	ENABLED
DRAM Self-Refresh	ENABLED
Ethernet Auto Power-Down	ENABLED

The Ethernet interfaces are set as follows:

Full power mode:	1
Low power mode:	5

The USB interfaces are set as follows:

Full power mode:	0
Low power mode:	1

Users can disable the Ethernet automatic power-down and sleep mode feature by running the following command. In this case, the information about the number of Ethernet interfaces in full or low power mode will not be shown:

```
# pwrctl config --ethapd off
# pwrctl show
```

The settings for the Power Management Configuration are listed below:

Functional Block	Status
CPU Speed	0
CPU r4k Wait	ENABLED
DRAM Self-Refresh	ENABLED
Ethernet Auto Power-Down	DISABLED

The Ethernet interfaces are set as follows:

Full power mode:	0
Low power mode:	1

Building a Power Management Image

To build a power-management-enabled image, follow the steps below:

1. In the top level directory, type **make menuconfig**.
2. Load the 96368GW profile or any other profile of your choice.
3. Select the **Power Management** driver in **Other Features**.
4. Select the **PWRCTL** utility.
5. Select the desired individual power management features that you want to enable, such as:
   - Ethernet Auto Power Down and Sleep
   - Automated MIPS Clk Divider
   - DDR Self-Refresh Power Saving
   - PCIe L1 Active State Power Management

   Note that some of these features are not available on all chips.
6. Save and then build the new profile.

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