BCM96XXX

Broadband Router Software (Data)

Software Release Notes
5.02L.04

Table of Contents

Chapter 1: Introduction

1.1 Overview

This document describes the 5.02L.04 release of the reference software for the Broadcom BCM96XXX series of xDSL and xPON products. These release notes contain the information about features, enhancements and bug fixes for the release.

This release supports the following build platforms:

- BCM63138 and BCM63148
- BCM63168 and BCM63268
- BCM963381
- BCM962118 and BCM962116
- BCM6838X and BCM6848X
- BCM6858X B0 and B1 revisions
- BCM68360
- BCM68460
- BCM47189 (experimental)

This release contains the following items:

- 4.1 Linux kernel.
- Precompiled router images that can be downloaded to the Broadcom BCM96XXX reference boards.
- Source code for the Broadband Router, including the bootloader and common firmware environment (CFE).

1.2 Important Notices

The following important notices apply to the 5.02L.04 release:

- Linux Kernel is upgraded to version 4.1.45.

1.3 Related Documents

For the latest document, 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.

Item	Title	Document Number	Source
[1]	*EPON/GPON HGU Processor Software Suite*	6838XX-PG1xx-R	docSAFE
[2]	*FAP_WRED_OPERATION_GUIDE*	–	docs/customerDocs
[3]	*Speed_Service_Operation_Guide.pdf*	CPE-AN18xx-R	docSAFE/ docs/customerDocs
[4]	*ButtonConfiguration.pdf*	–	docs/customerDocs
[5]	*BCA CPE Software Board Parameters bcm963xx_board_config_parameters.pdf*	963XX-SWUM4xx-R	docSAFE/ docs/customerDocs
[6]	*BCM963XX CFE Boot Loader and Flash Memory Structure: CFE Boot Loader Version 1.0.37-0.X*	963XX-AN1xx-R	docSAFE/ docs/customerDocs
[7]	*Linux 3.4 Migration Guide.pdf*	CPE-AN3xx-R	docSAFE/ docs/customerDocs
[8]	*FLOWSTATS_AppNotes.pdf*	CPE-AN2xx-R	docSAFE/ docs/customerDocs
[9]	*BCA Modular Software Download*	CPE-AN1xx-R	docSAFE
[10]	*Configuration Management System (CMS) Developer’s Guide*	CPE-SWUM1xx-R	docSAFE/ docs/customerDocs
[11]	*CMS-supported-parameters-report.pdf*	–	docs/customerDocs
[12]	*FirewallConfig.pdf*	CPE-AN15xx-R	docSAFE/ docs/customerDocs
[13]	*BCM963XX Linux Software Development Guide LinuxDeveloperGuide.pdf*	963XX-SWUM2xx-R	docSAFE/ docs/customerDocs
[14]	*Toolchain Release 1.8*	crosstools-gcc-5.3-linux-4.1-uclibc-1.0.12-glibc-2.22-binutils-2.25-Rel1.8-full.tar.bz2	CSP
[15]	*Broadband Router Software (Voice) Release Note*	96XXX_Voice-RN305-R	docSAFE
[16]	*[WLAN:] Functionality Issues with WDS on certain releases*	*KB240891*	CSP Knowledge Base
[17]	*L2_Acceleration_Support_AppNote.pdf*	–	docs/customerDocs
[18]	*Broadcom Execution Environment Platform*	CPE-BEEP-AN100-R	docSAFE
[19]	*MultiPath TCP (MPTCP) Application Note*	MPTCP-AN100-R	docs/customerDocs
[20]	*DDR_Configuration_CPE-AN31xx-SWRDS.pdf*	CPE-AN31xx	docSAFE/ docs/customerDocs
[21]	*Introduction to Broadcom Execution Environment Platform*	CPE-BEEP-AN200	docSAFE
[22]	*Broadcom Broadband Commander (BBC)*	CPE-BEEP-UG300	docSAFE

Chapter 2: New Features and Enhancements in 5.02L.04

2.1 New Features

The following new features are implemented in 5.02L.04.

2.1.1 [BEEPv2] Broadcom Execution Environment Platform Updates

BEEPv2: Separation of framework and execution environment – Broadcom Execution Environment Platform (BEEP) and Broadcom Execution Environment (BEE).

The BEEP framework allows an EE (BEE only in this release) to be installable, update-able, and un-installable. The BEE utilizes OverlayFS and allows Deployment Units (DU) to share the same base file system. The BEE is the root container with DU run in a nested container. The Broadcom package builder allows a software package to contain any number of libraries, EU, and configuration files. It supports five digest algorithms; HMAC-SHA256 is the default algorithm. Applications supported as BEE DU are spTestSuite, dad, cwmp, tr69, iPerfv2, Samba Service, and dsldiagd. The BEE allows finer granularity of data model access by Profile. OpenWRT sets guest Wi-Fi and TR69 configuration by consuming BEE DAD's service. The BEE manifest files have attribute names that are aligned to OCI rather than proprietary Broadcom attribute names. Flash restriction on EE and all BEE DU is now supported. Broadcom Broadband Commander (BBC) is a new tool running on the desktop to configure BEE in BEEP framework. BEEP has been fully tested on 963138GW and 963148GW platforms. Docker is now available as part of the BEEP Framework. Details can be found in the BEEP documentation.

2.1.2 [BCM62118/BCM62116] Added NVRAM Mirroring Support

This release supports mirroring NVRAMs for chips using Gen3 and newer Boot ROM. The image will contain multiple copies of NVRAM_DATA in addition to the primary copy. Firmware will always synchronize all the NVRAM_DATA when NVRAM data is written. In case the primary NVRAM is missing or corrupt, firmware will scan through the entire 1 MB of boot block to search for mirror NVRAM and restore the content of the primary copy.

2.1.3 [BCM6846] Support New PON SoC

The BCM6846 is a low-cost smart GW, single-chip GPON/EPON concurrent dual band Wi-Fi HGU device that enables the realization of a cost-effective SFU/HGU access device for GPON (2.5/1.25), EPON (1/1 and 2/1), and 1G/2.5G AE (Active Ethernet). It supports 4x GBE PHYs, and 1x RGMII LAN interfaces.

The BCM6846 supports small packet WAN<->LAN routing concurrent with multi-port Ethernet switching, L3 packet processing, dual concurrent IEEE 802.11ac/n wireless networking (via PCIe) interfaces, and multi-line Voice-over-IP (VoIP) processing.

L2/L3 packet processing is completely offloaded from the Host, utilizing the XRDP (4th generation Runner) network processor engine.

The BCM6846 includes an integrated dual-core ARM-A7 high performance CPU with 32 KB I/D caches and 256 KB L2 cache.

The BCM6846 has two USB 2.0 integrated USB controllers with transceiver and two PCIe single lane Gen 2.

The BCM6846 supports a 16-bit DDR3-1600 MT/s controller and PHY, supporting both control plane and data path.

Additional supported interfaces include NAND flash, Serial Port Interface (SPI), I^2C, Pulse Code Modulation (PCM) Highway, along with a host of general purpose inputs/outputs (GPIOs), MDIO, interrupts, timers, and pulse width modulators (PWM).

The BCM6846 build supports only pure UBI file system.

In this release AVS is supported for BCM68460 A0 revision only.

2.1.4 [BCM6836] Added Support for eMMC

Added support for eMMC devices. Support includes boot from eMMC and full support as a storage device.

2.1.5 [BCM6836] Enable Support for 1 GB DDR

Enable support for 1 GB DDR devices. Refer to the “CPE DDR Configuration” document on docSAFE (CPE-AN3100) for more details.

2.1.6 [BCM6858] Broadcom Speed Service for HGU

Enabled Broadcom Speed Service through the WAN interface.

2.1.7 BRCM Speed Service – Added Support for IPv6 Traffic

Added support for IPv6 connection in BRCM Speed Service.

To enable IPv6 support, the CPE should support IPv6 WAN and should have an active IPv6 WAN service.

NOTE: [BCM63138/63148/62118] Support for IPv6 Speed Service towards LAN also available.

Running Speed Service server

When the Speed Service server is running it will listen on specified TCP port and will accept connections from clients in both IPv4 and IPv6 protocols.

Use the following command to run the server:

```
./speedsvc server 8080 8090
```

- 8080 – TCP port
- 8090 – UDP port

Client configuration

Speed service client can be conjured using UI page (Diagnostics->Speed Service). The difference between IPv4 Speed Service configuration and IPv6 is described below:

– Server address – this field should be filled with IPv6 address of the server.
– UDP Payload Length – this field maximum value should be less than 1452.

The rest of the configuration is identical to the one in IPv4 version of the Speed Service

2.1.8 [BCM6858] Added NGPON2 Performance Monitoring

Added support for NGPON2 performance monitoring counters in the NGPON2 driver and in OMCI.

2.1.9 [PON] Added Support for OMCI Performance Counters for the VEIP Interface

Added support for the following performance counters:

- G.988 clause 9.5.2: Ethernet PMHD
- G.988 clause 9.5.3: Ethernet PMHD 2
- G.988 clause 9.5.4: Ethernet PMHD 3
- G.988 clause 9.3.30: Ethernet frame PMHD upstream
- G.988 clause 9.3.31: Ethernet frame PMHD downstream

2.1.10 [BCM6858] Added Support for Rogue ONU Detection

Added support for rogue ONU detection when working in ITU 10G standards (XGPON, NGPON2, XGS-PON) WAN.

Configuring the optical module TX_SD signal input pin should be done in the board profile in boardparms.c file under the value of bp_usRogueOnuEn. The feature is configured and enabled through the rdpa_gpon_rogue_onu_set() API.

The feature can work in two modes:

- TX monitor – the TX_SD signal is compared to the LBE signal to detect rogue transmission of the optical module.
- TX fault – the TX_SD signal is measured to detect a faulty (> clock_cycle) transmission.

2.1.11 [PON] Enable LAN Port SP+WRR QoS

Enable configuration of LAN port SP+WRR scheduler via tmctl application.

2.1.12 [EPON] Extended Multiple LLID Support

Extended multiple LLID support for EPON WAN type. Support is extended up to 16 LLIDs in DPoE SFU and 8 LLIDs in DPoE HGU profile. Multi links can be set by OAM through the OLT.

2.1.13 [PON] OMCI/MDM Decoupling

The OMCI stack is decoupled from the CMS framework. The OMCI process can run as a standalone process without other CMS processes such as SMD, SSK, and so on. The OMCI-related libraries are consolidated and reorganized.

The OMCI process directly invokes Broadcom Control Utility APIs (VLANCtl, GPONCtl, TMCtl, and so on) for the device configuration, and invokes the newly introduced OMC Wrapper RUT APIs for the interactions with the CMS or non-CMS framework. Those RUT APIs are fully implemented and integrated in the CMS-based Broadcom CPE solution. It is expected that customers using a non-CMS framework will implement those RUT APIs.

Refer to the *OMCI Integration Guide* (CPE-AN3200) document for more details.

2.1.14 [PON] User Space RDPA Interface

Introduce RDPA user-space API. This feature allows access to port, egress_tm, and tcont objects APIs from user space. The supported APIs are included in the user_api.h file. To enable and use the APIs, the lbdmf lib should be linked.

2.1.15 [BCM6858/6836/6846] Runner DHD Offload Support

Unicast traffic offload is enabled.

The BCM6846 supports offloading of DHD#0 only. DHD#0 may be located on either of the two PCIe interfaces according to PCIe boot order. The boot order can be changed using NVRAM.

2.1.16 [BCM6858/6836/6846] Ingress Filtering in Downstream HGU by Ingress Classifier

Added new **IP Flow** type to RDPA Ingress Classifier object to enable trap/drop actions in IP Class flow.

2.1.17 [BCM6858/6836/6846/5504X] Flooding by Runner Bridge

Enabled flooding for traffic with unknown DA through the Runner network processor.

2.1.18 [BCM6858/6836/6846] Policers in HGU

Enabled Policers by IP Class.

2.1.19 [BCM6858/6836/6846] LAN Remote Loopback

Added remote loopback (RX→TX) support on LAN ports.

2.1.20 [BCM6858/6836/6846/5504X] Triple VLAN Tag Support

Enabled third VLAN identification and modification.

2.1.21 [BCM6858/6836/6846/5504X] Line-Rate Rate Limiter/Policer

Enabled line-rate limit for downstream/upstream rate limiters and Policers, through new overhead parameter in RDPA System object.

2.1.22 [BCM6858/6836/6846/5504X] Transparent Multicast Forwarding

Added Ingress Classifier flow lookup to IPTV multicast flow to allow selective forwarding of multicast packets via Ingress classification flow by using *include_mcast* parameter.

2.1.23 [BCM6858/6836/6846/5504X] Ingress Rate Limit

Added Unknown DA/Multicast/Broadcast ingress rate limiters per port.

2.1.24 [BCM6858/6836/6846] Ingress Flow Control

Enabled ingress flow control in upstream.

2.1.25 [BCM6858/6836/684/5504X] VLAN-based Ingress Filter Support

Enabled ingress filters per VLAN. Configuration can be either through port object or through VLAN object rather than through ingress filter object.

2.1.26 [BCM6858/6836/6846/5504X] Protocol Filters Support

Allowed selected protocols to be filtered on port/VLAN RX.

Supported protocols: Any traffic (default), IPoEv4, IPoEv6, PPPoE, and Non-IP.

2.1.27 [BCM6858/6836/6846/5504X] MAC Learning Enable/Disable per Port/VID

Added new attribute to VLAN object controlling behavior of SA and DA lookup per VLAN (same as in port object).

2.1.28 [BCM6858/6836/6846/5504X] Per Port CPU Meters

Enabled meter configuration per port (per SID in DPU application).

2.1.29 [BCM6858/6836/6846/5504X] CPU Redirect (Stand-Alone Test)

Enabled injection of packet from CPU and retrieving it back to CPU with meta data after full processing. Enabled by setting rx_cpu_redirect parameter to rdpa_rx_redirect_to_cpu_all when calling the rdpa_system_cfg_set() API.

2.1.30 [BCM6858/6836/6846/5504X] Ingress QoS per Port/VID

Enabled high/low discard priority setting in case of ingress congestion. Configuration is per LAN port/SID in upstream or per VLAN in downstream.

2.1.31 [BCM5504X] Multicast/Broadcast Counters per SID

Added RX/TX Multicast/Broadcast packet statistics per SID.

2.1.32 [BCM6858/6836/6846] Support IP Multicast FC Bypass Mode in IP Class

Enabled IP multicast option in FC bypass. Functionality is the same as provided for with the BCM6838/6848 devices.

2.1.33 [BCM6858/6836/6846/5504X] WRED Configurable Maximum Drop Probability

Enabled configuration of WRED maximum drop probability per egress queue in egress TM object.

2.1.34 [BCM6858/6836/6846/5504X] Multicast IPv4/IPv6/Other Ingress Filters

Added following ingress filters: Multicast IPv4, Multicast IPv6, and Multicast non-IP.

2.1.35 [BCM6858/6836/6846/5504X] Bypass Ingress Filters for CPU TX Ingress Traffic

Added an option to bypass ingress filters for CPU TX traffic forwarded by Runner.

2.1.36 [BCM55045] System Port Support

Added system port support on RGMII port.

2.1.37 [BCM47189] Support CMS Platform

Added 947189GW profile and 947189acnrm boardID. It allows CMS to run on the BCM947189 platform; not all functions are tested.

2.2 Enhancements

Enhancements to features implemented in prior releases are listed below:

- [BCM96XXX] Multicast RTP sequence feature enhancement.
  - Allow the feature to be turned on/off during run time (no build time dependency).
  - Allow the selection of one or more specific multicast groups for RTP sampling instead of global enabling.
  - Count and display the current lost RTP packets and current RTP sequence number.
- [BCM63138/62118/6858/6836] Enabled USB UAS (USB Attached SCSI) support to improve throughput.
- [BCM63268] Increased low priority DQM queue size between FAP and CPU to absorb packet burst from DSL interface.
- [BCM63268/63168] [FAP] Support Hardware Acceleration of PPPoA and IPoA multicast streams.
- [BCM63138/63148/62118] Provide RDPA APIs to get current Egress Queue Occupancy. New APIs are `rdpa_cmd_drv_get_q_size()` and `rdpa_cmd_drv_get_q_occupancy()`. BDMF dump of egress TM object also displays the current queue occupancy.
- [Flow-cache] Flow-cache acceleration support for TCP traffic terminated in containers.
- [USB3.0] Low Power Management (LPM) is enabled by default.
- [Flow-Stats] Added support for flow-stats queries based on inner MAC addresses of L2-GRE traffic.
- [Interface Stats] Added 64 bit counter support in Bridge, PPP, XTM, VLANCTL, and Ethernet driver.
- [ETHTOOL] Provide ethtool interface to display device private flags for Ethernet interfaces.
- Deep Packet Inspection Web GUI has been enhanced to dynamically show Application and Device Instances that have active connections.
- Deep Packet Inspection dpictl library has been changed to provide application usable data through a functional API.
- Deep Packet Inspection Signature database upgraded to version 1.184.
- [SD Card] Added support for SD card auto-detection. This would allow for SD cards to be hot-pluggable in the system.
- [BCM63138/63148/63381] [Secure boot] Support configuring secure boot via CFE command line utility optcfg for Gen2 Boot ROM.
- [BCM63138] [Secure boot] Added support for EMMC secure boot.
- [MTD utilities] Updated mtd-utils to 2.0.1 to enable ubifs to automatically clean up pages that are written as 0xff.
- [Toolchains] Updated glibc toolchain to glibc 2.24.
- [BCM6858] Support for BCM6858 A0 devices is obsolete.
- [BCM6838/6848/6858] Improved rate convergence algorithm in speed service.
- [BCM 55045] Enabled 160 queues in downstream (together with 96 queues in upstream).
- [BCM6858/6836/5504X] Enlarged number of supported bridges to 128 and VLAN objects to 256.
- [BCM6858/6836/6846/5504X] Enabled classification to IPTV according to L2/L3/L2 or L3.
- [BCM6858/6836/6846] Allowed disabling IPTV filter by deleting IPTV object.
- [BCM6858/6836/6846] Added port field in IP Class lookup key.
- [BCM55045] Enlarged amount of packet buffers in downstream to 36K.
- [BCM6858/6836/6846/5504X] Added IPTV total RX valid counter, same as in 6838/6848.
- [BCM55045] Improved DPU performance by introducing dpu_split_scheduling_mode parameter in system object. When enabled, physical interfaces 0–1 and 2–7 are limited to 80 queues each.
- [BCM6838] Added support for a total of 33 TCONTs – 32 TCONTs for data and one TCONT for OMCI. Support in GPON and RDPA driver level only.
- Improved software download speed when using Linux web interface.
- [PON] tmctl utility – Added support for dual rate configuration.
- [PON] tmctl utility – Added an option to define port egress queue ID.
- [PON] tmctl utility – Added support for SP+WRR configuration of a LAN port.

2.3 DSL PHY Updates

DHY PHY versions included in the release are shown in Table 1.

Table 1: DSL PHY Versions

Chip Family	DSL PHY Version	Description
BCM63138	A2pvfbH043h	Single PHY for all modes
	B2pvfbH043h	Annex B
BCM63148	A2pvbJ042p	Single PHY for all modes
	B2pvbJ040h	Annex B
BCM63268	A2pv6F039v4	Annex A
	B2pv6F039v	Annex B
	A2pv4bF038r1	Bonding
	A2pvbF039v4	5-band bonding
BCM63381	A2pvI042r	Single PHY for all modes
	B2pvI042r	Annex B

Chapter 3: Bug Fixes and Open Issues in 5.02L.04

3.1 Bugs Fixed in 5.02L.04

The following table lists previously reported bugs that have been fixed in this release.

Table 2: Bugs Fixed in 5.02L.04

Reference	Description
20186	[BCM63138/BCM63148] USB1.1 read failure is sometimes noticed when reading large files. USB 2.0/3.0 has no issues.
23232	[BCM6858X] Rogue ONU detection is not functional.
24293	[Kernel Driver] Major device numbers assignment for Broadcom drivers is changed to either use dynamic assignment or allocate from the range not used by Linux.
24520	On BCM63138, the DDR Self-Refresh feature, which became available in 5.02L.02, was found to cause performance issues on XTM/DSL interface. The feature is now disabled by default.
24716	[BCM6858] Registration ID value is limited to 10 characters. Registration ID is extended through /data/reg_id file in the non-volatile segment of the file system. If the file is absent, then the old NVRAM registration ID is used.
25007	[PON] Incorrect presentation of upstream and downstream FEC state through gponctl.
25303	[BCM63268/63381/6328/6318/6362] Ethernet driver does not service LAN and WAN receive queues fairly, resulting in larger packet latency for traffic from one side over other.
25690	[UART] Serial port drops and corrupts output when set_termios is called.
25700	[BCM6858X/68360] [GPON] Upstream packets smaller than 128B may be transmitted to OLT corrupted.
25732	[BCM63138/63148] Improved packet copy mechanism in Runner for traffic towards host CPU. This change improves host packet forwarding performance for large size packets.
25744	[BCM6836] [EPON] CTC encryption does not work.
25794	[USB3.0] USB3.0 detection issue during system reboot under some corner conditions.
25880	[BCM6836][EPON] AES encryption does not work.
25947	[BCM68360] Errors when adding a multicast channel from WLAN client if the same channel is already associated to a wired LAN port.
25948	[BCM63148] Energy Efficient Ethernet must be disabled in 1000BT because it causes packet loss on other links and a workaround that was implemented causes emissions at 2.5 GHz.
25949	[BCM62118] Two workarounds for Energy Efficient Ethernet and for Ethernet Auto-Power-Down implemented for BCM63148 are incorrectly applied to BCM4908 where they are not applicable.
25956	Logical SPU interfaces created by the SPU driver MUST have an MTU setting that is the same size as the corresponding transmitting physical interface.
26048	[BCM6838] Crash when sending traffic to a not offloaded Dongle station.
26056	[BCM68360] Occasional BIP8 errors when connected to BCM68901 PMD device.
26188	[Kernel File system] Enable devtmpfs in kernel so that SHMEM will not break tmpfs.
26332	[BCM6858] Call trace print during boot when enabling 10K jumbo packets.
26333	[SIP-ALG] [CDROUTER] cdrouter_sip_60 and cdrouter_sip_62 test case failure.
26337	[XTM] Linux crash during ADSL link up/down endurance test.
26350	[Flow-cache] Upstream traffic corruption when using LAN side GRE tunnels.
26430	[BCM6858X/68360][GPON] Downstream traffic through GEM index 31 cannot pass.
26453	[BCM63268] PTM bonding to non-bonding transition (or vice versa) stress test with traffic may lead to system/CPE freeze/unresponsive.
26479	[BCM63138/63148/62118] Ethernet WAN port trunking/LAG does not work properly.
26482	[BCM63138/63148/62118] Multicast traffic from bonding/trunked Ethernet WAN interface is not accelerated by Runner.

Table 2: Bugs Fixed in 5.02L.04 (Continued)

Reference	Description
26484	[BCM63138/63148/62118] IPv6 multicast traffic towards DHD-Offloaded WLAN clients does not get accelerated by Runner.
26505	[BCM63268] [FAP] [Multicast] UDP checksum errors noticed with multiple clients joining the same stream and flow-cache multicast learning is enabled.
26515	[NGPON2] In O9 state, Complete_u PLOAM are not transmitted on every applicable PLOAM grant.
26516	[BCM63138/63148/62118] CFE should disable TX/RX of all ports (including ports not specified in board parameters) before booting to Linux to avoid packets entering the system from unused switch ports.
26525	[Flow-cache][PPTP] Skip flow processing for compressed PPTP frames to avoid sequence mismatching issues.
26557	[PON] ONU stuck after recreating OMCI re-provisioning with high load of background traffic. Configuring RDPA GPON gem_ds_cfg will not enable GEM by default and requires a manual enabling.
26573	[FAP] [Multicast] IPv4 multicast fragmented packets are not forwarded correctly by the system.
26615	[XTM] Synchronization issue due to race condition leads to kernel crash during repeated VDSL sync tests.
26627	[BCM62118] [L2-Acceleration] Runner to switch traffic does not make use of all three IMP ports resulting in throughput capped at 2.5 Gbps.
26664	[53125] Applied errata “SF-ER A0.05: BCM53125 May Lose Link in 100 Mbps Mode when EEE Feature is Enabled” from docSAFE BCM53125-ES103.
26684	[SWMDK] SWMDK (Switch MDK application) failed to start again after stopping/killing the process.
26740	[Build] The last remaining .autodetect files have been replaced with autodetect files (including some duplicates).
26767	[BCM6858] L3 protocol field in ingress classifier not working.
26704	[xDSL Bonding] Possible loss of Bonded WAN connectivity when one line goes down within a short period of other line coming up.
26786	[XTM] System dead-lock due to del_time_sync() during tests involving random re-training of Line#1 and Line#2.
26816	[BCM6858] Some ingress class field combinations containing generic fields do not work.
27002	[ATM Bonding] Kernel BUG noticed when running line up/down test concurrently with add/delete of ATM interface.
27021	[XGPON] ONU wrongly accepts XGS burst profiles in TDMA mode.
27152	[Flow-cache] [L2-Acceleration] Ethernet LLC/SNAP packets gets accelerated by flow cache and Runner.
27175	[PON] ESP pass-through does not support L3 NAT.
27186	[Flow-cache] Disabling flow-cache (using “fcctl disable”) does not completely disable all flow-cache processing.
27237	[BCM63138/63148/62118] Sometimes small packets from host are not padded with zeros.
27304	[Flow-cache] IPv6 header corruption for IPv6-over-L2GRE traffic flows.
27329	[BCM6858] SP scheduling inaccurate in some cases.
27343	[BCM63138/63148] Traffic issues in ADSL mode when both path0 and path1 are enabled.
27351	[Kernel 4.1] Linux code is corrected to properly check interface MTU size before forwarding the packets.
27364	[BCM62118] Reserved multicast packets could not be received by the gateway CPU from switch LAN ports.
27392	[BCM6858/6836] IPTV channel port vector may not be updated correctly after leave from WLAN.
27514	For BCM63148 with the SPU acceleration engine enabled, IPSec packets that get accelerated by flow cache will trigger kernel panic.
27530	[BCM6858] EGPHY link is reset after an external 10G PHY link speed is changed.
27541	[GPON] Upstream data integrity when using more than eight TCONTs.
27649	[BCM63138][GFAST] Deleting and re-creating upstream queues with traffic could lead to upstream stall.
27742	[Flow-cache] Flow creation/eviction related processing in flow-cache increases with number of flows.
27770	[Kernel Bonding][STP] Switch Bonded/LAG'd ports can not pass traffic when STP is enabled.
27809	[BCM6838/6848][DHD OFFLOAD] Fix race condition in station connect/disconnect sequence.
27810	[BCM6858] ONU fails to transmit PLOAM messages accumulated in its PLOAMs queue.
27825	[BCM6858] Kernel crash on boot up when USB3.0 is disabled at compile time using menuconfig.

Table 2: Bugs Fixed in 5.02L.04 (Continued)

Reference	Description
27843	[Conntrack] Regardless drop feature of connection tracking does not work for unidirectional flows.
27844	[BCM63381] Fix Boot ROM secure boot hang problem.
27872	[EXTIRQ] Race condition between extIrq config code and core Linux drivers.
27876	[BCM63138/63148] [xDSL] Deleting and recreating queues with over-subscribed traffic may lead to upstream stall.
27970	[IGMP] IGMP Join/Leave are flooded to all LAN ports when Linux snooper is compiled in.
27980	[BCM6858] ONU ID is truncated to 8 bits when passed to user callback by xGPON driver.
27988	Misconfiguration of hard_header_len in bcmenet could result in a crash.
28020	[PON] ONU will crash if flow-cache statistic interval is set to 5 seconds.
28049	[VLANCTL] [STP] STP does not work correctly if Broadcom VLAN interface is present on top of real LAN interface.
28107	[VLANCTL] IPv4 header checksum errors on Little-Endian platforms if DSCP is modified using VLANCTL rules.
28121	Kernel report WARNING message when system reboot.
28184	DPI Signature database upgraded to version 1.184.
28285	[BCM63138/63148/62118] [L2 Acceleration] Number of free context and flow entries goes out of sync under certain error scenarios.
28299	[PON] 2 LAN VLAN objects owned by different port object could not be linked to different IVL bridges if both had same VID enabled.
28364	Can now create up to 64 IPSEC tunnels.
1613	[BCM6858X] Up to 256 channels are supported in IPTV.
1627	[BCM6858] Traffic may get stuck when WAN RX mirroring is enabled.
1875	[BCM68360] Multicast to WLAN always goes through slow path.
2035	[BCM6836] Data corruption after configuring downstream port rate limit.
2070	[BCM6858] Modify IC flow not working.
2077	[BCM6858] XGPON DBRu reports not working.
2091	[BCM6858] Sometimes after deleting and adding IP class flows, traffic does not pass on configured flows.
2140	[BCM6858] RX drop counters per port not working.
2151	[BCM6858] Configuring port shaper on GBE WAN port drops all traffic.
2165	[BCM6838][DPU] Ingress classifier Generic fields not working.
2166	[BCM6858] CPU TX performance degradation.
2176	[BCM6836] GPON DBRu reporting not working.
2178	[BCM6858] DSCP remarking working only for a single DSCP→PBIT table.
2184	[BCM6838] CPU meter does not meter rate correctly.
2189	[BCM6858] QoS mapping for local switched non-IP traffic not working.
2195	[BCM6858] Rate limit not working well for some packet sizes.
2196	[BCM6858] Trap action in IPTV channel not working.
2202	[BCM55045] Rate limit not working in downstream.
2207	[BCM6858] One Ingress filter configuration may impact configuration of other filters.
2206	[BCM55045] Downstream traffic stuck after high rate transmitted.
2207	[BCM55045] Data stuck after sending IPTV traffic.
2212	[BCM6858] RX PLOAMs counted on OMCI GEM counter.
2267	[BCM55045] 512 TCAM entries supported instead of 1024.
2271	[BCM55045] Data corruption in upstream.
2297	[BCM6838] CPU TX may get stuck on high rate transmission.
2299	[BCM6858] IP flow configuration errors in some corner cases.

Table 2: Bugs Fixed in 5.02L.04 (Continued)

Reference	Description
2307	[BCM6858/5504X] 128 VLAN actions support (instead of 127).
2320	[BCM55045] Port byte counters not supported.
2325	[BCM6858] Downstream traffic discarded after moving LAN port.
2326	[BCM6858] High latency for GPON TX.
2335	[BCM6858] DHCP not identified correctly when from GBE WAN.
2337	[BCM6858] Policer “factor bytes” values are mapped incorrectly.
2339	[BCM6858] Delete and recreate WRR queue may cause queue to get blocked.
2341	[BCM55045] VLAN action on SIDs 5-7 not working.
2342	[BCM6858] RX port drop counters not working.
2365	[BCM6858] Increase maximal policer bucket size.
2374	[BCM6858] Modification of number of SP queues not working.
2376	[BCM6858] Reduced throughput degradation when RX rate above datapath capacity.
2381	[BCM6858] Queue parameters modification may cause traffic to get blocked.
2430	[BCM55045] Amount of upstream queues limited to 64.
2447	[BCM55045] Traffic stuck in DPU after a while.

3.2 Known Bugs and Limitations in 5.02L.04

The following table lists open bugs and known limitations with the 5.02L.04 release.

Table 3: Known Bugs and Limitations in Release 5.02L.04

Reference	Description
XXX	[BCM6858, BCM6836] Software supports only a single I^2C bus.
7648	The iq command line utilities do not send output to the controlling terminal, just to the serial port.
10547	USB SMB file transfer throughput degrades over the Far End (FE) interface when voice is enabled.
10636	[BCM63168] GMAC traffic stops after a link is reestablished when BPM is compiled out.
14778	PTM bonding packet loss on a given operational line when restarting the other line during traffic.
15294	[GRE] Flow-cache does not accelerate packets over MTU size over GRE tunnel.
15535	[BCM63138/BCM63148] Under Runner congestion conditions, traffic (from WAN or LAN) that is dropped due to unavailability of Ingress handler Runner buffers, is not reported in device statistics.
16546	[BCM963138/BCM963148] Software support for USB device not available.
17527	[BCM63138/63148/62118] UDP packet fragmentation is not supported by Runner. Packets requiring fragmentation, in other words, exceeding flow MTU, are handled by flow-cache.
19893	[BCM63168] LAN-to-LAN traffic is not accelerated by FAP when GMAC-WAN port is active.
19905	[BCM63168] L2-Switch based VLAN operations are not supported on GMAC-WAN port.
20118	[USB/SATA] Some flash drives (Transcend USB3.0 8 GB) are pre-formatted without the use of partition table, and thus contain no partitions. CPE does not mount them automatically, though they can still be mounted manually using the correct file system type.
21161	[BCM63138/BCM63148] Runner flows do not hit if Egress Interface MTU is greater than 2047 bytes.
24238	[BCM6838X] No support for FTTdp application.
25268	[BEEP] IPv6 is not yet supported.
26054	[PON] TTL value is not decremented for routed multicast traffic from WAN to LAN.
26162	[BCM6838X/6848X][EPON] A kernel crash might occur after OAM reset.
26369	[BEE] Error codes 9026, 9027, 9028, and 9031 are not triggered.
26386	[Kernel Bonding] Multicast traffic does not get accelerated towards bonded Ethernet LAN ports.
27306	[BCM689XX PMD] Rogue and eye-safety alarms are disabled by default.
27904	[BEE] Console error says tr69c is launched. This is an error message that can be ignored.
27976	[BEE] In some cases, resolved flag of DU is false. EU can still be started.
28267	[BCM6838/6848] Broadcom Speed Service is not working.
28278	[BCM6858/6836/6846] IP Class statistics not accurate in some cases.
28299	[BCM6858/6836/6846/5504X] Cannot create two IVL bridges with common LAN VIDs.
28303	[BEEP] If BEE exits abruptly, BEE cannot be started again; must un-install and install back.
28308	[BEEP] Memory and flash usage in DM are not accurate.
28319	[BEE] Some kernel debug error messages are displayed on console when container starts. Error messages do not affect functionality.
28330	[BEE] cwmp package built with pure181 does not work on TR98 image, and vice versa.
28337	[BEEP] Make clean does not clean all built DU under /userspace/dlModules/beep/.
28353	[BEE] spRobot cannot DoMath test after the first DoMath operation.
28363	[BEEP] BBC client tool install operation will not work if packages are not stored in top directory of server.
28424	[BCM68901] PMD device driver information collection mechanism is triggered each second in a high priority tasklet and might interrupt lower priority processes.
28443	[BCM63268] [SPDSVC] IPv6 Speed Service not supported.

Table 3: Known Bugs and Limitations in Release 5.02L.04 (Continued)

Reference	Description
28453	[BCM6846] CFE may stall for about a minute during boot.
537	[BCM6838X/6848X] Service queues not working.
722	[EPON] Packet-based QoS mapping is not working in upstream Flow-cache.
1055	[BCM6858/6836/6846] Cannot add rate limit on egress TM object created without rate limit configured.
1478	[BCM6838 WLAN Dongle] Low inter BSS TCP throughput from 802.11ac client to 802.11n client.
1479	[PON] Upstream DSCP to P-bit mapping does not work in GbE mode.
1848	[BCM6858/6836/6846] DHD offload is limited to unicast traffic. Multicast traffic is forwarded via WFD.
2029	[BCM6858X][EPON CTC] Upstream packet-based QoS mapping not supported.
2342	[BCM6858/6836/6846] RX GEM discards counter is not incremented for IPTV filtered packets.
2436	[BCM6858/6846/6836] Ingress flow control is inaccurate.
2456	[BCM55045] Downstream rate limit is not working on more than one port.
2459	[BCM6836/6846] Broadcom Speed Service is not implemented.
2493	[BCM55045] DPU split scheduling mode (downstream performance optimization) not working.
2500	[BCM55045] Control SID not configured as highest priority in egress queues scheduling.
2504	[BCM6858/6836/6846/55045] Memory leak when deleting ingress classifier flows pointing to VLAN actions.

Chapter 4: WLAN Updates

4.1 WLAN Updates

4.1.1 Default Software Version (17.2)

- impl30, WLAN software package version 7.14.170.1708 (WLAN software stack for DSL/PON platforms)
- impl27, WLAN software package version 9.10.178.7106 (Initial WLAN software stack support specific for BCM47189 platform)

4.1.2 Fixes and Changes

- [dhd:] Add multicast/broadcast counter support for proprietary CONFIG_BCM_KF_EXTSTATS (ref#26212).
- [dhd:] Add 64-bit counters support (ref#28011).
- [dhd:] Fixed a crash issue when sending multicast traffic from ETH WAN to WLAN when WMF and offload is disabled (ref#28181).
- PKTC-related fixes:
  - [dhd:] Fixed a crash with trace ...dhd_sendpkt→dhd_bus_txdata→dhd_prot_txqueue_flush... (ref#27834).
  - [wl driver:] Fixed a potential buffer leak when deleting chaining entry (ref#26851).
  - [wl driver:] Fixed a potential crash when initializing dwds connection (ref#27957).
- [wlcsm_dm:] WPA2-PSK (security) Settings in NVRAM and Web UI may be out of sync (ref# 27024).
- [wlcsm_dm:] NVRAM may not be saved across reboot with manually re-configured NVRAM values (ref#27992).
- [wlmngr2/Pure TR181:] Fixed issue that fails to set 80 or 160 MHz bandwidth with message wlmngr:error:338.173:mdm_validateParamNodeString:4756:param name=ExtensionChannel, error=9007(ref# 27356).
- [pcie:] Added ability to configure PCIe parameters (SSC, boot order, speed, and so on) with NVRAM without requiring recompilation (ref#26910).
- Misc. Endianess fixes for MIPS platforms.

Notes:

- [dhd:] Replaced ctdma nvramvars with mutxmax nvram to control max MU clients at boot. Default is 0 (no MU support) for BCM6838/6848/47189 PCIe Gen1 platforms (ref#27839).
- [userspace/apps/wlan:] Removed old wlmgr and renamed 181wlmngr to wlmngr2 (ref#27953#).
- [6846/runner:] Only dhd 0 interface can be offloaded. Note this limitation in hardware/system interface ordering in design.

Chapter 5: BCM96XXX Broadband Router Software

5.1 Architecture

This section describes the high-level architecture of the BCM96XXX Broadband Router software. It is intended for new users of the Broadcom BCM96XXX Broadband Router reference software. Those already familiar with the software architecture can skip this section.

When the system is powered on, a bootloader called the Common Firmware Environment (CFE) initializes the hardware and loads the kernel and system image.

The kernel is Linux 4.1. Broadcom provides additional drivers and kernel modules via dynamic loadable objects.

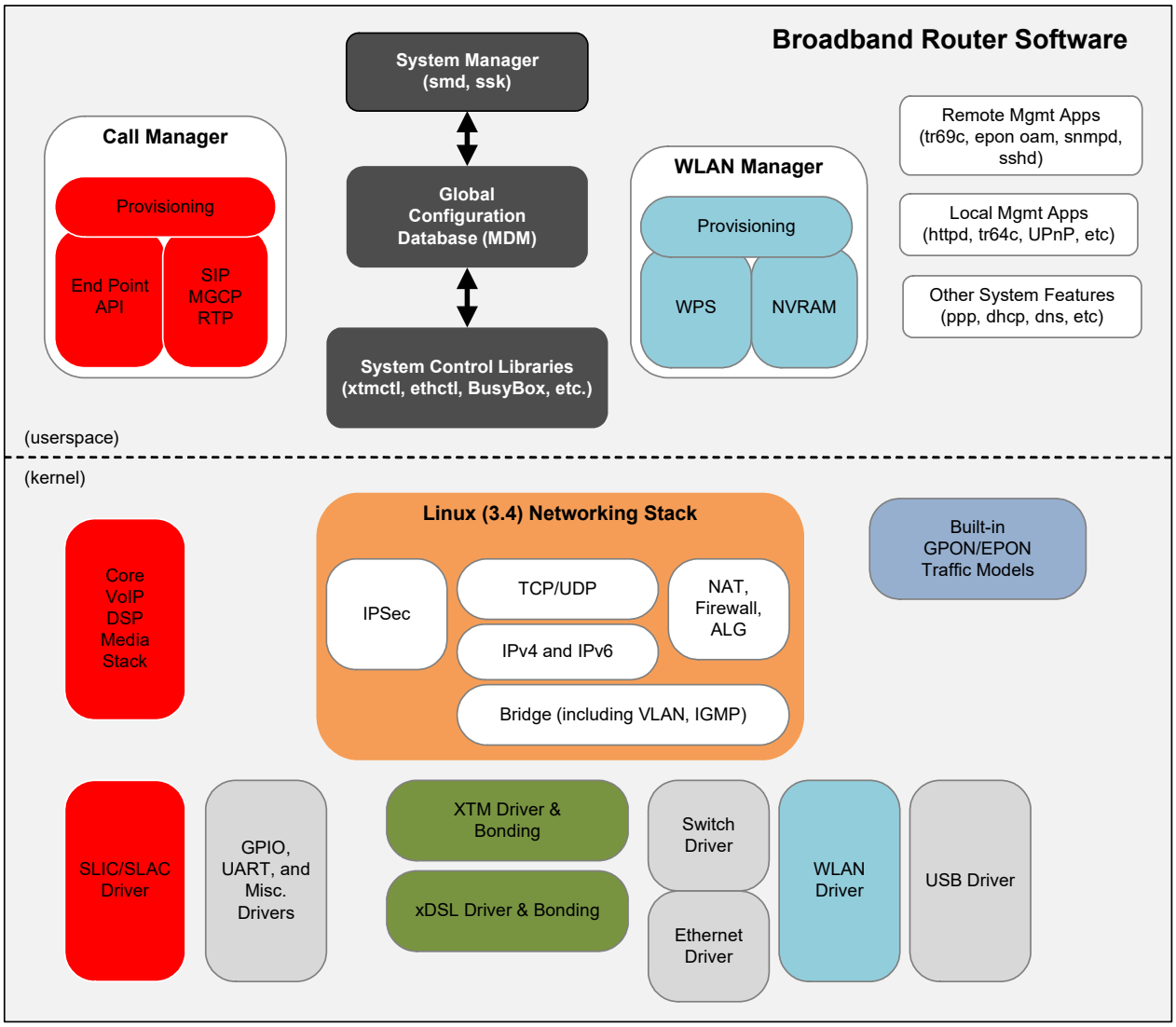
The system image is a compressed, read-only file system using SquashFS. A small read-write temporary/nonpersistent file system (tmpfs) is also configured for use by the system software.

In userspace, a common micro-library of useful utilities called “busybox” is used for many low-level features, including the shell, networking commands, and so on. Broadcom has also developed a userspace management system called CMS, which is fully described in the “Configuration Management System (CMS) Developer’s Guide”.

All userspace processes run as separate threads in their own address space.

A high-level diagram of the software architecture is shown in Figure 1 on page 24.

Figure 1: BCM96XXX Broadband Router Software Architecture



NOTE: In Figure 1, the DSLxChange software (shown in the red boxes) is provided separately.

5.2 Summary of Features

The table below lists all the features supported by the reference software, including the release in which it first appeared, and any additional notes about that feature.

Table 4: Broadband Router Software Features

Feature	Version	Notes
Bootloader/CFE		
64 KB CFE bootloader with LZMA compression	4.02L.01	–
WebUI upload of image from CFE	4.02L.01	–
Dual image boot	4.02L.01	–
Storage of config in flash	4.02L.01	–
Support for dual config files in flash	4.04L.01	–
Scratchpad in flash	4.02L.01	–
Support for NAND flash	4.06L.01	–
DSL		
Dying Gasp	4.02L.01	–
ATM QoS: CBR, rt-VBR, nrt-VBR, UBR-with PCR, UBR service categories and associated traffic parameters (PCR, SCR, MBS)	4.02L.01	–
Multiple PVCs	4.02L.01	–
Multiple Protocol VLAN mux	4.02L.01	Support for multiple protocols on a single PVC using VLAN ID.
Multiple Service PVC (MSC)	4.04L.01	Support for PPPoE, IpoE, and Bridge over a single PVC.
Simultaneous config for ATM and PTM, and live switching	4.04L.01	–
ADSL CLI command integration with MDM	4.04L.01	When the adsl command is used with the start or configure option, configuration changes are saved to the MDM. Also added are —save and —restore options, so that users can save the current driver configuration to the MDM or restore the configuration from the MDM to the driver.
ATM bonding	4.04L.02	–
PTM bonding	4.04L.02	–
Kernel		
Linux 2.6.30	4.06L.01	Linux 2.6.30 is not supported from 4.14L.x onwards.
Linux 3.4	4.14L.01	Linux 3.4 is not supported from 5.02L.x onwards.
Linux 4.1	5.02L.01	–
Networking Protocols		
RFC2684 VC-MUX, LLC/SNAP encapsulations for bridged or routed packets	4.02L.01	–
802.1q/1p VLAN over RFC2684 bridge encapsulation	4.02L.01	–
PPPoA	4.02L.02	Support for AUTO, PAP, CHAP, and MS-CHAP authentication. Auto or static IP address assignment.
PPPoE	4.02L.01	Support for AUTO, PAP, CHAP, and MS-CHAP authentication. Auto or static IP address assignment.

Table 4: Broadband Router Software Features (Continued)

Feature	Version	Notes
PPPoE pass-through	4.02L.01	Supports concurrent PPPoE clients inside the modem and PPPoE clients on the LAN devices.
PPPoE filtering of non-PPPoE packets between WAN and LAN	4.02L.01	Supports filtered non-PPPoE packets.
Auto clean up of remote stalled PPP sessions at BRAS	4.02L.01	–
IpoA	4.02L.01	–
IpoE/MER (IP over Ethernet over AAL5)	4.02L.01	–
Transparent bridging between all LAN and WAN interfaces	4.02L.01	–
WAN-to-WAN blocking in bridge mode	4.02L.01	–
Ethernet as WAN	4.02L.01	–
Networking		
Full Cone NAT	4.02L.01	–
DMZ Host	4.02L.01	–
ALGs		
FTP	4.02L.01	–
TFTP	4.02L.01	–
SIP	4.02L.01	This feature was further enhanced in 4.04L.01.
RTSP	4.02L.01	–
H.323	4.02L.01	–
Port Triggering	4.02L.01	–
PTP	4.02L.01	–
IPsec/VPN and IPsec/L2TP	4.02L.01	–
VPNs		
IPsec VPN	4.02L.02	–
L2TP client	4.04L.01	–
PPtP client	4.06L.01	–
Firewall/Filtering		
Stateful Inspection	4.02L.01	–
Denial of Service suppression	4.02L.01	ARP, Ping, Ping of Death, Land, SYNC, Smurf, unreachable, teardrop, SYN flood, fraggle, and echo.
Packet filtering	4.02L.01	Packets can be blocked based on interface, MAC address, IP address, protocol, and port number.
LAN side firewall	4.02L.03	By default, the LAN-side firewall is disabled.
Parental Control		
Time of day usage restriction	4.02L.01	–
URI/URL Filtering	4.02L.01	Supports INCLUDE and EXCLUDE modes.
QoS		
IP/Bridge/802.1p	4.02L.01	–
Rate Control on upstream traffic	4.02L.02	–
Routing		

Table 4: Broadband Router Software Features (Continued)

Feature	Version	Notes
RIP v1/v2	4.02L.01	Enable RIP over multiple WAN interfaces.
Policy Routing	4.02L.01	Routes packets based on criteria other than destination IP address.
IGMP		
Proxy and snooping	4.02L.01	–
IGMP v2 and v3	4.02L.01	–
Support for Ipv6	4.02L.03	–
IPv6		
IPv6 Ready Logo Certified	4.02L.03	–
IPv6 Firewall	4.02L.03	–
IPv6 capable apps	4.02L.03	telnetd, ftpd, sshd, and httpd.
File systems		
SquashFS	4.02L.01	File system used on NOR flash systems.
JFFS2	4.04L.01	File system used on NAND flash systems.
tmpfs	4.02L.01	Small read/write file system.
VFAT	4.02L.01	For USB automount feature.
NTFS	4.04L.01	For USB automount feature. Support for Unicode and files greater than 2 GB requires a different toolchain.
USB		
USB 1.1 Host Driver	4.02L.01	On BCM6338 devices.
USB 1.1 Device Driver	4.02L.01	On BCM6338 and BCM6358 devices.
USB 2.0 Host Driver	4.02L.01	On BCM6358, BCM6368, BCM6362, and BCM63281 devices.
USB 2.0 Device Driver	4.02L.01	On BCM6368, BCM6362, and BCM63281 devices.
Automatic mounting of USB disks	4.02L.01	–
Access to mounted USB disk via FTP	4.02L.01	–
Tools and Utilities		
toolchain (gcc-4.6)	4.14L.01	–
uclibc (0.9.32)	4.14L.01	–
BusyBox (v1.0)	4.02L.01	–
libcreduction	4.02L.01	–
DHCP Server		
Support for multiple subnets	4.02L.03	–
Static IP lease	4.02L.01	–
DHCP relay	4.02L.01	–
DHCP client	4.02L.01	–
LAN Services		
Second IP address on LAN interface	4.02L.01	On DHCPD service on second IP address.
DNS Proxy	–	This feature was further enhanced in 4.04L.01.
Built-in DNS server	4.02L.01	–
Caching previous requests	4.02L.01	–
Web UI		

Table 4: Broadband Router Software Features (Continued)

Feature	Version	Notes
Protection against Cross Site Request Forgery attack	4.04L.01	–
TR-069		
Digest Authentication, SSL and Basic Authentication, and SSL and Digest Authentication	4.02L.01	–
Auto-launch and exit-on-idle	4.02L.01	This feature saves system memory when the tr69c process is not running.
TR-098	4.02L.01	Many parameters are supported. See CMS-supported-parameters-report.PDF. Additional parameters can be easily configured by the customer.
TR-098 profile support	4.02L.01	IPPing, ATMLoopback, and DSLDiagnostics.
TR-111 (part 1)	4.02L.01	–
TR-140	4.04L.01	Storage Data Model (partially supported.)
TR-104	4.04L.01	Voice data model, used with the VoIP software, which is provided separately.
TR-064	4.02L.01	Supported
TR-143	4.16L.04	Network Throughput Performance Tests and Statistical Monitoring.
TR-157	4.16L.04	Software Module Management
TR-181	4.16L.04	Many parameters are supported. See CMS-supported-parameters-report.PDF. Additional parameters can be easily configured by the customer.
SNMP		
v1/v2c agent	4.02L.01	–
MIB-II	4.02L.01	–
RFC 2662 ADSL line MIB	4.02L.01	–
RFC 2515 ATM MIB	4.02L.01	–
UpnP		
Internet Gateway Device (IGDv1.0)	4.02L.01	–
Finite (24-hour) duration of virtual server entries created using UpnP	4.04L.01	To protect against a scenario where a PC client creates a virtual server entry on the Broadband Router and then leaves the network without deleting the virtual server entry, virtual server entries created by UpnP have a maximum lifetime of 24 hours.
Security		
Three-level login	4.02L.01	Local admin, local user, and remote support.
Service access based on incoming interface and/or source IP address	4.02L.01	This has changed from the 3.x model. For details, refer to FirewallConfig.PDFD.
Automatic logout from CLI after inactivity	4.02L.01	–
Audit and Logging		
Send log to remote syslog server	4.02L.01	–
Diagnostics		
Interface Connectivity	4.02L.01	Ethernet and USB.
DSL Service Connectivity	4.02L.01	xDSL Synchronization, OAM F5 segment ping, and OAM F5 end-to-end ping.
Internet Connectivity	4.02L.01	ISP authentication, assigned IP address, and default gateway/primary DNS server connectivity.
Other Features		
USB Printer Server	4.02L.01	Supports USB printer server using IPP protocol.

Table 4: Broadband Router Software Features (Continued)

Feature	Version	Notes
Dynamic DNS	4.02L.01	–
SNTP time synchronization	4.02L.01	–
SSH	4.02L.01	–
Telnet	4.02L.01	–
DLNA Support	4.06L.01	–
Power Management	4.04L.02	–
Ingress QoS	4.10L.01	–
Acceleration of Multicast Traffic	4.10L.01	–
Buffer Pool Management (BPM)	4.10L.01	–
OSGI/JVM	4.10L.01	–

5.3 Install, Load, and Configure the Software

The following instructions use the 4.16L.03 release as an example. Replace the 4.16L.03 string with the number of the release you are using.

5.3.1 Install the BCM96XXX Broadband Router Software Release Tarball

The BCM96XXX Broadband Router installation components are stored in a compressed tarball. The tarball file, bcm963xx_<version#>_data_full_release.tar.gz, contains the binary images and source code. These instructions assume you are installing the Broadband Router Software on a Linux PC. To install the components, follow these steps:

1. Decide where you want to install the source code. Generally, this should be placed in the directory tree of an ordinary user.
2. If necessary, make the install directory.
   `mkdir $HOME/router_416/`
3. cd into the install directory.
   `cd $HOME/router_416`
4. Extract the tarball into that directory.
   `tar xvfz bcm963xx_4.16L.03_data_full_release.tar.gz`
5. The `bcminstall` script has been deprecated. Create a subdirectory called “bcm963xx”.
   `mkdir bcm963xx`
6. cd to BCM963XX and untar the data_src tarball into your directory.
   `cd bcm963xx” and “tar xzf ../bcm963xx_4.16L.03_data_src.tar.gz`
7. If you have received additional add-on tarballs, untar them from the BCM963XX directory just as you did with the data_src tarball.

5.3.2 Install the Toolchain

The `bcminstall` script will check that the toolchain is installed. The toolchain must be installed in /opt. You may need to “su” to root to be able to write to /opt.

NOTE: The new toolchain, designed for the Linux 4.1 kernel, is required. The old toolchain will not work with the 4.1 kernel.

To install the toolchain:

1. Untar crosstools-gcc-5.3-linux-4.1-uclibc-1.0.12-glibc-2.22-binutils-2.25-Rel1.8-full.tar.bz2.
   ```
   tar -xPfj crosstools-arm-gcc-5.3-linux-4.1-gibc-2.22-binutils-2.25.Rel1.8.tar.bz2”
   repeat for the mips,mipsel and aarch64 toolchains if needed
   ```

   The “P” option will instruct tar to use an absolute path, which is /opt.
2. Remove the older toolchains in /opt. (This step is optional.)

5.3.3 Download Software Images to the Reference Board

The reference board provided by Broadcom typically has the bootloader and router images already installed. By default, the router will address 192.168.1.1 on the 192.168.1.x subnet on the LAN (Ethernet) side. Follow the instructions in this section if you need to download new or custom-built images.

There are various ways to load an image onto the Broadband router, such as from a:

- Linux Web UI
- FTP server on the router
- TFTP server on the router
- CLI TFTP client command
- CFE command line
- Simple CFE web interface

The Linux Web UI, FTP server, and TFTP server methods can only be used if there is already a router image installed on the board and the board can successfully boot Linux.

The CFE command line and CFE web interface methods can be used if the board has only a bootloader installed or if the router cannot boot up to Linux.

If no bootloader is installed on the board, a bootloader must be installed using a JTAG debugger. Refer to the "BCM963XX CFE Boot Loader and Flash Memory Structure: CFE Boot Loader Version 1.0.37-0.X" Application Note for instructions.

5.3.4 Load an Image via the Linux Web UI

1. Configure your PC to acquire the IP address using DHCP.
2. Connect an Ethernet cable between the PC and the Broadcom BCM96XXX Broadband Router.
3. Open a web browser on the PC, and type **http://192.168.1.1** in the address bar.
4. Login with the username **admin** and password **admin**.
5. Go to the **management** and then **Update software** section.
6. .Select the appropriate image from the PC. The router will upload the image, burn it to the flash, and reboot.

5.3.5 Load an Image via an FTP Server on the Router

1. Configure your PC to acquire the IP address using DHCP.
2. Connect an Ethernet cable between the PC and the Broadcom BCM96XXX Broadband Router.
3. Connect to the router by typing **ftp 192.168.1.1**.
4. Log in using username **admin** and password **admin**.
5. Type **bin**.
6. Type **put <image-name>**.

5.3.6 Load an Image from the CFE Command Line (TFTP)

In order to use the CLI TFTP client command on the router, you must configure and run a TFTP server on the LAN PC connected to the Broadband Router.

1. Connect to the serial port of the router with these parameters:
   a. baud rate = 115200
   b. 8 data bits
   c. 1 stop bit
   d. No parity
   e. No flow control
2. Turn the router on and press the Space key on the serial port within 1 second to stop the automatic boot process. By default, the router's address is 192.168.1.1 and the router will try to get the image from 192.168.1.100.
3. Configure your PC with a static IP address of **192.168.1.100**.
4. Connect an Ethernet cable between the PC and the Broadband Router. The Ethernet cable must be plugged into eth0 on the Broadband Router. Typically, eth0 is on one of the ends but, in some cases, eth0 may be one of the middle ports. Some trial and error is needed here. If you do not plug the Ethernet cable into eth0, then the next step will time-out. If this happens, try a different Ethernet port.
5. Next, get the image.
   a. To get a "Broadcom tagged" image, type **f <image-name>**.
   b. To get a "whole image" (an image that contains the NVRAM, CFE bootloader, and Linux image), type **w <image-name>**. Note whole images end in ".w."

5.3.7 Load an Image from the CFE Web Interface

The CFE has a simple web interface that can only do one thing, upload an image.

1. Configure your PC with a static IP address of **192.168.1.100**.
2. Connect an Ethernet cable between the PC and the Broadband Router. The Ethernet cable must be plugged into eth0 on the Broadband Router. Typically, eth0 is on one of the ends but, in some cases, eth0 may be one of the middle ports. Some trial and error is needed here. If you do not plug the Ethernet cable into eth0, then the next step will time-out. If this happens, try a different Ethernet port.
3. Open a web browser on the PC and type **?http://192.168.1.1**. in the address bar.
4. Select the image from the LAN PC. The router will upload the image, burn it to the flash, and reboot.

5.3.8 Configure the Broadband Router

By default, the router address is 192.168.1.1 on the 192.168.1.x subnet on the LAN (Ethernet) side. There are several ways to configure the BCM96XXX Broadband Router. The easiest way is through the WebUI. Follow these steps:

1. Configure your PC to acquire an IP address using DHCP.
2. Connect the PC and the Broadcom BCM96XXX Broadband Router via an Ethernet cable.
3. Open a web browser on the PC and type **?http://192.168.1.1** in the address bar.
4. Type the username (**admin**) and password (**admin**).

   You may see a quick setup web page. If so, follow the instructions on that page. Alternatively, you may choose to skip the quick setup page.

Most settings are under the Advanced Setup, Wireless, or Management sections on the left panel of the web page.

5.3.9 Install the Microsoft Windows NDIS USB Drivers

To install the Microsoft Windows Remote NDIS USB drivers, follow these steps:

1. On a Windows 98, Windows Me, Windows 2000, or Windows XP PC, create a temporary directory.
   ```
   mkdir \temp\bcm963xxusb
   ```
2. Change the location to that of the temporary directory.
   ```
   cd \temp\bcm963xxusb
   ```
3. Copy bcm963xxwinusbrndis.zip from the Linux PC to the Windows PC. This zip file is located at /opt/bcm963xxwinusbrndis.zip.
4. Unzip bcm963xxwinusbrndis.zip into the temporary directory.
5. Connect the PC and the BCM963XX DSL router via a USB cable.
6. The first time that this is done, the Windows PC displays the New Hardware Found dialog. When prompted for the location of the driver, specify the temporary directory, \temp\bcm963xxusb.
7. On a Windows 98 or Windows Me system, reboot the Windows PC.
8. The BCM96XXX Broadband Router Windows USB driver looks like a network adapter card to Windows and is bound to TCP/IP. Configure TCP/IP appropriately for your environment.

The driver is now operational.

5.3.10 Build the Broadband Router Software

Refer to the documents that describe the BCM96XXX build environment in detail:

- LinuxDeveloperGuide-963XX-SWUM2xx-SWRDS.pdf (see "Related Documents" on page 7)
- SoftwareBoardParameters-963XX-SWUM4xx-R.pdf (see "Related Documents" on page 7)

To build the BCM96XXX Broadband Router image, follow these steps:

1. Navigate to the BCM963XX directory.
2. Remove any temporary files.
   `make PROFILE=<profile_name> clean`
   `<profile_name>` is one of the predefined profiles listed under bcm963xx/targets. You can also create a customized profile by running `make menuconfig`. Refer to the "*BCM963XX Linux Software Development Guide LinuxDeveloperGuide.pdf*".
3. Build an image.
   `make PROFILE=<profile_name> [BRCM_BOARD_ID=boardID]`
   For example, to build an image for a BCM63138-based board, type **make PROFILE=963138GW**.
   The BRCM_BOARD_ID parameter is optional. Refer to *bcm963xx_board_config_parameters.pdf* (see "Related Documents" on page 7) for more details.
   If your board has a different hardware configuration, you must create a new board parameter table in boardparms.c, which is located in bcm963xx/targets.

The image created by this build is located in the bcm963xx/targets/<profile_name> directory. That image will be copied to the bcm963xx/images directory with a build timestamp attached to the file name.

5.3.11 Build Host Requirements

A PC running the Linux operating system is required to build the reference software. In general, the Linux operating system should be relatively recent (RHEL5.3 or newer). Due to the variety of Linux operating system distributions, it is not possible to specify the exact requirements. However, here are some general items that will help ensure that the Broadcom BCM96XXX reference software release is successfully compiled.

If given a choice during the Linux operating system installation process, choose the Development option. This option will install the following tools that are useful for software development:

- make 3.81
- automake 1.10.2
- autoconf 2.65
- kernel 2.6.21 or later
- ncurses: for `make menuconfig`
- perl: for data model generation

On Debian and Ubuntu systems, make sure that /bin/sh points to /bin/bash and not /bin/dash.

Example: Building an Ubuntu build host (as of Ubuntu 12.04 -- Precise Pangolin)

Perform a basic install/update:

```
sudo su -
apt-get update
apt-get upgrade
```

dpkg-reconfigure dash # and change back to /bin/sh:

```
apt-get install
```

build-essential automake flex bison libncurses5-dev lzma-dev liblzma-dev lzma binutils-dev libtool:

```
liblzo2-dev uuid-dev
```

If build machine is 64-bit

```
ia32-libs libc6-dev-i386
```

If /bin/arch does not exist, create a /bin/arch shell script that calls “uname -m”:

```
sudo su -
cd /
tar xf crosstools-mips-gcc-4.6-linux-3.4-uclibc-0.9.32-binutils-2.21.Rel1.1.tar.bz2
```

5.4 [BCM963138/BCM963148] DDR and Flash Configuration

5.4.1 DDR Configuration

BCM63138/BCM63148 stores the DDR configuration (size, clock, speed grade, memory chip data width, and so on) in the NVRAM. The DDR configuration is a 32-bit board parameter ID bp_ulMemoryConfig in the boardparms.c file for a particular board ID and is saved in NVRAM.

When a new board first boots up, the CFE ROM uses default safe mode DDR configuration to initialize the DDR and run CFE RAM. The CFE RAM then saves the configuration to NVRAM. The CFE RAM always compares the DDR configuration from the value set in boardparms.c to the NVRAM configuration. It updates the NVRAM configuration and reboots automatically if they are different. This allows the DDR configuration to be updated on the board automatically if the new software release changes the DDR configuration.

There is a way to prevent this automatic update when setting the NVRAM configuration overwrite bit. When CFE starts, and just before DDR Shmoo is running, the CFE prints out the current DDR configuration in NVRAM:

```
…
MAIN
DRAM
NVRAM memcMCB chksum 0xf51e43ef
DDR3-1600 CL11 128MBx2
…
```

The DDR configuration board parameter is defined in the following format in boardparms.c:

```
{bp_ulMemoryConfig, .u.ul = BP_DDR_SPEED_533_8_8_8 | BP_DDR_TOTAL_SIZE_128MB|
    BP_DDR_DEVICE_WIDTH_16},
```

This means single ×16 DDR chip of total size 128 MB running at DDR3 1066 data rate with CAS latency = 8.

```
{bp_ulMemoryConfig, .u.ul = BP_DDR_SPEED_800_11_11_11 | BP_DDR_TOTAL_SIZE_1024MB|
    BP_DDR_DEVICE_WIDTH_8},
```

This means two x8 DDR chips of 512 MB each running at DDR3 1600 data rate with CAS latency = 11.

The complete definitions of these parameters are listed below:

```
#define BP_DDR_SPEED_MASK            0x1f
#define BP_DDR_SPEED_SHIFT           0
#define BP_DDR_SPEED_SAFE            0
#define BP_DDR_SPEED_400_6_6_6          1
#define BP_DDR_SPEED_533_7_7_7          2
#define BP_DDR_SPEED_533_8_8_8          3
#define BP_DDR_SPEED_667_9_9_9          4
#define BP_DDR_SPEED_667_10_10_10       5
#define BP_DDR_SPEED_800_10_10_10       6
#define BP_DDR_SPEED_800_11_11_11       7
#define BP_DDR_SPEED_CUSTOM_1           27
#define BP_DDR_SPEED_CUSTOM_2           28
#define BP_DDR_SPEED_CUSTOM_3           29
#define BP_DDR_SPEED_CUSTOM_4           30

#define BP_DDR_DEVICE_WIDTH_MASK     0x70
#define BP_DDR_DEVICE_WIDTH_SHIFT    5
#define BP_DDR_DEVICE_WIDTH_8        (0 << BP_DDR_DEVICE_WIDTH_SHIFT)
#define BP_DDR_DEVICE_WIDTH_16       (1 << BP_DDR_DEVICE_WIDTH_SHIFT)

#define BP_DDR_TOTAL_SIZE_MASK       0xf00
#define BP_DDR_TOTAL_SIZE_SHIFT      8
#define BP_DDR_TOTAL_SIZE_64MB       (1 << BP_DDR_TOTAL_SIZE_SHIFT)
#define BP_DDR_TOTAL_SIZE_128MB      (2 << BP_DDR_TOTAL_SIZE_SHIFT)
#define BP_DDR_TOTAL_SIZE_256MB      (3 << BP_DDR_TOTAL_SIZE_SHIFT)
#define BP_DDR_TOTAL_SIZE_512MB      (4 << BP_DDR_TOTAL_SIZE_SHIFT)
#define BP_DDR_TOTAL_SIZE_1024MB     (5 << BP_DDR_TOTAL_SIZE_SHIFT)
#define BP_DDR_TOTAL_SIZE_2048MB     (6 << BP_DDR_TOTAL_SIZE_SHIFT)
```

5.4.2 Changing DDR Configuration

When using a different DDR chip than the BCM63138/BCM63148 reference design, create a new board ID with the correct bp_ulMemoryConfig setting. Loading the new code will automatically update the DDR configuration in the NVRAM.

CFE also supports a “ddr” command to manually change the DDR configuration from the CFE prompt without making any software change:

```
CFE> ddr
DDR Config OVERRIDE             :  0x307  0x80000303
Config Changed... REBOOT NEEDED
*** command status = 0
CFE>
```

The command writes the new configuration to NVRAM. In the example above, 0x307 is the old DDR configuration in the NVRAM and CFE board parameters. This command changes the DDR clock from 800 MHz to 533 MHz. It is also necessary to set bit 31. This bit is the NVRAM configuration overwrite bit that tells the CFE to not compare its built-in board parameter configuration 0x307 against NVRAM setting 0x303 and to update NVRAM. This ensures that CFE always uses the value entered from the command line.

5.4.3 DDR Safe Mode

If a board fails to boot due to the DDR memory problem, the BCM63138/BCM63148 CFE has an option to run in DDR safe mode and allow the board to boot for further debugging or fixing with a new DDR configuration. The DDR safe mode runs at a 533 MHz DDR clock with other conservative DDR parameters.

To run in the safe mode:

1. Power off the device.
2. Hold down the 'a' key.
3. Power on the device and type 's' to enter safe mode when this message appears:

```
CFE-ROM WAS ABORTED
Please choose one of the following options:
 c  - continue
 s  - DDR safe mode
```

To keep the board in safe mode without this special key abort, run the DDR command in CFE console and set the DDR configuration to 0x80000000 and reset the board:

```
CFE> ddr
DDR Config OVERRIDE             :  0x223  0x80000000
Config Changed... REBOOT NEEDED
*** command status = 0
```

5.4.4 Supported DDR Configuration

We have revised the early key abort to permit the DDR MCB selection to be specified at that point. This is very important for BCM63138, BCM63148, and BCM62118.

CFE-ROM Was Aborted

Please choose one of the following options:

- c - continue
- s - DDR safe mode
- i - followed by 0 to boot to a previous fs image
- 0 - followed by hex numbers to select MCB; CR/NL to continue

Each configuration has a corresponding MCB that is used by the DDR library during the initialization. CFE currently supports a limited number of common configurations and MCB due to the image size limitation.

The supported configuration is defined in cfe/cfe/arch/arm/board/bcm63xx_rom/src/bcm63xx_impl1/2_ddr_mcb.c.

Table 5 on page 39 lists the currently supported configurations for BCM63138 and BCM63148 devices and Table 6 on page 39 lists the configurations for the BCM62118 device.

Table 5: Supported BCM63138/BCM63148 DDR Configurations

Configuration	Value
DDR3-1066 CL8 Total 128 MB one 16-bit part	0x223
DDR3-1600 CL11 Total 128 MB One 16-bit part	0x227
DDR3-1066 CL8 Total 256 MB One 16-bit part	0x323
DDR3-1066 CL8 Total 256 MB two 8-bit parts	0x303
DDR3-1600 CL11 Total 256 MB One 16-bit part	0x327
DDR3-1600 CL11 Total 256 MB Two 8-bit parts	0x307
DDR3-1600 CL11 Total 256 MB One 16-bit part 0.5% SSC	0x2327
DDR3-1600 CL11 Total 256 MB One 16-bit part HT SRT	0x10327
DDR3-1600 CL11 Total 256 MB One 16-bit part HT ASR	0x20327
DDR3-800 CL6 Total 512 MB One 16-bit part	0x421 (safe mode)
DDR3-1066 CL8 Total 512 MB One 16-bit part	0x423
DDR3-1066 CL8 Total 512 MB two 8-bit parts	0x403
DDR3-1600 CL11 Total 512 MB one 16-bit part	0x427
DDR3-1600 CL11 Total 512 MB two 8-bit parts	0x407
DDR3-1600 CL11 Total 512 MB one 16-bit part 0.5% SSC	0x2427
DDR3-1600 CL11 Total 512 MB two 8-bit parts 0.5% SSC	0x2407
DDR3-1600 CL11 Total 512 MB one 16-bit part HT SRT	0x10427
DDR3-1600 CL11 Total 512 MB one 16-bit part HT ASR	0x20427
DDR3-1066 CL8 Total 1024 MB two 8-bit parts	0x503
DDR3-1600 CL11 Total 1024 MB two 8-bit parts	0x507
DDR3-1600 CL11 Total 1024 MB two 8-bit parts 0.5% SSC	0x2507

Table 6: Supported BCM62118 DDR Configurations

Configuration	Value
DDR3-1066 CL8 Total 512 MB one 16-bit part 1% SSC	0x1423
DDR3-1600 CL11 Total 512 MB one 16-bit part 1% SSC	0x1427
DDR3-1066 CL8 Total 1024 MB one 16-bit part	0x523 (safe mode)
DDR3-1066 CL8 Total 1024 MB one 16-bit part 1% SSC	0x1523
DDR3-1066 CL8 Total 1024 MB two 16-bit parts 1% SSC	0x41523
DDR3-1600 CL11 Total 1024 MB one 16-bit part 1% SSC	0x1527
DDR3-1600 CL11 Total 1024 MB two 16-bit parts 1% SSC	0x41527
DDR3-1600 CL11 Total 1024 MB two 16-bit parts 1% SSC HT SRT	0x51527
DDR3-1600 CL11 Total 1024 MB two 16-bit parts 1% SSC HT ASR	0x61527
DDR3-1066 CL8 Total 2048 MB two 16-bit parts 1% SSC	0x41623
DDR3-1600 CL11 Total 2048 MB two 16-bit parts 1% SSC	0x41627

Chapter 6: Supporting Documents

This release contains additional documents under the `docs/customerDocs` directory. There is continuous effort to keep these documents current, however, some documents may be out-of-date and should be used as reference only. Recently updated and important documents are marked with (***). Other documents may be found in the *App Notes & Software Manuals - BCA CPE* directory in docSAFE.

Table 7: customerDocs Documentation

Document Name	DocSAFE Document Number
636x-XTM-Bonding-InfoNote.pdf	–
AdvancedDMZ.pdf	–
AppDebuggingGuideUsingGDB.pdf	CPE-AN500-R
AppsUnderNAPT.pdf	–
BatteryManagementUnitUserGuide.pdf	–
bcm963xx_bootloader_apppnote.pdf	963XX-AN102-R
BPM_AppNote_CPE-AN100-RDS.pdf	CPE-AN100-R
Broadband_CPE_GMAC_WAN-CPE-AN1300-R.pdf	CPE-AN1300-R
ButtonConfiguration.pdf (***)	–
CLI_Reference_Manual-963XX-SWUM103-RDS.pdf (***)	963XX-SWUM103-R
CMS_Configuration-File-CPE-AN700-SWRDS.pdf (***)	CPE-AN700-R
CMS_Developers_Guide-CPE-SWUM102-SWRDS.pdf	CPE-SWUM102-R
CMS-DESKTOP-LINUX-CPE-AN601-RDS.pdf	CPE-AN601-R
Consumer_Release.pdf	–
DFS_troubleshooting_Rev_2_0.pdf	–
DHD_Offload_AppNote-CPE-AN2300-RDS.pdf	CPE-AN2300-R
DLNAServerUserGuide.pdf	–
Downsizing_the_CPE_Linux_Flash_Image-96XXX-AN101-RDS.pdf	96XXX-AN101-R
DPI_AppNote.pdf	–
eponctl_commands_v_0_1.pdf	–
ethswctl_commands_v_0_1.pdf	–
FAP_TM_Operation_Guide-CPE-AN400-R.pdf	CPE-AN400-R
FAP_WRED_OPERATION_GUIDE.pdf (***)	–
FirewallConfig_CPE-AN1500-RDS.pdf	CPE-AN1500-R
FLOWSTATS_AppNote_CPE-AN202-RDS.pdf	CPE-AN202-R
GMAC WAN Application Note	CPE-AN1300-R
gponif_commands_CPE-AN1200-SWRDS.pdf	CPE-AN1200-R
IEEE1905Explained.pdf	–
IEEE1905UserGuide.pdf	–
IGMPUserGuide_CPE-AN2200-RDS.pdf	CPE-AN2200-R
Igmpv3Proxy.pdf	–
IngressQoS_AppNote_963XX-AN401-SWRDS.pdf	963XX-AN401-R
IPSecUserGuide.pdf	963XX-UM2xx-R
Kernel_Bonding_Driver_AppNote	–
Linux_3.4_Migration_Guide-CPE-AN300-R.pdf	CPE-AN300-R

Table 7: customerDocs Documentation (Continued)

Document Name	DocSAFE Document Number
LinuxDeveloperGuide_963XX-SWUM202-SWRDS.pdf	963XX-SWUM202-R
L2_Acceleration_Support_AppNote.pdf	–
MDK_API_CLI_For_InternalSwitches_v1_0.pdf	–
MIMO_9470x_Plus_4322_WL_Test_command_sequences_0418-2008.pdf	–
MoCA20_API.pdf	–
MoCA20_Diag-MOCA-TI102-R.pdf	MOCA-TI102-R
MPTCP_WAN_AppNote	–
MultipleBearer_Vdsl.pdf	–
MultipleSubnet.pdf	–
MultiService.pdf	–
NAND_Flash-CPE-AN1102-SWRDS.pdf	CPE-AN1102-R
OMCI_Message_Capture_and_Playback-CPE-AN2700-RDS.pdf	CPE-AN2700-R
OMCI_SFU_HGU_Configuration-CPE-AN2600-RDS.pdf	CPE-AN2600-R
OMCI_WEBUI_Tool_CPE-AN2400-RDS.pdf	CPE-AN2400-R
OMCIPM_Driver_API-CPE-AN2500-RDS.pdf	CPE-AN2500-R
osgiJvmDevelopmentGuide.pdf	–
PacketQoS.pdf	–
PowerManagementForDSL_Linux-CPE-AN900-SWRDS.pdf	CPE-AN900-R
PrinterServerSetup.pdf	–
Radarthrs_tuning_for_DFS_rev_4_0.pdf	–
RDPA_Traffic_Management_Operation_Guide-RDPA-AN100-R.pdf	RDPA-AN100-R
SeltTest_AppNote_CPE-AN1900-SWRDS.pdf	CPE-AN1900-R
SF2_QoS.pdf	–
SoftwareBoardParameters-963XX-SWUM402-R.pdf	963XX-SWUM402-R
Speed_Service_Operation_Guide-CPE-AN1800-SWRDS.pdf (***)	CPE-AN1800-R
switch_api_supplementv0_5.pdf	–
TR64.pdf	–
TR69VendorRPC_AppNote.pdf	–
TraceCapture_and_PortMirroring-CPE-AN2100-RDS.pdf (***)	CPE-AN2100-R
trng.pdf	–
Using_and_Configuring_printk-CPE-AN800-SWRDS.pdf (***)	CPE-AN800-R
VLAN_Control_Utility-VLAN-AN100-R	VLAN-AN100-R
VlanMux.pdf	–
WAPIOperationGuide.pdf	–
WifiAsWan.pdf (***)	–
WLANIngressQoS_AppNote.pdf	–
WLTool-80211-TI300-R.pdf	–
Work_with_packet_engines_2011_1116.pdf	–
WPSCustomerReference.pdf	–
WPSOperationGuide.pdf	–

Chapter 7: Source Code Directory Structure

7.1 Linux Kernel Source Code

The Linux kernel source code is located at /kernel/linux. It includes the following subdirectories that are specific to BCM96XXX.

NOTE: The source code in the directories and subdirectories listed below was developed by Broadcom. All these files can be required to be made available in the source code format.

Table 8: Linux Kernel Directory Structure

Directory	Description
/kernel/linux/arch/mips/brcm-boards/generic	–
/kernel/linux/arch/mips/brcm-boards/bcm963xx	These directories contain hardware initialization code for MIPS processor capabilities, SDRAM size, MIPS timer, and interrupts.
/kernel/linux/net/ipv4/netfilter/Broadcom	This directory contains NAT application-level-gateway (ALG) code developed by Broadcom.
/bcmdrivers/opensource/char/board/bcm963xx	This directory contains drivers for miscellaneous functions such as flash memory programming and LED toggling.
/bcmdrivers/opensource/char/serial	This directory contains the serial port driver.
/bcmdrivers/opensource/net/	This directory contains the serial Ethernet and XTMRT driver.
/bcmdrivers/opensource/include/bcm963xx	This directory contains header files for the BCM96XXX.

All other source code in the directory and subdirectories of /kernel/linux was developed as part of Linux project. Some of the files contain modifications made by Broadcom. All of these files can be required to be made available in the source code format.

7.2 Broadcom Proprietary Kernel Source Code

Broadcom proprietary kernel code is in various directories, listed in Table 9.

CAUTION! The source code in the directories and subdirectories listed below was developed by Broadcom. These files are subject to Broadcom SLA and cannot be released in the source code format although the applications or modules created from these files can be required to be made available in object code format.

Table 9: Broadcom Proprietary Kernel Directory Structure

Directory	Description
/bcmdrivers/broadcom/atm	This directory contains the driver for the Linux-defined ATM adaptation layer.
/bcmdrivers/broadcom/char	This directory contains drivers for ADSL connections and the Broadcom-defined ATM API.
/bcmdrivers/broadcom/net	This directory contains drivers for Ethernet, USB, and WLAN.
/bcmdrivers/broadcom/include/bcm963xx	This directory contains header files for the BCM963XX.
/targets/	This directory contains logical build PROFILEs for all hardware boards.
/shared	This directory contains source files that are shared by Linux router images and CFE bootloader images. It contains Broadcom and opensource subdirectories. The opensource directory contains boardparms and flash driver. The boardparms contains board-specific hardware definitions for all hardware boards.

7.3 Broadcom Proprietary Userspace Source Code

Broadcom proprietary userspace code is under userspace/private. The subdirectories are listed in Table 10.

CAUTION! The application source code in the directories and subdirectories listed below and any other source code under userspace/private was developed by Broadcom. These files are subject to Broadcom SLA and cannot be released in the source code format although the applications or modules created from these files can be required to be made available in object code format.

Table 10: Broadcom Proprietary Userspace Directory Structure

Directory	Description
/userspace/private/apps/adslctl	This directory contains a command line utility that controls the Broadcom ADSL driver.
/userspace/private/apps/atmctl	This directory contains a command line utility that controls the Broadcom ATM driver.
/userspace/private/apps/smd	This is the main CPE management application.
/userspace/private/apps/ssk	This is an assistant application to smd.
/userspace/private/apps/httpd	This is the Web UI server.
/userspace/private/apps/tr69c	This directory contains DSL Forum TR-69 WAN management protocol CPE side implementation.
/userspace/private/apps/upnp	This directory contains the Universal Plug and Play (UPnP) device support.
/userspace/private/apps/vodsl	This directory contains voice-over-DSL support.
/userspace/private/apps/wlctl	This directory contains the wireless driver configuration utility.
/userspace/private/apps/cellularapp	This directory contains the daemon for LTE WAN.
/userspace/private/apps/samos telephony	This directory contains LTE WAN “at” parser, modem-boot, and modem-fsa.

7.4 Open Source Userspace Source Code

Opensource userspace code is under userspace/public and userspace/gpl. They are listed in Table 11.

CAUTION! The application source code in the directories and subdirectories listed above is Open Source. Some of the files contain modifications made by Broadcom. All these files can be required to be made available in the source code format.

Table 11: Open Source Userspace Directory Structure

Directory	Description
/userspace/gpl/apps/atm2684	This directory contains the RFC 2684 user mode control application.
/userspace/gpl/apps/bridge-utils	This directory contains the user mode control utility to support bridge mode.
/userspace/gpl/apps/busybox	This directory contains the BusyBox utilities.
/userspace/gpl/apps/ebtables	This directory contains MAC layer packet filtering and manipulating support.
/userspace/gpl/apps/ftpd	This directory contains the bftpd FTP server.
/userspace/gpl/apps/iproute2	This directory contains Iproute2 Linux utility to support TC. **NOTE:** TC is no longer used as the upstream QoS mechanism starting from v3.06L1.
/userspace/gpl/apps/iproute2	This directory contains the Iproute2 and Traffic Control which supports various methods for classifying, prioritizing, sharing, and limiting both inbound and outbound traffic.
/userspace/gpl/apps/iptables	This directory contains IP layer packet filtering and Network Address/Port Translation support.
/userspace/gpl/apps/udhcp	This directory contains the DHCP server and client.
/userspace/gpl/apps/zebra	This directory contains RIP application.
/userspace/public/apps/dhcpv6	This directory contains the IPv6 DHCP server.
/userspace/public/apps/ipsec-tools	This directory contains Linux 2.6 IPsec VPN.
/userspace/public/apps/ledctl	This directory contains a simple LED control command utility.
/userspace/public/apps/ppp	This directory contains the PPP daemon.
/userspace/public/apps/samos ril	This directory contains rild daemon, ril library, and ril utility.
/userspace/public/apps/sshd	This directory contains the SSHD server.
/userspace/public/libs/cms_boardctl	This directory contains a library for various board IOCTLs.
/userspace/public/libs/cms_msg	This directory contains a library for message passing inside CMS.
/userspace/public/libs/cms_util	This directory contains a library of various useful functions used by CMS.
/userspace/public/libs/openssl	This directory contains the openssl library.

7.5 Open Source Project References

The open source software listed in Table 12 is used in this release.

Table 12: Open Source Project References

Name	Version	License	Url
Accel-pptp	2013.04.09	GPLv2	http://sourceforge.net/projects/accel-pptp/
Apache Felix Framework	3.0.1	Apache License 2.0	http://svn.apache.org/viewvc/felix/releases/org.apache.felix.framework-3.0.1/
Busybox	1.26.2	GPLv2	https://busybox.net/downloads/busybox-1.26.2.tar.bz2
Conntrack-tools	1.4.1	GPLv2	http://www.netfilter.org/projects/conntrack-tools/files/conntrack-tools-1.4.1.tar.bz2
Convert::Binary::C	0.77	GPL	http://search.cpan.org/CPAN/authors/id/M/MH/MHX/Convert-Binary-C-0.77.tar.gz
DBUS	1.10.8	GPLv2	http://dbus.freedesktop.org/releases/dbus/dbus-1.10.8.tar.gz
Dhcpv6	20080615	BSD	http://downloads.sourceforge.net/project/wide-dhcpv6/wide-dhcpv6/wide-dhcpv6-20080615/wide-dhcpv6-20080615.tar.gz
Dhrystone	2.2	Public Domain	http://homepages.cwi.nl/~steven/dry.c
Dnsproxy-nexgen	CVS Revision 1.1.1.1	GPLv2	http://dproxy.cvs.sourceforge.net/viewvc/dproxy/dproxy-nexgen/ (CVS Revision 1.1.1.1/ Fri Mar 17 08:25:44)
Dropbear	2016.74	MIT-style	https://matt.ucc.asn.au/dropbear/releases/dropbear-2016.74.tar.bz2
Ebtables	2.0.10-4	GPLv2	http://sourceforge.net/projects/ebtables/files/ebtables/ebtables-2-0-10-4/ebtables-v2.0.10-4.tar.gz/download
Ethtool	3.1	GPL	https://www.kernel.org/pub/software/network/ethtool/ethtool-3.10.tar.xz
GLIB	2.41.1	LGPLv2 GNU LIBRARY GENERAL PUBLIC LICENSE	https://download.gnome.org/sources/glib/2.41/glib-2.41.1.tar.xz
GNU Classpath	0.98	GPL	https://ftp.gnu.org/gnu/classpath/classpath-0.98.tar.gz
GNU Zebra	0.93a	GPLv2	ftp://ftp.sunet.se/pub/network/zebra/zebra-0.93a.tar.gz
Iperf	2.0.9	BSD	https://iperf.fr/download/source/iperf-2.0.9-source.tar.gz
Iproute2	4.3.0	GPLv2	https://www.kernel.org/pub/linux/utils/net/iproute2/iproute2-4.3.0.tar.gz
Iptables	1.4.21	GPLv2	http://www.netfilter.org/projects/iptables/files/iptables-1.4.21.tar.bz2
JamVM	JamVM 1.54	GPLv2	http://sourceforge.net/projects/jamvm/files/jamvm/JamVM%201.5.4/jamvm-1.5.4.tar.gz/download
LXC - Linux Containers	2.0.4	LGPLv2.1+ & BSD, GPLv2	https://linuxcontainers.org/downloads/lxc-2.0.4.tar.gz
Libcap	2.24	BSD	https://www.kernel.org/pub/linux/libs/security/linux-privs/libcap2/libcap-2.24.tar.gz
Libcurl	7.52.1	MIT	http://curl.haxx.se/download/curl-7.52.1.tar.gz
Libmnl	1.0.3	GPLv2	http://www.netfilter.org/projects/libmnl/files/libmnl-1.0.3.tar.bz2

Table 12: Open Source Project References (Continued)

Name	Version	License	Url
Libnetfilter_conntrack	1.0.3	GPLv2	http://www.netfilter.org/projects/libnetfilter_conntrack/files/libnetfilter_conntrack-1.0.3.tar.bz2
Libnetfilter_cthelper	1.0.0	GPLv2	http://www.netfilter.org/projects/libnetfilter_cthelper/files/libnetfilter_cthelper-1.0.0.tar.bz2
Libnetfilter_cttimeout	1.0.0	GPLv2	http://www.netfilter.org/projects/libnetfilter_cttimeout/files/libnetfilter_cttimeout-1.0.0.tar.bz2
Libnetfilter_queue	1.0.2	GPLv2	http://www.netfilter.org/projects/libnetfilter_queue/files/libnetfilter_queue-1.0.2.tar.bz2
Libnfnetlink	1.0.1	GPLv2	http://www.netfilter.org/projects/libnfnetlink/files/libnfnetlink-1.0.1.tar.bz2
Libpcap	1.8.1	BSD	http://www.tcpdump.org/release/libpcap-1.8.1.tar.gz
Linux Kernel	4.1.38	GPLv2	https://www.kernel.org/pub/linux/kernel/v4.x/linux-4.1.38.tar.gz
Lmbench	3.0-a9	GPLv2 Plus Publication Restriction	http://downloads.sourceforge.net/project/lmbench/development/lmbench-3.0-a9/lmbench-3.0-a9.tgz
Mtd	1.4.0	GPLv2	http://git.infradead.org/mtd-utils.git/snapshot/56840a198a70604ece50d9d727cebcc28930ab4c.tar.gz
Ntfs-3g	2016.2.22	GPLv2 & LGPLv2	https://tuxera.com/opensource/ntfs-3g_ntfsprogs-2016.2.22.tgz
Open vSwitch	2.5.0	Apache 2.0	http://openvswitch.org/releases/openvswitch-2.5.0.tar.gz
OpenBSD-crypto	$OpenBSD: v 1.2	BSD	http://ftp.usa.openbsd.org/pub/OpenBSD/src/sys/crypto/
OpenVPN	2.3.12	GPLv2	https://openvpn.net/index.php/open-source/downloads.html
Pciutils	3.4.1	GPLv2	https://www.kernel.org/pub/software/utils/pciutils/pciutils-3.4.1.tar.gz
Radvd	1.8	BSD	http://www.litech.org/radvd/dist/radvd-1.8.tar.gz
Samba	3.0.37	GPLv2	http://ftp.samba.org/pub/samba/samba-3.0.37.tar.gz
Strace	4.15	BSD	https://github.com/strace/strace/archive/v4.15.tar.gz
Stress	1.0.4	GPLv2	http://people.seas.harvard.edu/~apw/stress/stress-1.0.4.tar.gz
Sysstat	9.0.3	GPLv2	http://perso.orange.fr/sebastien.godard/sysstat-9.0.3.tar.bz2
Tcpdump	4.8.1	BSD	http://www.tcpdump.org/release/tcpdump-4.8.1.tar.gz
Valgrind	3.8.1	GPLv2	http://valgrind.org/downloads/valgrind-3.8.1.tar.bz2
ZLIB	1.2.8	ZLIB	http://zlib.net/zlib-1.2.8.tar.gz
alljoyn	15.09.00a	ISC (http://opensource.org/licenses/ISC)	https://allseenalliance.org/releases/alljoyn/15.09/alljoyn-15.09.00a-src.tar.gz
davidshimjs-qrcode	0.0.1	Open	http://davidshimjs.github.io/qrcodejs/
e2fsprogs	1.43.4	GPLv2	https://www.kernel.org/pub/linux/kernel/people/tytso/e2fsprogs/v1.43.4/e2fsprogs-1.43.4.tar.gz

Table 12: Open Source Project References (Continued)

Name	Version	License	Url
expat	2.1.0	MIT	http://sourceforge.net/projects/expat/files/expat/2.1.0/expat-2.1.0.tar.gz/download"
ffi	3.2.1	MIT	ftp://sourceware.org/pub/libffi/libffi-3.2.1.tar.gz
fping	3.13	BSD with advertising	http://fping.org/dist/fping-3.13.tar.gz
ftpd	1.0.24	GPLv2	cvs -z3 -d:pserver:anonymous@bftpd.cvs.sourceforge.net:/cvsroot/bftpd co -D20030509 bftpd
iperf3	3.1.4	BSD	https://github.com/esnet/iperf/releases
ipsec_tools	0.8.0	BSD	http://sourceforge.net/projects/ipsec-tools/files/ipsec-tools/0.8.0/ipsec-tools-0.8.0.tar.bz2/download
jqplot	1.0.8	MIT and GPLv2	https://bitbucket.org/cleonello/jqplot/downloads/
jqplot	1.0.8	MIT and GPLv2	https://bitbucket.org/cleonello/jqplot/downloads/
jqplot	1.0.8	MIT and GPLv2	https://bitbucket.org/cleonello/jqplot/downloads/
jsonc	0.11	MIT	https://s3.amazonaws.com/json-c_releases/releases/json-c-0.11.tar.gz
libevent	2.0.22	BSD	http://libevent.org/
libfdt		BSD	https://github.com/RobertCNelson/dtc.git
libjpeg	9.1.0	BSD	http://www.ijg.org/files/jpegsrc.v9a.tar.gz
libminiupnpc	1.9.20150206	BSD	http://miniupnp.tuxfamily.org/files/miniupnpc-1.9.20150206.tar.gz
libstrophe	1.1	MIT and GPLv3	https://github.com/strophe/libstrophe/archive/master.zip
libwebsockets	1.6.2	LGPLv2	http://git.libwebsockets.org/cgi-bin/cgit/libwebsockets/snapshot/libwebsockets-1.6.2.tar.gz
libxmlw	2.9.0	MIT	http://xmlsoft.org/libxml2/libxml2-sources-2.9.0.tar.gz
lzo	2.0.9	GPLv2	http://www.oberhumer.com/opensource/lzo/
make_ext4fs	4.3_r3	GPL	
mmc-utils	Git commit: Fit usage to 80 cols" <f4eb241519f8d500ce6068a70d2389be39ac5189>"	GPLv2	https://git.kernel.org/pub/scm/linux/kernel/git/cjb/mmc-utils.git
openl2tpd	1.6	GPLv2	ftp://ftp.openl2tp.org/releases/openl2tp-1.6/openl2tp-1.6.tar.gz
openssl	1.0.2a	BSD	http://www.openssl.org/source/openssl-1.0.2a.tar.gz
ppp	2.4.1	BSD	ftp://ftp.samba.org/pub/ppp/ppp-2.4.1.tar.gz
ppp	2.4.5	BSD	ftp://ftp.samba.org/pub/ppp/ppp-2.4.5.tar.gz
pptp	1.7.2	GPLv2	http://sourceforge.net/projects/pptpclient/files/pptp/pptp-1.7.2/pptp-1.7.2.tar.gz

Table 12: Open Source Project References (Continued)

Name	Version	License	Url
redsocks	0.5	Apache	https://github.com/darkk/redsocks
sqlite	3.8.6	Public Domain	http://www.sqlite.org/2014/sqlite-autoconf-3080600.tar.gz
stlport	5.2.1	BSD-like	https://sourceforge.net/projects/stlport/files/STLport/STLport-5.2.1/STLport-5.2.1.tar.gz/download
tablesorter	2.0.3	MIT and GPLv2	http://tablesorter.com/__jquery.tablesorter.zip
treetable	3.2.0	MIT and GPLv2	http://github.com/ludo/jquery-treetable/zipball/3.2.0
uClibc	0.93.2	LGPL	http://www.uclibc.org/downloads/uClibc-0.9.32.tar.bz2""
udhcp	0.9.6	GPLv2	http://archive.debian.org/debian/pool/main/u/udhcp/udhcp_0.9.6.orig.tar.gz
udhcp	0.9.6	GPLv2	http://archive.debian.org/debian/pool/main/u/udhcp/udhcp_0.9.6.orig.tar.gz

Revision History

96XXX_Data-RN210-R; December 1, 2017

- Updated for v5.02L.04

Previous Release History

Revision	*Date*	*Change Description*
96XXX_Data-RN209-R	May 19, 2017	Updated for v5.02L.03
96XXX_Data-RN208-R	December 29, 2016	Updated for v5.02L.02A
96XXX_Data-RN207-R	September 16, 2016	Updated for v5.02L.02
96XXX_Data-RN206-R	June 2, 2016	Updated for v5.02L.01
96XXX_Data-RN205-R	February 22, 2016	Updated for v4.16L.05
96XXX_Data-RN204-R	September 4, 2015	Updated for v4.16L.04
96XXX_Data-RN203-R	April 1, 2015	**Added:** • Last two lines to Table 20: “Open Source Project References,”
96XXX_Data-RN202-R	January 14, 2015	Updated for v4.16L.03
96XXX_Data-RN201-R	October 15, 2014	Updated for v4.16L.02A
96XXX_Data-RN200-R	July 17, 2014	Updated for v4.16L.02
96XXX_Data-RN105-R	February 14, 2014	Updated for v4.16L.01A
96XXX_Data-RN104-R	January 24, 2014	Updated for v4.16L.01
96XXX_Data-RN103-R	December 3, 2013	Updated for v4.14L.04
96XXX_Data-RN102-R	August 13, 2013	Updated for v4.14L.03
96XXX_Data-RN101-R	July 31, 2013	Updated for v4.14L.02
96XXX_Data-RN100-R	July 31, 2013	Initial release, documenting v4.14L.01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