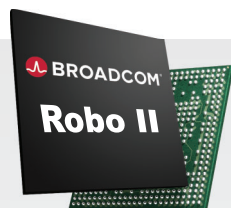


## SOFTWARE BRIEF

# Robo-OS™

## Lightweight Web-Managed and CloudSmart™ Operating System for Next Generation RoboSwitch™ Product Line



- Lightweight Operating System for L2 focused applications.
- Designed for next-generation RoboSwitch architecture – Robo II.
- Utilizing internal Robo II CPU (ARM M7) and RAM memory.
- Full software stack, from drivers to applications and web-pages for simple device management.
- Optimized for mobile devices including smartphones, tablets, and laptops.
- RESTful APIs for integration into cloud managed networks.
- Utilizing open-source software packages.
- Includes localization framework to enable simple adaptation to non-English languages.

### OVERVIEW

The Broadcom® Robo-OS™ is a lightweight operating system designed for L2 switching platforms that utilize next generation RoboSwitch™ architecture, also-known-as Robo II. It is a full software stack for system vendors, ODM, and OEM customers who are looking for a complete software solution for Web-managed SMB and industrial switches. Its supported features and design were carefully selected for these web-managed applications as well as the needed capabilities of the emerging cloud-managed switch market.

The Robo-OS lean structure and modest resource requirements, from compute and memory perspectives, enable it to run on-chip in its entirety, minimizing RBOM cost, and development effort for OEMs and ODMs.

The Robo-OS operating system building blocks (depicted in the block diagram below) utilize open-source-based software packages, such as OpenRTOS (based on the open-source FreeRTOS), LwIP (a lightweight open source TCP/IP stack) and other packages. By using open-source software packages, Robo-OS customers to benefit from a large community of developers and validation engineers delivering robust and up-to-date solutions to the broad industry. Moreover, this community constantly generates new features that can be easily integrated into the Robo-OS.

The Robo-OS is also designed to support cloud management solutions, where the network nodes are managed from a central location out-side the business premise. All of the Robo-OS web-based features can be activated through RESTful APIs and cloud agents. Through the integration of cloud management, end-users can deliver many of the features in managed switches using the same low-cost Robo Switch web-managed solution.

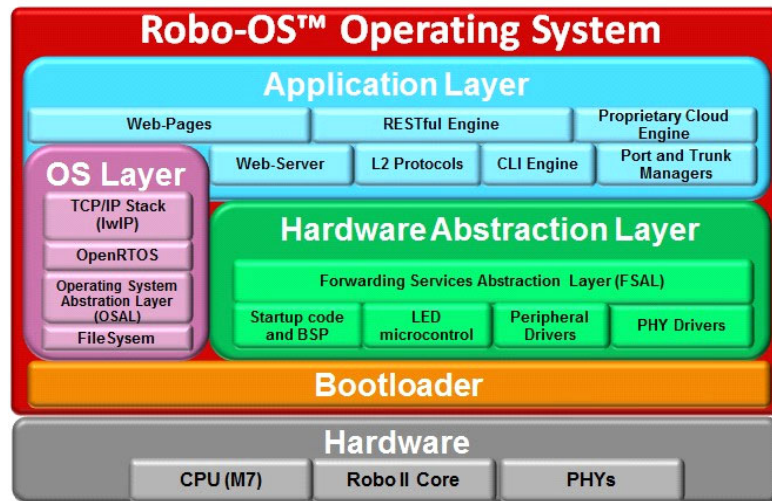
### BENEFITS

- A lightweight L2 switching operating system designed for cost optimized Web-managed devices and utilizes internal CPU and internal RAM only.
- Delivered by Broadcom for Web-Managed ('W') Robo II SKUs.
- Feature-set optimized for SMB applications.
- Easy check-box-like configuration through a modern web GUI.
- Optimized for mobile devices (laptops, smartphones, tablets) via use of HTML5 technology.
- RESTful APIs for integration with cloud managed networks where devices' usage are not limited by the internal device compute and storage resources.
- Feature-rich with extensive support for QoS, protection, and management requirements of SMB applications.

### FEATURES

- 25 WEB GUI screens for complete check-box-like feature activation.
- Port-level configuration: port speed and LAG construction.
- Rapid Spanning Tree for loop prevention and network failure restoration.
- Multicast support via static multicast group configuration and IGMP snooping.
- Ingress and egress mirroring for troubleshooting and traffic analysis purposes.
- Rich QoS support, including metering, shaping, scheduling (SP + WRR) and congestion avoidance (tail drop + WRED), 802.3x flow control.
- IEEE 1588v2 transparent clock support for end-to-end network time synchronization.
- Network node auto-discovery support via LLDP.
- CloudSmart management support via the RESTful APIs.
- Easy-to-use localization-engine for a simple adaptation of the Web-GUI to non-English languages used by the customer.

| Robo-OS |                                                           |
|---------|-----------------------------------------------------------|
| ✓       | Full SW Stack                                             |
| ✓       | Web GUI                                                   |
| ✓       | Restful API                                               |
| ✓       | Localization Framework                                    |
| ✓       | SMB Features (QoS Protection, Forwarding, and Management) |
| ✓       | RBOM Optimized                                            |



Robo-OS Block Diagram

## ROBO-OS COMPONENTS

| Layer                      | Components                            | Description                                                                                                 | Code Source            |
|----------------------------|---------------------------------------|-------------------------------------------------------------------------------------------------------------|------------------------|
| Bootloader Layer           | Bootloader                            | Broadcom bootloader with Dual Image support.                                                                | Broadcom               |
| Hardware Abstraction Layer | Start-up code and BSP                 | Drivers for Avenger Peripherals (Flash, I <sup>2</sup> C etc.). ARM CMSIS layer to setup internal ARM core. | Broadcom               |
| Hardware Abstraction Layer | PHY Drivers                           | Support for external PHYs.                                                                                  | Broadcom               |
| Hardware Abstraction Layer | LED microcode                         | LED customization.                                                                                          | Broadcom               |
| Hardware Abstraction Layer | Switch Configuration FSAL API         | APIs exposing Avenger hardware features.                                                                    | Broadcom               |
| OS Layer                   | OpenRTOS                              | Multi-threaded Operating System – commercial version of FreeRTOS (non GPL open source OS).                  | Open-Source/Commercial |
| OS Layer                   | TCP/IP Stack                          | Open Source lwIP (non-GPL). Supports IPv4/6, Autoconf, DHCP, ARP, ICMP, TCP/UDP, etc.                       | Open Source            |
| OS Layer                   | OSAL                                  | Operating System Abstraction Layer.                                                                         | Broadcom               |
| OS Layer                   | Persistent Configuration/ File System | Save and retrieve switch configuration from flash in JSON format utilizing FAT filesystem.                  | Open-Source/Commercial |
| Application Layer          | Web Engine                            | Cesanta Mongoose commercial web-server.                                                                     | Open-Source/Commercial |
| Application Layer          | Web Pages                             | Reference web pages to configure switch features.                                                           | Broadcom               |
| Application Layer          | CLI Engine                            | CLI engine to enable customers to add CLI commands.                                                         | Broadcom               |
| Application Layer          | L2 Protocols                          | IGMP Snooping, LLDP, and RSTP.                                                                              | Broadcom / Open Source |
| Development Tools          | Toolchain                             | Standard open source GCC ARM toolchain.                                                                     | SDK                    |

## ORDERING INFORMATION

Robo-OS is provided with specific part-numbers in Broadcom's next generation RoboSwitch product line, also known as Robo II. Please refer to the Robo II devices (53112, 5315x, 5316x) Data Sheet and Product Brief ordering information to locate the web-managed part-numbers that are associated with the Robo-OS software.

## ABOUT BROADCOM

Broadcom (NASDAQ: AVGO) is a diversified global semiconductor leader built on 50 years of innovation, collaboration and engineering excellence. Broadcom's extensive product portfolio serves multiple applications within four primary end markets: wired infrastructure, wireless communications, enterprise storage and industrial & others. Broadcom is changing the world by Connecting everything®.



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