

## **Standard Bootstrap Firmware**

RedBoot™ is a comprehensive debug and bootstrap firmware solution for the development, deployment and management of embedded devices. It supports the installation, execution and debugging of all types of embedded applications, ranging from native stand-alone, proprietary and eCos® RTOS based applications, through to embedded Linux® systems.

RedBoot has been adopted by many semiconductor and development board manufacturers as their standard bootstrap firmware. It is the standard firmware shipped with all Intel® XScale® development boards, various Freescale ARM and PowerPC platforms, and NXP set top box reference designs. All major architectures are supported including ARM®, ColdFire®, MIPS®, PowerPC®, SuperH®, XScale® and x86. RedBoot has been deployed in embedded products from ASCOM®, Axis®, HP®, Intel®, Linksys®, Meraki®, NETGEAR®, Watchguard®, Yamaha®, Zyxel® and many others. Most development boards supported by eCosCentric's eCosPro® Developer's Kit also include a port of RedBoot.

The feature set of RedBoot provides support for all phases of a product's life-cycle. In the initial development phases it provides a standardized bootstrap and debug environment on commercial development boards and on an OEM's own prototype hardware. During manufacturing it can provide application installation, power-on self tests (POST), and built-in diagnostic tests to enhance quality control and assurance. Finally, when deployed in products and used in the field, RedBoot provides the system bootstrap mechanism, site specific configuration ability, as well as a straightforward migration path for firmware upgrades.

eCosCentric provides a range of commercial RedBoot focused services that cover porting, customization and technical support, simplifying the provision of firmware for your embedded design. RedBoot is fully open source, and free of royalty and product license fees.

## **Technical Overview**

RedBoot is, in essence, a minimal eCos RTOS application, using the hardware abstraction layer (HAL) of eCos to provide its portability and device access infrastructure. It therefore inherits the key eCos qualities of reliability, portability and configurability, and leverages the wide range of peripherals, processor ports, development and evaluation platforms already supported by the eCos HAL.

Typical flash memory footprints are less than 64kB for basic configurations, rising to 96kB or more for fully-featured systems that include TCP/IP & Ethernet connectivity, image decompression, journaling flash filing system (JFFS2), and Linux bootstrap support. The compact and configurable nature of RedBoot and eCos allows functionality to be enabled, customised, or removed to suit the requirements of the target system.

## **Functionality**

### **Bootstrap**

RedBoot has been architected for flexibility and rapid customisation. Interruptible boot scripts enable adaptable custom boot sequences that can automatically load application and data images from flash memory, removable memory cards, or even by downloading via an Ethernet connection.

## Functionality

### Bootstrap (Cont)

Power-on self testing is readily implemented and new RedBoot commands may be created to provide vendor specific customizations such as board diagnostics. These new commands can then be either inserted into the boot script or run interactively. In addition to the bootstrap of native and eCos RTOS based applications, RedBoot can also boot other operating systems, and in particular embedded Linux is explicitly supported. Linux-specific features include architecture-specific initialization of processor and board state, kernel boot parameters, kernel image decompression support, and kernel image loading from native ext2, JFFS2 and other file systems.

### Communication

RedBoot fully supports both serial and Ethernet based configuration, download and debugging. Supported protocols and formats include:

- **Command line:** terminal (serial), telnet (Ethernet)
- **File download:** X-modem and Y-modem (serial), TFTP and HTTP (Ethernet)
- **Network setup:** BOOTP and DHCP (Ethernet)
- **Debugging:** GDB remote connection (serial, Ethernet)
- **Image formats:** ELF, SREC, raw binary, gzip/zlib compressed binaries

### File Management

RedBoot manages multiple raw and compressed code and data images directly within the system's available flash memory space. It also includes a full set of file system commands supporting JFFS2 based flash partitions and MS-DOS compatible file systems on hard disks or plug in cards such as SD, MMC or Compact Flash, and read only access to Linux ext2 file systems. Configuration information such as networking parameters, the flash image directory, and the boot script are held in a reserved area of flash. Code can either be executed in place (if held in flash) or copied (with decompression if required) into RAM prior to use. The inherent flexibility of RedBoot image handling simplifies system development and deployment, and even provides for the updating of RedBoot itself. eCosCentric also provides the optional RBL extension for reliable in-field upgrades. This ensures that backup copies of updated files are retained and will be used should the upgrade process be interrupted or fail.

### System and Application Debugging

Support for direct connection of the GNU source level debugger (GDB) to the target system is integrated into RedBoot, enabling immediate download and debugging of embedded applications from within the debugger environment. Developers can make use of all the standard GDB features such as single stepping, breakpoints, watchpoints, state inspection, and interruption of the application's execution. A communication channel is also provided that allows the application to send diagnostic messages for display on the host. The debug support is compatible with both the command line version of GDB and GUI-based debug functionality incorporated in eCosCentric's Eclipse-based IDE.

RedBoot also provides a command line interface (CLI), through which developers have full access to all the commands provided by RedBoot, such as configuration, flash management, image download, and code execution. They may also inspect, edit, fill, copy, compare, or checksum memory.

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