MANAGING A REAL-TIME EMBEDDED LINUX PLATFORM WITH BUILDROOT

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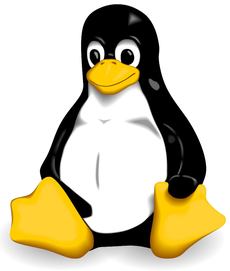


Motivation

Desktop distributions are an awkward implementation of an Embedded RTOS

- Architecture-dependent binary packages
- Loaded with unnecessary software
- Huge footprints

First Try: Build Linux from Source

- Success! But..
- Is as difficult as it sounds
- Overwhelming number of packages and patches
- No version control
- Cross-compile even more headaches

Did not do what we needed:

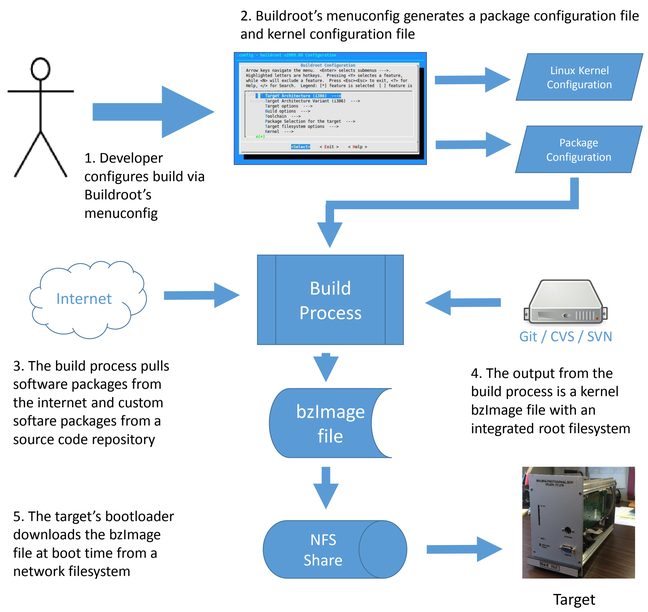
- Small-footprint network bootable image
- Automated build system
- Support for multiple architectures
- Integrated system for building and deploying real-time application software

Solution

Buildroot + ucLibc + Busybox + RTAI

- **Buildroot** – downloads, unpacks, configures, compiles and installs system software automatically
- **uClibc** – Small-footprint standard C library
- **Busybox** – all-in-one UNIX utilities and shell
- **RTAI** – Real-Time Linux extensions

Simplified Build Process



Results

Quantitative Results

- Whole build process is automated resulting in much quicker build times (hours not days)
- Kernel and root filesystem size: 3.5 MB – 20 MB (reduction of 99%)
- Boot-time: ~9 seconds

Qualitative Results

- Allows integration with revision control into the platform development process, making it easier to manage an ecosystem of targets
- Community support for x86 & ARM targets gives us confidence that future targets can be supported without much effort

Deployments

ARM Cortex A-9

Power Supply Control and Regulation for the Fermilab Linac

PC/104 AMD Geode SBC

Quench Protection System for Tevatron Electron Lens (TEL II)

Intel Core 2 Duo VME/VXS

Beam Position Monitor prototype for Fermilab Booster

PC/104 Integrated in NIM module

Power Supply Control and Regulation for NuMI beam line