



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 \bullet
- 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

MANAGING A REAL-TIME EMBEDDED LINUX PLATFORM WITH BUILDROOT

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Solution



Buildroot + ucLibc + Busybox + RTAI Buildroot – downloads, unpacks, configures, compiles and installs system software automatically **<u>uClibc</u>** uClibc – Small-footprint standard C library **Busybox** – all-in-one UNIX utilities and shell

RTAI – Real-Time Linux extensions RTAL

Simplified Build Process 2. Buildroot's menuconfig generates a package configuration file and kernel configuration file onfiguratio ckage Selection for the target rget filesystem options ---> 1. Developer Configuratior configures build via Buildroot's menuconfig Build Internet Process Git / CVS / SVN 3. The build process pulls 4. The output from the software packages from build process is a kernel the internet and custom bzImage file with an bzimag softare packages from a integrated root filesystem source code repository 5. The target's bootloader downloads the bzImage NFS file at boot time from a Share network filesystem Target





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



Intel Core 2 Duo

VME/VXS

and Regulation for the Fermilab Linac

Power Supply Control

Beam Position Monitor prototype for Fermilab Booster





PC/104 Integrated in NIM module



Quench Protection System for Tevatron Electron Lens (TEL II)

Power Supply Control and Regulation for NuMI beam line