mkosi-initrd: Building initrds out of distribution packages
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Why do we need an initrd?
Status quo

Host
- Daemons
- Kernel
- Kernel Modules
- Binaries
- Config files
- Units
- Initrd
- Shared libraries

Initramfs
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- Shared libraries
- NSS


dracut
Problems with the Status Quo

- Packaging + dracut packaging => https://github.com/dracutdevs/dracut/pull/2535
- Unclear where to report bugs
- Hard to customize
- Slow
Goal

Package Repository

Initramfs

- Daemons
- Kernel
- Kernel Modules
- Binaries
- Config files
- Units
- Initrd
- Shared libraries
- NSS
- ...
Advantages of building the initrd out of packages

- Reliable installation => package managers are good at installing packages
- Sane dependency resolution => package managers are good at tracking dependencies
- Reproducible => We don’t pull files from the host
- No need to learn yet another system
- Clear ownership of bugs
- Any packaging improvements automatically apply to the initrd
- Initrd can be built off-host and signed for secure boot via UKI
Requirements to build the initrd out of packages

- Careful packaging is required to keep the initramfs size manageable
- Low hanging fruit:
  - gcc-libs should be a split package
  - Kernel modules should be packaged separately from the kernel
  - There should be a minimal locale package
  - ...
What is mkosi?
Quick Start

mkosi -d arch -p systemd -p linux --autologin qemu
CentOS Stream 9
Kernel 5.14.0-350.el9.x86_64 on an x86_64

localhost login: root (automatic login)

Last login: Wed Aug  9 12:44:36 on tty1
[root@localhost ~]#  

Debian GNU/Linux trixie/sid localhost ttyS0

localhost login: root (automatic login)

Welcome to Debian GNU/Linux 6.4.0-1-amd64 #1 SMP PREEMPT_DYNAMIC Debian 6.4.4-2 (2023-07-30) x86_64

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Wed Aug  9 10:30:29 UTC 2023 on tty1
root@localhost:~ #  

Arch Linux 6.4.8-arch1-1 (ttyS0)
archlinux login: root (automatic login)

Last login: Wed Aug  9 12:44:36 on tty1
[root@archlinux ~]#  

Ubuntu 23.04 localhost ttyS0

localhost login: root (automatic login)

Welcome to Ubuntu 23.04 (GNU/Linux 6.2.0-1009-kvm x86_64)
* Documentation:  https://help.ubuntu.com
* Management:  https://landscape.canonical.com
* Support:  https://ubuntu.com/advantage
Last login: Wed Aug  9 10:25:24 UTC 2023 on ttyS0
root@localhost:~ #  

Fedora Linux 39 (Rawhide Prerelease)
Kernel 6.5.0-0.rc5.36.fc39.x86_64 on an x86_64 (ttyS0)
fedora login: root (automatic login)

Last login: Wed Aug  9 12:44:36 on tty1
[root@fedora ~]#  

Have a lot of fun...
localhost:~ #  

No root privileges required!
Configuration

[Match]
Distribution=fedora

[Distribution]
Release=rawhide

[Content]
Packages=kernel-core
        systemd
        systemd-boot
        udev
        util-linux
        grub2-pc
mkosi-initrd

- A mkosi configuration to build initramfs images
- Used to be standalone, now part of mkosi itself
- Used to build the default initramfs for mkosi images
- Support for Arch, Ubuntu, Debian, OpenSUSE, CentOS, Fedora, ...
mkosi-initrd kernel-install plugin

- Configured in install.conf
- Either as initrd generator or as UKI generator
- Microcode is included
- Reuses package manager caches from /var
- Customizations in /usr/lib/mkosi-initrd or /etc/mkosi-initrd
mkosi-initrd standalone

```
mkosi
  --include mkosi-initrd
  --extra-tree /usr/lib/modules/$(uname -r):/usr/lib/modules/$(uname -r)
  --extra-tree /usr/lib/firmware:/usr/lib/firmware
  --kernel-modules-exclude=".*"
  --kernel-modules-include-host=yes
```
Integration tests

- root=LABEL= ...
- LUKS
- LVM
- VirtioFS
- LUKS+LVM
- root=gpt-auto
- NFS
- RAID
- NVME-TCP
- iSCSI
- ...

Diagram showing integration tests including LUKS, LVM, VirtioFS, LUKS+LVM, root=gpt-auto, NFS, RAID, NVME-TCP, and iSCSI.
https://github.com/systemd/mkosi/tree/main/mkosi/resources/mkosi-initrd