Red Hat
Enterprise Linux

RHEL Image Mode - bootc

Why, What and How

Ingo Boernig
Chief Architect
Field CTO Team

Wolfgang Marx
CE Specialist Solution Architect, OCP+V

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Infrastructure & organizational complexity

is still a problem...

Common challenges that involve the OS

- **Different platforms require different tools, teams and expertise**
- **Testing and validation are time consuming**
- Application support matrix
- **No one budgets for maintenance and upgrades**
- Negotiating between stakeholders
- **Drift between images, instances, and runtime**
- **Immutable aspirations vs. mutable realities**
- Image inventory, versioning, and pruning
- Let's not forget security!

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We've learned from past initiatives

Backup / cloning

mksysb

Image creation tools

Immutable distros

Virtual appliances

Key takeaway: Everybody wants the OS to be completely **customizable**... until the point that they want it to be **immutable!**

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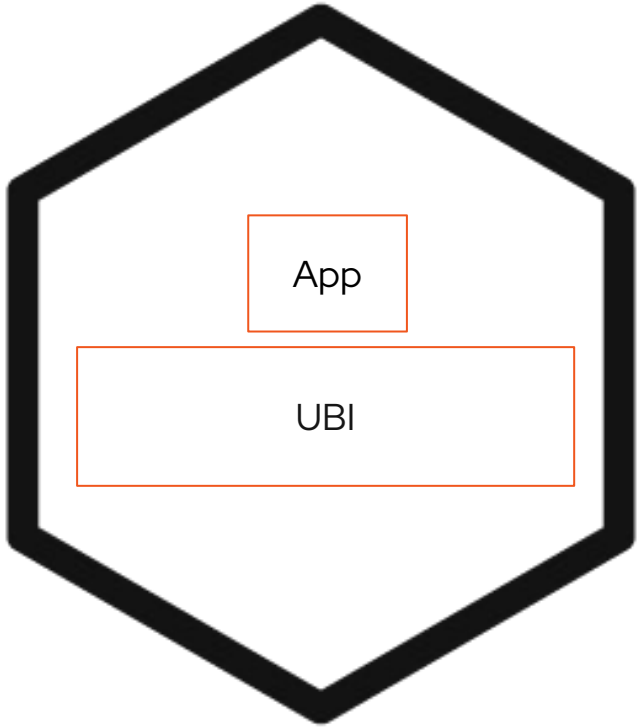
Containers revolutionized application deployment

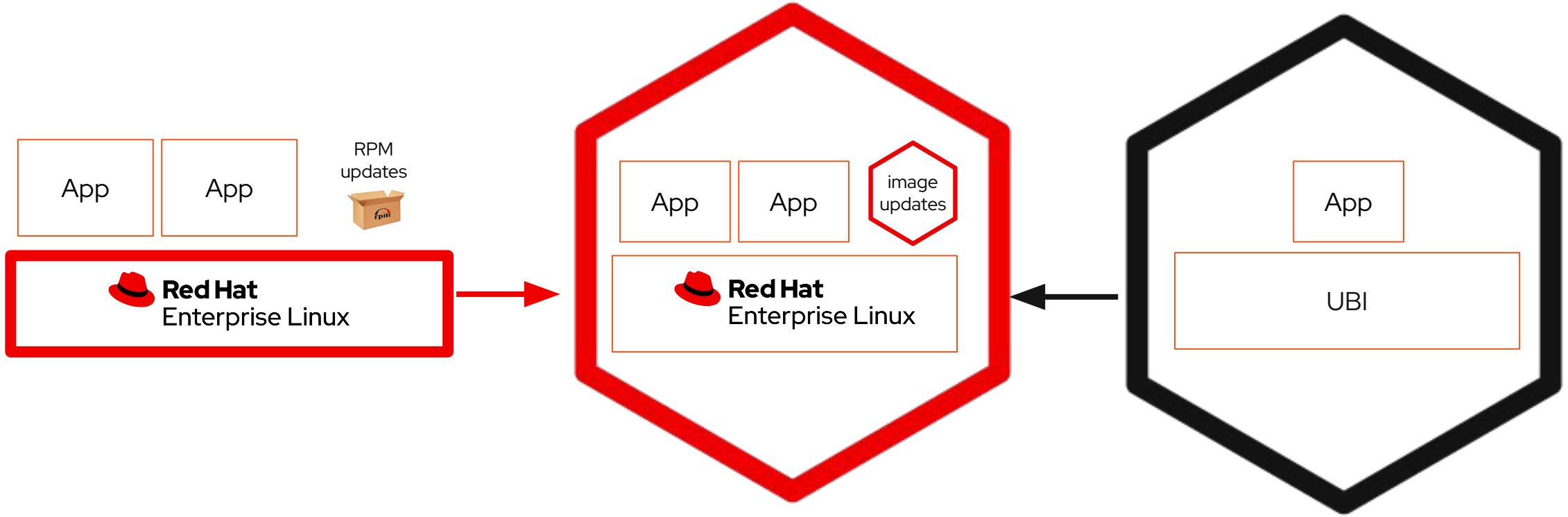


- Standardized packaging via OCI image format
- Standardized delivery via OCI registry
- Clarity and transparency with the container file
- Deployment portability & predictability
- Rich ecosystem of security, automation, & orchestration tooling
- Rapid adoption and pervasive

...and they will also become the language of modern IT

Introducing image mode for Red Hat Enterprise Linux

Combining the power of RHEL with the benefits of containers



Package mode

Image mode

Application container

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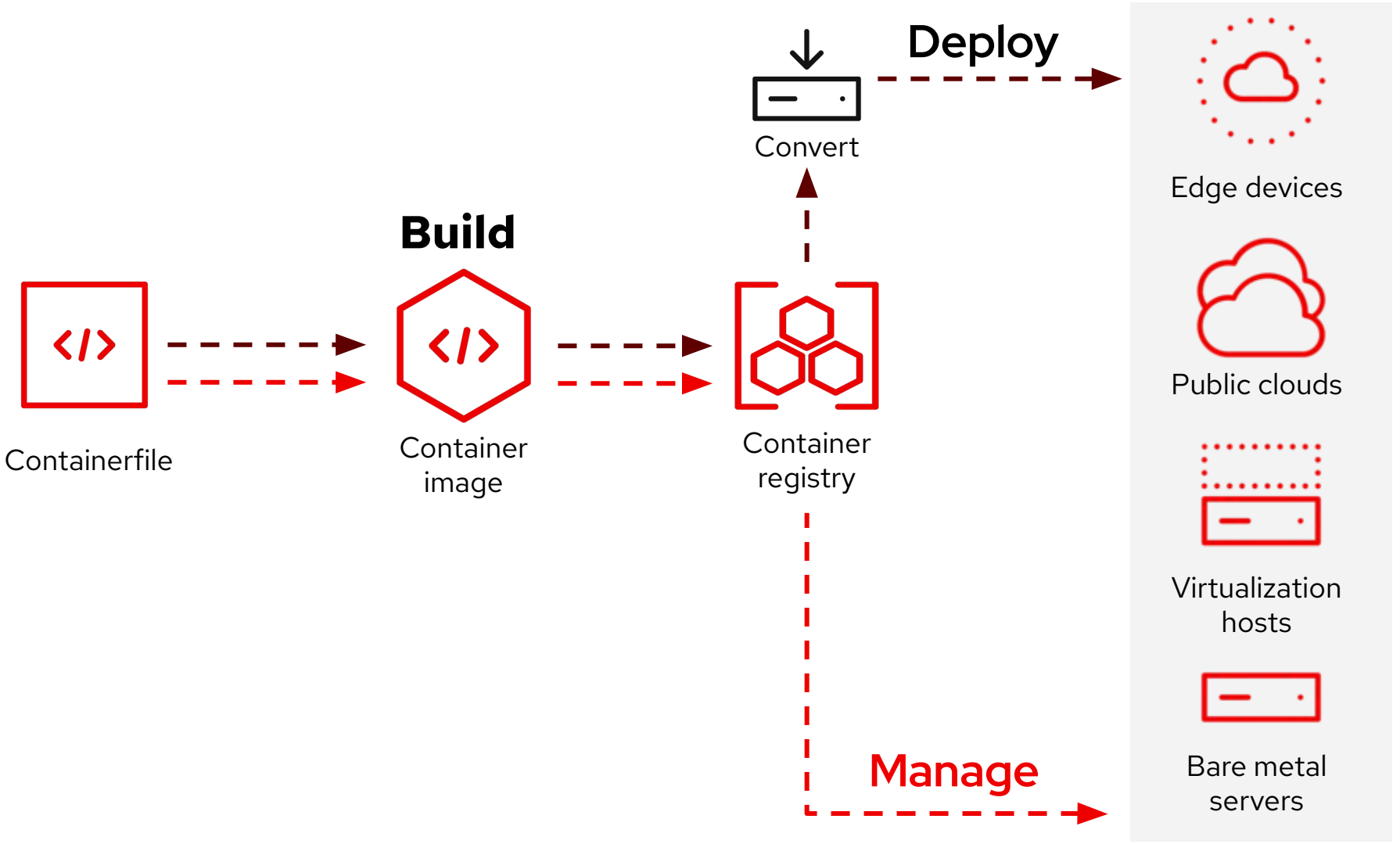
Image mode for Red Hat Enterprise Linux

Simple. Consistent. Anywhere.



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One RHEL, two modes

	Package mode	Image mode
Smallest Unit	RPM package	OCI image
Updates	Package update (`dnf update`)	Image update (`bootc upgrade`)
Package installation	`dnf install`	Build OCI image with new package installed; then update (`bootc upgrade`)
System installation	Anaconda with `%packages`	Anaconda with ostreecontainer --url
Build raw, qcow2, AMI, GCP, VMware, Azure image	Image Builder	Bootc Image Builder

registry.redhat.io/rhel9/rhel-bootc:9.5

The RHEL bootc image is available here!

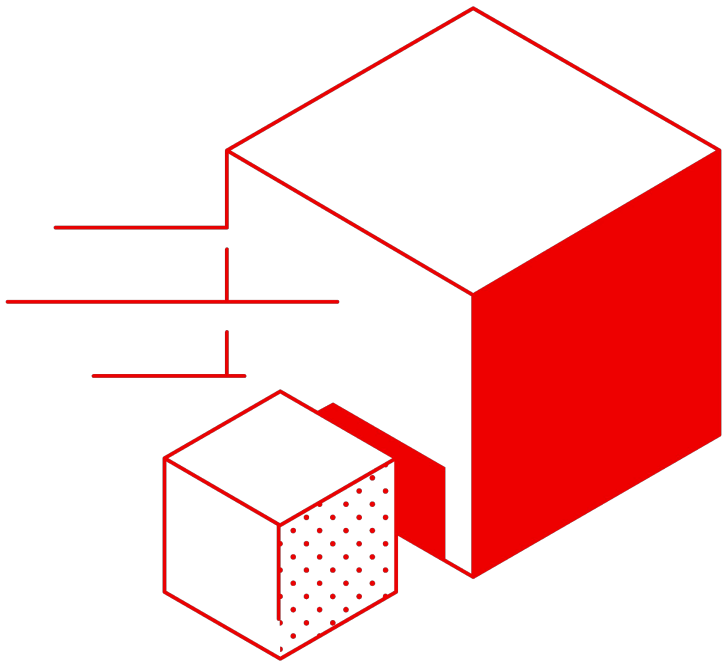


Image Specs:

- 439 rpms
- ~785M compressed
- ~2.2G on disk

Primary contents:

- systemd, kernel, bootc
- rpm-ostree[1]
- linux-firmware
- NetworkManager
- podman
- python
- Misc CLI tools: jq, sos

No cloud-init or virt agents

Documentation

bootc

A/B booting of container images

`bootc upgrade`

Download and stage an updated container image.

- Automatic updates on by default. Configurable using bootc-fetch-apply-updates.timer

`bootc rollback`

Rollback to the previous state. Staged updates are discarded

`bootc switch`

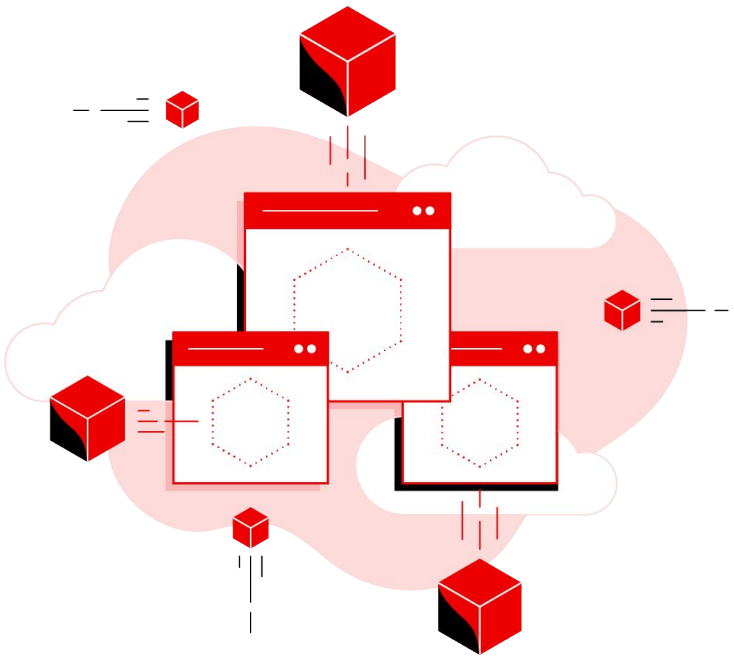
Change to a different reference image

`bootc install`

Install container image **`to-disk`** or **`to-filesystem`**

- Man page
- https://github.com/containers/bootc
- https://github.com/containers/podman-desktop-extension-bootc

Image mode creates opportunities to think differently

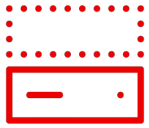


- **All RHEL users** will benefit from standardization, simplicity and portability across all of their environments that span the hybrid clouds
- **DevOps teams** can easily plug RHEL into their CI/CD & GitOps workflows, easing the friction that exists between the platform and the application.
- **Security teams** can apply container security tools, from scanning and validation to cryptography and attestation to the base elements of the operating system, making their jobs far less complex.
- **Solution providers** will love how easy it is to build and distribute their offerings on the trusted RHEL platform

Recommended use cases

AI/ML stacks

Perfectly version app dependencies from kernel, GPU & accelerator drivers, frameworks, runtimes, etc



1:1 App/Host

Manage the OS and app as a single unit

Edge appliances

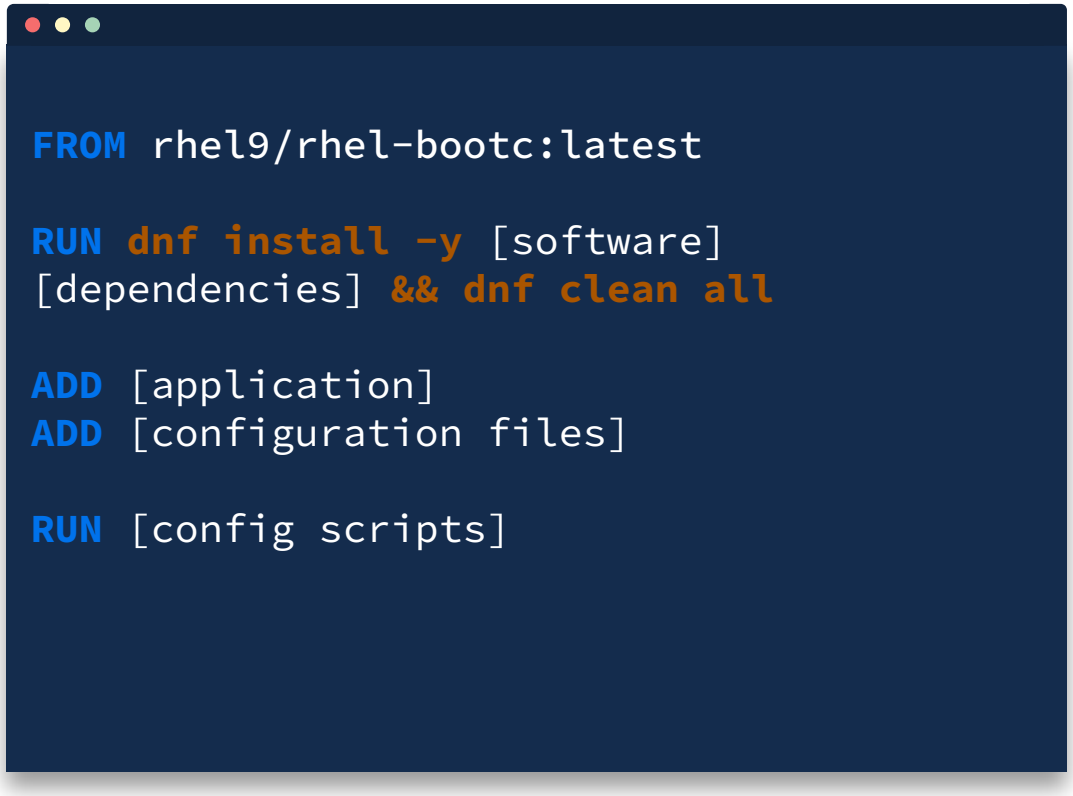
Registries and auto-updates make managing a fleet of identical systems a snap

Container hosts

Simplify and manage the OS in the same way as your applications

Image mode for RHEL

A container-native workflow for the life cycle of a system



Build

A *bootc* base image & container file is all that's needed to describe a system, applications, and dependencies. Use your existing container tools or pipelines to quickly create and test images.

Deploy

Easily convert to a VM/cloud image or deploy on bare metal using RHEL's installer. The container image includes full hardware drivers, but not cloud agents by default.

Manage

Designed for modern GitOps & CI/CD driven environments. Systems will auto-update from the container registry by default. More advanced control and automation is available via custom rollouts (e.g. Ansible). Intelligence via Insights and on-prem content curation via Satellite are planned for the future.

Image mode for RHEL

Encapsulate differences in a sequence of builds

```
# Derive standard operating environment
FROM rhel9/rhel-bootc:latest

RUN dnf install -y [system agents]
[dependencies] && dnf clean all

COPY [unpackaged application]
COPY [configuration files]

RUN [config scripts]
```

```
# Derive database server from SOE
FROM corp-repo/corp-soe:latest

RUN dnf install -y [database]
[dependencies] && dnf clean all

COPY [configuration files]

RUN [config scripts]
```

Installation with a) Anaconda || b) Bootc-image-builder

Let's get this started

Anaconda

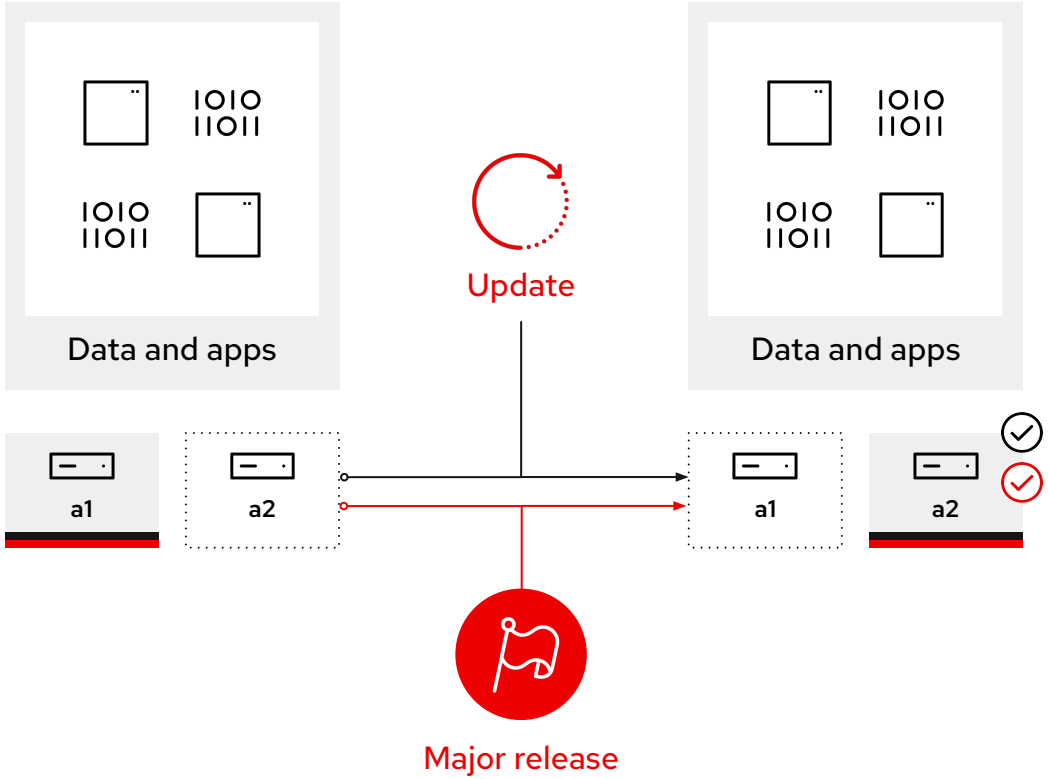
Use existing kickstart expertise with image mode for RHEL

Bootc image builder

A containerized tool that creates disk images and self-installing Anaconda ISOs from bootc container images

rpm-ostree

Immutable operating system (OS) and stateful configuration and storage



Transactional updates (A → B model)

- OS binaries and libraries (/usr*) are immutable and read-only
- State (r/w) is maintained in /var and /etc
- No in-between state during updates
- Updates are staged in the background and applied upon reboot
- Reboots can be scheduled with maintenance windows to ensure the highest possible uptime

Support seamless major release upgrades from Red Hat Enterprise Linux 8 → 9 and 10

- Help extend the serviceable life of hardware in the field

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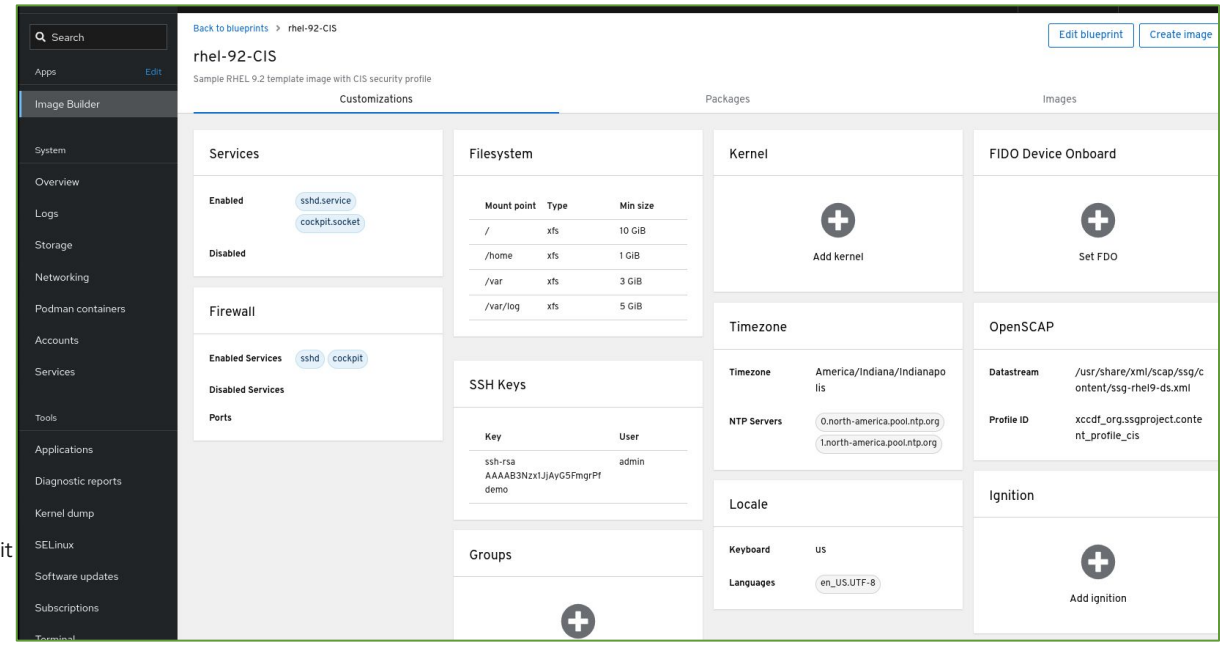
Red Hat Enterprise Linux image builder

Save time and ensure consistency when deploying RHEL systems at scale



- Image creation and management for VMs, clouds and more
- Import and export blueprint files
  - Share your blueprints with coworkers or your customers
- Image creation for Immutable ostree deployments

Try it

URL's and Labs

URL: Image Mode RHEL Lab in demo.redhat.com

URL: Red Hat Enterprise Linux Image Mode demo - use cases

URL: OSTree on Github

URL: RPM-Ostree on Github

URL: bootc on Github

URL: bootc YouTube Video

URL: BootC Base images available

URL: Using image mode for RHEL to build, deploy, and manage operating systems

URL: fedora-bootc-minimal

URL: RHEL image mode 2.1.0 by Jörg Kasting

URL: How to build, deploy, and manage image mode for RHEL - by Jörg Kastning

OpenShift Anwendertreffen in Hamburg

JETZT ANMELDEN – 28. OpenShift Anwendertreffen am 09. April 2025 in Hamburg

Liebe OpenShift Anwendertreffen Community,

nun habt ihr die Möglichkeit, euch für das aufkommende OpenShift Anwendertreffen anzumelden! Es wird am **Mittwoch, 09. April 2025** in der **Factory Hammerbrooklyn** in **Hamburg** von **9:30 bis 16:30** Uhr stattfinden.

JETZT ANMELDEN / REGISTER NOW

[URL: 28. OpenShift Anwendertreffen - Anmeldung]

Demo

Image mode for RHEL

Build a container image

- Based on bootc image, so that it containers a kernel
- Test the image as container (not VM)

Build a qcow2 disk image

- Use bootc image builder to create a qcow file
- Test the image as VM (not container)

Update

- Update a file in the VM (stateful workload use case)
- Add "missing" vim to Containerfile and build image
- Upgrade VM (check vim & stateful workload)

Thank you

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