

OSTree 简介

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包管理器 (RPM)

解决问题：

- 指定软件分发标准
 - 元数据存储包版本、大小、说明...
 - 安装、卸载、升级、校验...
- 将源代码打包成二进制软件包
- 自动查找依赖
- ...

包管理器 (RPM)

存在问题：

- RPM 大部分只能更新，不能回滚
- 依赖关系管理，对系统的基础包依赖导致系统更新困难
- 不同的发行版之间切换几乎不可能
- 使用RPM部署复杂应用困难
- RPM 编写规则不友好

应用解决方式 - SCLs

Software Collections: <https://www.softwarecollections.org/en/>

RedHat 针对包管理器存在问题，提出了 SCLs 概念，使用SCL，可以在系统上构建并同时安装相同软件的多个版本。SCL 不会对系统已有软件产生影响。

应用解决方式 - SCLs

解决问题：

- 不需要修改 RPM 本身（修改 spec 文件）
- 不会覆盖修改系统文件，/opt/rh/<version>/root （不影响系统更新）
- 可以依赖其他 SCL
- 允许同时存在多个版本，可按需卸载

应用解决方式 - SCLs

```
root@3199: /opt/rh
$ tree -L 2 /opt/rh/devtoolset-8
/opt/rh/devtoolset-8
├── enable
├── root
│   ├── bin -> usr/bin
│   ├── boot
│   ├── dev
│   ├── etc
│   ├── home
│   ├── lib -> usr/lib
│   ├── lib64 -> usr/lib64
│   ├── media
│   ├── mnt
│   ├── opt
│   ├── proc
│   ├── root
│   ├── run
│   ├── sbin -> usr/sbin
│   ├── srv
│   ├── sys
│   ├── tmp
│   ├── usr
│   └── var
20 directories, 1 file
```

应用解决方式 - SCLs

存在问题：

- 依赖发行版（RHEL, CentOS, Fedora...）不同的发行版之间切换几乎不可能
- 使用RPM部署复杂应用困难
- RPM 编写规则不友好

应用解决方式 - Container

解决问题：

- 不会覆盖修改系统文件，container image
- 不依赖特定发行版
- 允许同时存在多个版本 container image

应用解决方式 - Container

存在问题：

- container 生命周期管理， Kubernetes
- 安全问题， 大部分 container image 都存在各种 CVE

操作系统

如果所有的应用都以 container 运行，那操作系统还运行着什么？

```
UID      PID    PPID    C  STIME TTY          TIME CMD
root      1      0      2  21:06 ?        00:00:00 /usr/lib/systemd/systemd --switched-root --system --deserialize 21
root     456      1      0  21:06 ?        00:00:00 /usr/lib/systemd/systemd-journald
root     471      1      0  21:06 ?        00:00:00 /usr/sbin/lsmd -f
root     474      1      0  21:06 ?        00:00:00 /usr/lib/systemd/systemd-udevd
root     568      1      0  21:06 ?        00:00:00 /sbin/auditd -n
dbus     590      1      0  21:06 ?        00:00:00 /bin/dbus-daemon --system --address=systemd: --nofork --nopidfile --systemd-activation
root     591      1      0  21:06 ?        00:00:00 /usr/sbin/NetworkManager --no-daemon
root     594      1      0  21:06 ?        00:00:00 /usr/sbin/irqbalance --foreground
root     595      1      0  21:06 ?        00:00:00 /usr/lib/systemd/systemd-logind
root     596      1      0  21:06 ?        00:00:00 /usr/sbin/rsyslogd -n
root     599      1      0  21:06 ?        00:00:00 /usr/sbin/crond -n
root     605      1      0  21:06 ?        00:00:00 login -- root
root     615      1      0  21:06 ?        00:00:00 /usr/sbin/wpa_supplicant -u -f /var/log/wpa_supplicant.log -c /etc/wpa_supplicant/wpa_supplicant.conf -u -f /var
/log/wpa_supplicant.log -P /var/run/wpa_supplicant.pid
polkitd   616      1      0  21:06 ?        00:00:00 /usr/lib/polkit-1/polkitd --no-debug
root     775      1      0  21:06 ?        00:00:00 /usr/sbin/sshd -D
root     777      1      0  21:06 ?        00:00:00 /usr/bin/python -Es /usr/sbin/tuned -l -P
root    1275      1      0  21:06 ?        00:00:00 /usr/libexec/postfix/master -w
postfix   1297    1275      0  21:06 ?        00:00:00 pickup -l -t unix -u
postfix   1298    1275      0  21:06 ?        00:00:00 qmgr -l -t unix -u
root    1925     605      0  21:06 tty1      00:00:00 -bash
root    1946    1925      0  21:07 tty1      00:00:00 ps -ef
```

OS 安装方式

不同的 Linux 发行版有不同的安装器进行安装：

- Redhat - Anaconda
- Ubuntu - Preseed
- Photon - photon-os-installer
- ...

OS 升级方式 - 包管理器

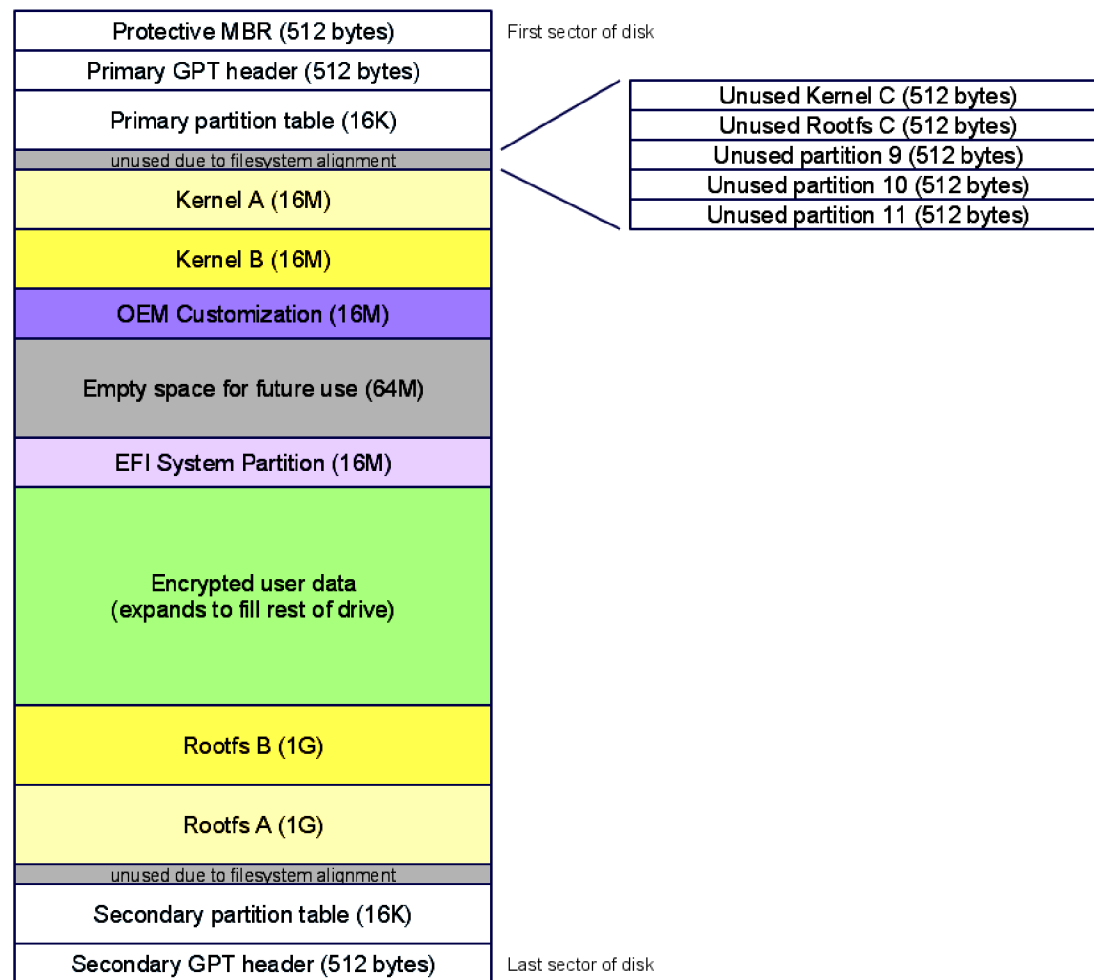
所有应用都运行在 Container 中，Host OS 仍可能安装部分软件，比如 Debug、硬件驱动等。

存在问题：

- 更新依赖问题
- 回滚困难
- 随着软件包增多，测试成本增加

OS 升级方式 - Active-Backup

Active-Backup, 系统中同时存在多个 rootfs, 始终只有一个在工作 (Active), 一个在闲置 (Backup), 当系统更新时, 将完整 rootfs 写入到 Backup 中, 重启生效。



OS 升级方式 - Active-Backup

解决问题

- 原子更新
- 目标版本（状态）明确

OS 升级方式 - Active-Backup

存在问题

- 分区固定，需要衡量根分区大小
- 需要多个 rootfs 对应分区，浪费空间
- 需要重启生效
- 每次下载完整的 rootfs，升级动作耗时长

OS 升级方式 - rpm-ostree(OSTree)

<https://ostreedev.github.io/ostree/>

- 基于 OSTree
 - "git for OS"
 - 原子升级，支持回滚
 - 允许在多个 rootfs 之间切换
 - 不可变文件系统
- 使用 RPM 构建 rootfs
- Package Layer：支持通过 `rpm-ostree install` 安装 RPM

OS 升级方式 - rpm-ostree(OSTree)

解决问题：

- 原子更新
- 单一 repo 存储多个 rootfs
- 增量更新

OS 升级方式 - rpm-ostree(OSTree)

存在问题：

- 需要重启生效
- 文件系统只读(除 /var 和 /etc)

rpm-ostree 安装

支持 OSTree 安装器：

- Anaconda
- photon-os-installer
- ...

rpm-ostree 安装

安装流程:

- 初始化 OSTree FS: `ostree admin --sysroot=/ init-fs`
- 初始化 OS: `ostree admin --sysroot=/ os-init "photon"`
- 部署指定 deployment:
`ostree admin --sysroot=/ deploy --os=photon $repo_ref`
- 创建临时文件: `/var/home/`, `/var/opt/`
- 配置 Grub, 生成 `fstab`
- `chroot`

rpm-ostree 启动

The Boot Loader Specification:

https://systemd.io/BOOT_LOADER_SPECIFICATION/

Dracut:

<https://github.com/ostreedev/ostree/blob/master/src/boot/dracut/module-setup.sh>

```
install() {  
    dracut_install /usr/lib/ostree/ostree-prepare-root  
    inst_simple "${systemdsystemunitdir}/ostree-prepare-root.service"  
    mkdir -p "${initdir}${systemdsystemconfdir}/initrd-root-fs.target.wants"  
    ln_r "${systemdsystemunitdir}/ostree-prepare-root.service" \  
        "${systemdsystemconfdir}/initrd-root-fs.target.wants/ostree-prepare-root.service"  
}
```

rpm-ostree 升级与回滚

升级

- /etc/ 在升级过程中采用三路合并(3-way merge)
`ostree admin config-diff`
 - 将当前的 /etc/ 文件与 base rootfs 中的 /usr/etc 比较，保留发生变化的部分
 - 当前 /etc/ 中没有修改过的配置，更新为目标版本 /usr/etc/ 的配置
- /var/ 不被修改

回滚: `rpm-ostree rollback`

Demo

SCLs

```
centos7 SCLs
查看 devtoolset-8
ls /opt/rh/
less /opt/rh/devtoolset-8/enable
tree /opt/rh/devtoolset-8/root -L 1
安装 devtoolset-9
yum install devtoolset-9
ll /opt/rh/
find devtoolset-8 -name "*gcc"
find devtoolset-9 -name "*gcc"
```

Active-Backup

```
[root@sda2 ~]# lsblk
NAME        MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
sda          8:0     0  100G  0 disk
├─sda1       8:1     0    4G  0 part /boot
├─sda2       8:2     0   20G  0 part /
└─sda3       8:3     0   20G  0 part
sr0         11:0     1 1024M  0 rom
[root@sda2 ~]# python3
Python 3.6.8 (default, Oct 13 2020, 16:18:22)
[GCC 4.8.5 20150623 (Red Hat 4.8.5-44)] on linux
Type "help", "copyright", "credits" or "license" for more information.
>>>
[root@sda2 ~]#
```

Active-Backup

```
[root@sda3 ~]# lsblk
NAME        MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
sda          8:0    0  100G  0 disk
├─sda1       8:1    0    4G  0 part /boot
├─sda2       8:2    0   20G  0 part
└─sda3       8:3    0   20G  0 part /
sr0         11:0    1 1024M  0 rom
[root@sda3 ~]# python3
-bash: python3: command not found
[root@sda3 ~]#
```

OSTree

```
# Generated by Anaconda 34.24.9
# Generated by pykickstart v3.32
#version=DEVEL
# Use graphical install
graphical

%post --erroronfail
cp /etc/skel/.bash* /root
%end

# Keyboard layouts
keyboard --xlayouts='us'
# System language
lang en_US.UTF-8

# Firewall configuration
firewall --use-system-defaults

# OSTree setup
ostreesetup --osname="fedora" --remote="fedora" --url="file:///ostree/repo" --ref="fedora/34/x86_64/silverblue" --nogpg

# Run the Setup Agent on first boot
firstboot --enable

# Generated using Blivet version 3.3.3
ignoredisk --only-use=sda
```

OSTree

```
[root@fedora ~]# tree /boot/
/boot/
├── boot -> .
├── efi
│   ├── EFI
│   │   ├── BOOT
│   │   │   ├── BOOTX64.EFI
│   │   │   └── fbx64.efi
│   │   └── fedora
│   │       ├── BOOTX64.CSV
│   │       ├── fonts
│   │       ├── grub.cfg
│   │       ├── grubx64.efi
│   │       ├── mmx64.efi
│   │       ├── shim.efi
│   │       ├── shimx64.efi
│   │       └── shimx64-fedora.efi
├── grub2
│   ├── grub.cfg -> ../loader/grub.cfg
│   └── grubenv
├── loader -> loader.1
├── loader.1
│   ├── entries
│   │   ├── ostree-1-fedora.conf
│   │   └── ostree-2-fedora.conf
│   └── grub.cfg
├── lost+found
└── ostree
    ├── fedora-677fa42df184821d59c97258d8b5a07af7f04944e6721bcaf81536801b6d3c5b
    │   ├── initramfs-5.11.12-300.fc34.x86_64.img
    │   └── vmlinuz-5.11.12-300.fc34.x86_64
    ├── fedora-f50d4cd1b1cad4ca44321d8b7c9df22f4b6318d7b161fa246a4f51c43ebbcfd6
    │   ├── initramfs-5.11.18-300.fc34.x86_64.img
    │   └── vmlinuz-5.11.18-300.fc34.x86_64
    └── 14 directories, 18 files
```

OSTree

```
[yiran@fedora ~]$ rpm-ostree status
State: idle
Deployments:
• ostree://fedora:fedora/34/x86_64/silverblue
    Version: 34.20210423.n.0 (2021-04-23T08:10:25Z)
    Commit: 7b99463136830fd9b18f8daf5f7973f3e15eaa3532f8dbcbb4f7eb9673170461
    GPGSignature: Valid signature by 8C5BA6990BDB26E19F2A1A801161AE6945719A39

    ostree://fedora:fedora/34/x86_64/silverblue
    Version: 34.20210511.0 (2021-05-11T01:42:56Z)
    Commit: 521dc34beee35c8ce236ffd2bac65b2f9ce2db2d2b5c60e1ea5f0a7aa9b140e1
    GPGSignature: Valid signature by 8C5BA6990BDB26E19F2A1A801161AE6945719A39
[yiran@fedora ~]$ rpm-ostree upgrade --check
.. Receiving metadata objects: 0/(estimating) -/s 0 bytes...
Receiving metadata objects: 0/(estimating) -/s 0 bytes... done
AvailableUpdate:
    Version: 34.20210512.0 (2021-05-12T05:19:28Z)
    Commit: 12f85a0d59d262b5d128305de5634215e71c17c2dc2464f5669aa877085b5b43
    GPGSignature: Valid signature by 8C5BA6990BDB26E19F2A1A801161AE6945719A39
    Diff: 253 upgraded, 5 downgraded, 2 removed, 3 added
[yiran@fedora ~]$
```

OSTree

```
1 metadata, 0 content objects fetched; 592 B transferred in 3 seconds; 0 bytes content written
AvailableUpdate:
  Version: 34.20210512.0 (2021-05-12T05:19:28Z)
  Commit: 12f85a0d59d262b5d128305de5634215e71c17c2dc2464f5669aa877085b5b43
  GPSSignature: 1 signature
    Signature made Wed 12 May 2021 01:19:33 PM CST using RSA key ID 1161AE6945719A39
    Good signature from "Fedora <fedora-34-primary@fedoraproject.org>"
  Upgraded: ModemManager 1.14.10-2.fc34 -> 1.16.4-1.fc34
    ModemManager-glib 1.14.10-2.fc34 -> 1.16.4-1.fc34
    NetworkManager 1:1.30.2-1.fc34 -> 1:1.30.4-1.fc34
    NetworkManager-adsl 1:1.30.2-1.fc34 -> 1:1.30.4-1.fc34
    NetworkManager-bluetooth 1:1.30.2-1.fc34 -> 1:1.30.4-1.fc34
    NetworkManager-config-connectivity-fedora 1:1.30.2-1.fc34 -> 1:1.30.4-1.fc34
    NetworkManager-libnm 1:1.30.2-1.fc34 -> 1:1.30.4-1.fc34
    NetworkManager-ppp 1:1.30.2-1.fc34 -> 1:1.30.4-1.fc34
    NetworkManager-ssh 1.2.11-2.fc33 -> 1.2.12-1.fc34
    NetworkManager-ssh-gnome 1.2.11-2.fc33 -> 1.2.12-1.fc34
    NetworkManager-wifi 1:1.30.2-1.fc34 -> 1:1.30.4-1.fc34
    NetworkManager-wwan 1:1.30.2-1.fc34 -> 1:1.30.4-1.fc34
    adwaita-cursor-theme 40.0~rc-1.fc34 -> 40.1.1-1.fc34
    adwaita-icon-theme 40.0~rc-1.fc34 -> 40.1.1-1.fc34
    at-spi2-core 2.40.0-1.fc34 -> 2.40.1-1.fc34
    bind-libs 32:9.16.11-5.fc34 -> 32:9.16.15-1.fc34
    bind-license 32:9.16.11-5.fc34 -> 32:9.16.15-1.fc34
    bind-utils 32:9.16.11-5.fc34 -> 32:9.16.15-1.fc34
    bluez 5.56-4.fc34 -> 5.58-1.fc34
    bluez-cups 5.56-4.fc34 -> 5.58-1.fc34
    bluez-libs 5.56-4.fc34 -> 5.58-1.fc34
    bluez-obexd 5.56-4.fc34 -> 5.58-1.fc34
    buildah 1.20.0-1.fc34 -> 1.20.1-4.fc34
    cldr-emoji-annotation 1:39~beta-1.fc34 -> 1:39-1.fc34
    cldr-emoji-annotation-dtd 1:39~beta-1.fc34 -> 1:39-1.fc34
    common 2:2.0.27-1.fc34 -> 2:2.0.27-2.fc34
    container-selinux 2:2.158.0-1.gite78ac4f.fc34 -> 2:2.160.0-2.fc34
    containers-common 4:1-13.fc34 -> 4:1-16.fc34
    coreutils 8.32-21.fc34 -> 8.32-24.fc34
```

OSTree

```
sane-airscan 0.99.24-1.fc34 -> 0.99.26-1.fc34
selinux-policy 34-1.fc34 -> 34.6-1.fc34
selinux-policy-targeted 34-1.fc34 -> 34.6-1.fc34
shadow-utils 2:4.8.1-7.fc34 -> 2:4.8.1-8.fc34
skopeo 1:1.2.2-24.fc34 -> 1:1.2.3-1.fc34
systemd 248-2.fc34 -> 248.2-1.fc34
systemd-libs 248-2.fc34 -> 248.2-1.fc34
systemd-networkd 248-2.fc34 -> 248.2-1.fc34
systemd-oomd-defaults 248-2.fc34 -> 248.2-1.fc34
systemd-pam 248-2.fc34 -> 248.2-1.fc34
systemd-rpm-macros 248-2.fc34 -> 248.2-1.fc34
systemd-udev 248-2.fc34 -> 248.2-1.fc34
tracker 3.1.1-1.fc34 -> 3.1.1-2.fc34
vim-minimal 2:8.2.2637-1.fc34 -> 2:8.2.2825-1.fc34
virtualbox-guest-additions 6.1.18-2.fc34 -> 6.1.22-1.fc34
volume_key-libs 0.3.12-10.fc34 -> 0.3.12-11.fc34
wget 1.21.1-2.fc34 -> 1.21.1-3.fc34
which 2.21-24.fc34 -> 2.21-26.fc34
wpebackend-fdo 1.9.90-1.fc34 -> 1.9.91-1.fc34
xdg-desktop-portal 1.8.1-2.fc34 -> 1.8.1-3.fc34
xdg-utils 1.1.3-8.fc34 -> 1.1.3-9.fc34
xkeyboard-config 2.32-1.fc34 -> 2.32-3.fc34
xorg-x11-drv-amdgpu 19.1.0-6.fc34 -> 19.1.0-8.fc34
xorg-x11-drv-libinput 0.30.0-5.fc34 -> 1.0.1-1.fc34
xorg-x11-xinit 1.4.0-9.fc34 -> 1.4.0-10.fc34
zchunk-libs 1.1.9-2.fc34 -> 1.1.11-1.fc34
Downgraded: c-ares 1.17.1-2.module_f34+11494+9ce8005d -> 1.17.1-2.fc34
            libuv 1:1.41.0-1.module_f34+11494+9ce8005d -> 1:1.41.0-1.fc34
            perl-Mozilla-CA 20200520-4.module_f34+11391+7bf06188 -> 20200520-4.fc34
            perl-Net-SSLeay 1.90-2.module_f34+11369+5aafb50 -> 1.90-2.fc34
            shim-x64 15-8 -> 15.4-4
Removed: bind-libs-lite-32:9.16.11-5.fc34.x86_64
          pipewire0.2-libs-0.2.7-5.fc34.x86_64
Added: libcloudproviders-0.3.1-3.fc34.x86_64
       libqrtr-glib-1.0.0-1.fc34.x86_64
```


OSTree

```
[yiran@fedora ~]$ rpm-ostree upgrade --preview |grep vim
      vim-minimal 2:8.2.2637-1.fc34 -> 2:8.2.2825-1.fc34
[yiran@fedora ~]$ rpm -q vim-minimal
vim-minimal-8.2.2637-1.fc34.x86_64
[yiran@fedora ~]$
```

OSTree

```
systemd 248-2.fc34 -> 248.2-1.fc34
systemd-libs 248-2.fc34 -> 248.2-1.fc34
systemd-networkd 248-2.fc34 -> 248.2-1.fc34
systemd-oomd-defaults 248-2.fc34 -> 248.2-1.fc34
systemd-pam 248-2.fc34 -> 248.2-1.fc34
systemd-rpm-macros 248-2.fc34 -> 248.2-1.fc34
systemd-udev 248-2.fc34 -> 248.2-1.fc34
tracker 3.1.1-1.fc34 -> 3.1.1-2.fc34
vim-minimal 2:8.2.2637-1.fc34 -> 2:8.2.2825-1.fc34
virtualbox-guest-additions 6.1.18-2.fc34 -> 6.1.22-1.fc34
volume_key-libs 0.3.12-10.fc34 -> 0.3.12-11.fc34
wget 1.21.1-2.fc34 -> 1.21.1-3.fc34
which 2.21-24.fc34 -> 2.21-26.fc34
wpebackend-fdo 1.9.90-1.fc34 -> 1.9.91-1.fc34
xdg-desktop-portal 1.8.1-2.fc34 -> 1.8.1-3.fc34
xdg-utils 1.1.3-8.fc34 -> 1.1.3-9.fc34
xkeyboard-config 2.32-1.fc34 -> 2.32-3.fc34
xorg-x11-drv-amdgpu 19.1.0-6.fc34 -> 19.1.0-8.fc34
xorg-x11-drv-libinput 0.30.0-5.fc34 -> 1.0.1-1.fc34
xorg-x11-xinit 1.4.0-9.fc34 -> 1.4.0-10.fc34
zchunk-libs 1.1.9-2.fc34 -> 1.1.11-1.fc34
Downgraded:
c-ares 1.17.1-2.module_f34+11494+9ce8005d -> 1.17.1-2.fc34
libuv 1:1.41.0-1.module_f34+11494+9ce8005d -> 1:1.41.0-1.fc34
perl-Mozilla-CA 20200520-4.module_f34+11391+7bf06188 -> 20200520-4.fc34
perl-Net-SSLeay 1.90-2.module_f34+11369+5aafb50 -> 1.90-2.fc34
shim-x64 15-8 -> 15.4-4
Removed:
bind-libs-lite-32:9.16.11-5.fc34.x86_64
pipewire0.2-libs-0.2.7-5.fc34.x86_64
Added:
libcloudproviders-0.3.1-3.fc34.x86_64
libqrtr-glib-1.0.0-1.fc34.x86_64
libudfread-1.1.2-1.fc34.x86_64
Run "systemctl reboot" to start a reboot
[yiran@fedora ~]$ rpm -q vim-minimal
vim-minimal-8.2.2637-1.fc34.x86_64
```

OSTree

```
[yiran@fedora ~]$ rpm-ostree status
State: idle
Deployments:
• ostree://fedora:fedora/34/x86_64/silverblue
    Version: 34.20210512.0 (2021-05-12T05:19:28Z)
    Commit: 12f85a0d59d262b5d128305de5634215e71c17c2dc2464f5669aa877085b5b43
    GPSSignature: Valid signature by 8C5BA6990BDB26E19F2A1A801161AE6945719A39

    ostree://fedora:fedora/34/x86_64/silverblue
    Version: 34.20210423.n.0 (2021-04-23T08:10:25Z)
    Commit: 7b99463136830fd9b18f8daf5f7973f3e15eaa3532f8dbcbb4f7eb9673170461
    GPSSignature: Valid signature by 8C5BA6990BDB26E19F2A1A801161AE6945719A39
[yiran@fedora ~]$ rpm -q vim-minimal
vim-minimal-8.2.2825-1.fc34.x86_64
[yiran@fedora ~]$
```

OSTree

```
samba-client-libs 2:4.14.4-0.fc34 -> 2:4.14.2-1.fc34
samba-common 2:4.14.4-0.fc34 -> 2:4.14.2-1.fc34
samba-common-libs 2:4.14.4-0.fc34 -> 2:4.14.2-1.fc34
sane-airscan 0.99.26-1.fc34 -> 0.99.24-1.fc34
selinux-policy 34.6-1.fc34 -> 34-1.fc34
selinux-policy-targeted 34.6-1.fc34 -> 34-1.fc34
shadow-utils 2:4.8.1-8.fc34 -> 2:4.8.1-7.fc34
skopeo 1:1.2.3-1.fc34 -> 1:1.2.2-24.fc34
systemd 248.2-1.fc34 -> 248-2.fc34
systemd-libs 248.2-1.fc34 -> 248-2.fc34
systemd-networkd 248.2-1.fc34 -> 248-2.fc34
systemd-oomd-defaults 248.2-1.fc34 -> 248-2.fc34
systemd-pam 248.2-1.fc34 -> 248-2.fc34
systemd-rpm-macros 248.2-1.fc34 -> 248-2.fc34
systemd-udev 248.2-1.fc34 -> 248-2.fc34
tracker 3.1.1-2.fc34 -> 3.1.1-1.fc34
vim-minimal 2:8.2.2825-1.fc34 -> 2:8.2.2637-1.fc34
virtualbox-guest-additions 6.1.22-1.fc34 -> 6.1.18-2.fc34
volume_key-libs 0.3.12-11.fc34 -> 0.3.12-10.fc34
wget 1.21.1-3.fc34 -> 1.21.1-2.fc34
which 2.21-26.fc34 -> 2.21-24.fc34
wpebackend-fdo 1.9.91-1.fc34 -> 1.9.90-1.fc34
xdg-desktop-portal 1.8.1-3.fc34 -> 1.8.1-2.fc34
xdg-utils 1.1.3-9.fc34 -> 1.1.3-8.fc34
xkeyboard-config 2.32-3.fc34 -> 2.32-1.fc34
xorg-x11-drv-amdgpu 19.1.0-8.fc34 -> 19.1.0-6.fc34
xorg-x11-drv-libinput 1.0.1-1.fc34 -> 0.30.0-5.fc34
xorg-x11-xinit 1.4.0-10.fc34 -> 1.4.0-9.fc34
zchunk-libs 1.1.11-1.fc34 -> 1.1.9-2.fc34
```

Removed:

```
libcloudproviders-0.3.1-3.fc34.x86_64
libqrtr-glib-1.0.0-1.fc34.x86_64
libudfread-1.1.2-1.fc34.x86_64
```

Added:

```
bind-libs-32:9.16.11-5.fc34.x86_64
pipewire0.2-libs-0.2.7-5.fc34.x86_64
```

Run "systemctl reboot" to start a reboot

OSTree

```
[yiran@fedora ~]$ ll -i /
total 48
 303 lrwxrwxrwx.   3 root root    7 May 11 21:10 bin -> usr/bin
   2 drwxr-xr-x.   7 root root 4096 May 12 21:03 boot
   1 drwxr-xr-x.  19 root root 3880 May 12 21:04 dev
145641 drwxr-xr-x.   1 root root 4066 May 12 21:04 etc
 307 lrwxrwxrwx.   3 root root    8 May 11 21:10 home -> var/home
 306 lrwxrwxrwx.   5 root root    7 May 11 21:10 lib -> usr/lib
 312 lrwxrwxrwx.   5 root root    9 May 11 21:10 lib64 -> usr/lib64
 310 lrwxrwxrwx.   3 root root    9 May 11 21:10 media -> run/media
 314 lrwxrwxrwx.   3 root root    7 May 11 21:10 mnt -> var/mnt
 323 lrwxrwxrwx.   3 root root    7 May 11 21:10 opt -> var/opt
 315 lrwxrwxrwx.   3 root root   14 May 11 21:10 ostree -> sysroot/ostree
   1 dr-xr-xr-x. 329 root root    0 May 12 21:04 proc
 320 lrwxrwxrwx.   3 root root   12 May 11 21:10 root -> var/roothome
   1 drwxr-xr-x.  49 root root 1280 May 12 21:05 run
 318 lrwxrwxrwx.   3 root root    8 May 11 21:10 sbin -> usr/sbin
 327 lrwxrwxrwx.   3 root root    7 May 11 21:10 srv -> var/srv
   1 dr-xr-xr-x.  13 root root    0 May 12 21:04 sys
 256 drwxr-xr-x.   1 root root   74 May 11 21:10 sysroot
   1 drwxrwxrwt.  20 root root   480 May 12 21:05 tmp
124376 drwxr-xr-x.   1 root root  106 Jan  1 1970 usr
124358 drwxr-xr-x.   1 root root   262 May 12 21:02 var
```

OSTree

```
[root@fedora ~]# rpm-ostree status
State: idle
Deployments:
• ostree://fedora:fedora/34/x86_64/silverblue
    Version: 34.20210423.n.0 (2021-04-23T08:10:25Z)
    Commit: 7b99463136830fd9b18f8daf5f7973f3e15eaa3532f8dbcbb4f7eb9673170461
    GPGSiganture: Valid signature by 8C5BA6990BDB26E19F2A1A801161AE6945719A39

    ostree://fedora:fedora/34/x86_64/silverblue
    Version: 34.20210512.0 (2021-05-12T05:19:28Z)
    Commit: 12f85a0d59d262b5d128305de5634215e71c17c2dc2464f5669aa877085b5b43
    GPGSiganture: Valid signature by 8C5BA6990BDB26E19F2A1A801161AE6945719A39
[root@fedora ~]# echo 7b99 > /etc/7b99
[root@fedora ~]# echo 7b99 > /var/7b99
[root@fedora ~]# ll -i /etc/7b99 /var/7b99
335566 -rw-r--r--. 1 root root 5 May 12 21:07 /etc/7b99
335567 -rw-r--r--. 1 root root 5 May 12 21:07 /var/7b99
[root@fedora ~]#
```

OSTree

```
[root@fedora ~]# rpm-ostree status
State: idle
Deployments:
• ostree://fedora:fedora/34/x86_64/silverblue
    Version: 34.20210512.0 (2021-05-12T05:19:28Z)
    Commit: 12f85a0d59d262b5d128305de5634215e71c17c2dc2464f5669aa877085b5b43
    GPSSignature: Valid signature by 8C5BA6990BDB26E19F2A1A801161AE6945719A39

    ostree://fedora:fedora/34/x86_64/silverblue
    Version: 34.20210423.n.0 (2021-04-23T08:10:25Z)
    Commit: 7b99463136830fd9b18f8daf5f7973f3e15eaa3532f8dbcb4f7eb9673170461
    GPSSignature: Valid signature by 8C5BA6990BDB26E19F2A1A801161AE6945719A39
[root@fedora ~]# ll -i /etc/7b99 /var/7b99
360746 -rw-r--r--. 1 root root 5 May 12 21:07 /etc/7b99
335567 -rw-r--r--. 1 root root 5 May 12 21:07 /var/7b99
[root@fedora ~]# cat /etc/7b99
7b99
[root@fedora ~]# cat /var/7b99
7b99
[root@fedora ~]#
```

OSTree

```
[root@fedora ~]# rpm-ostree status
State: idle
Deployments:
• ostree://fedora:fedora/34/x86_64/silverblue
    Version: 34.20210512.0 (2021-05-12T05:19:28Z)
    Commit: 12f85a0d59d262b5d128305de5634215e71c17c2dc2464f5669aa877085b5b43
    GPSSignature: Valid signature by 8C5BA6990BDB26E19F2A1A801161AE6945719A39

    ostree://fedora:fedora/34/x86_64/silverblue
    Version: 34.20210423.n.0 (2021-04-23T08:10:25Z)
    Commit: 7b99463136830fd9b18f8daf5f7973f3e15eaa3532f8dbcb4f7eb9673170461
    GPSSignature: Valid signature by 8C5BA6990BDB26E19F2A1A801161AE6945719A39
[root@fedora ~]# echo 12f8 >> /etc/7b99
[root@fedora ~]# echo 12f8 >> /var/7b99
[root@fedora ~]# cat /etc/7b99
7b99
12f8
[root@fedora ~]# cat /var/7b99
7b99
12f8
[root@fedora ~]# █
```


OSTree

```
[root@fedora ~]# rpm-ostree status
State: idle
Deployments:
  ostree://fedora:fedora/34/x86_64/silverblue
    Version: 34.20210512.0 (2021-05-12T05:19:28Z)
    Commit: 12f85a0d59d262b5d128305de5634215e71c17c2dc2464f5669aa877085b5b43
    GPSSignature: Valid signature by 8C5BA6990BDB26E19F2A1A801161AE6945719A39
    Diff: 253 upgraded, 5 downgraded, 2 removed, 3 added

• ostree://fedora:fedora/34/x86_64/silverblue
  Version: 34.20210423.n.0 (2021-04-23T08:10:25Z)
  Commit: 7b99463136830fd9b18f8daf5f7973f3e15eaa3532f8dbcbb4f7eb9673170461
  GPSSignature: Valid signature by 8C5BA6990BDB26E19F2A1A801161AE6945719A39
[root@fedora ~]# ll -i /etc/7b99 /var/7b99
335566 -rw-r--r--. 1 root root  5 May 12 21:07 /etc/7b99
335567 -rw-r--r--. 1 root root 10 May 12 21:10 /var/7b99
[root@fedora ~]# cat /etc/7b99
7b99
[root@fedora ~]# cat /var/7b99
7b99
12f8
yiran 2021-05-13 [root@fedora ~]#
```

OSTree

```
[root@fedora ~]# ll -i /etc/7b99
360746 -rw-r--r--. 1 root root 10 May 12 21:10 /etc/7b99
[root@fedora ~]# find /sysroot/ostree/ -inum 360746 -ls
 360746      4 -rw-r--r--   1 root    root          10 May 12 21:10 /sysroot/ostree/deploy/fedora/deploy/12f85a0d59d262b5d
128305de5634215e71c17c2dc2464f5669aa877085b5b43.1/etc/7b99
[root@fedora ~]#
[root@fedora ~]# ls -i /var/7b99
335567 /var/7b99
[root@fedora ~]# find /sysroot/ostree/ -inum 335567 -ls
 335567      4 -rw-r--r--   1 root    root          10 May 12 21:10 /sysroot/ostree/deploy/fedora/var/7b99
[root@fedora ~]#
```

OSTree

```
[root@fedora ~]# ll -i `which bash`
513 -rwxr-xr-x. 3 root root 1390080 Jan  1  1970 /usr/bin/bash
[root@fedora ~]# find /sysroot/ostree/ -inum 513 -ls
      513    1360 -rwxr-xr-x   3 root    root    1390080 Jan  1  1970 /sysroot/ostree/repo/objects/55/72114508f18f85f9effab1
13110622833f9ac7187ce36d098bddb226574fba.file
      513    1360 -rwxr-xr-x   3 root    root    1390080 Jan  1  1970 /sysroot/ostree/deploy/fedora/deploy/7b99463136830fd9b
18f8daf5f7973f3e15eaa3532f8dbcbb4f7eb9673170461.0/usr/bin/bash
      513    1360 -rwxr-xr-x   3 root    root    1390080 Jan  1  1970 /sysroot/ostree/deploy/fedora/deploy/12f85a0d59d262b5d
128305de5634215e71c17c2dc2464f5669aa877085b5b43.1/usr/bin/bash
[root@fedora ~]#
```

相关链接：

- <https://www.softwarecollections.org/en/>
- <https://ostreedev.github.io/ostree/>
- <https://github.com/coreos/rpm-ostree>
- <https://blog.verbum.org/2020/08/22/immutable-→-reprovisionable-anti-hysteresis/>