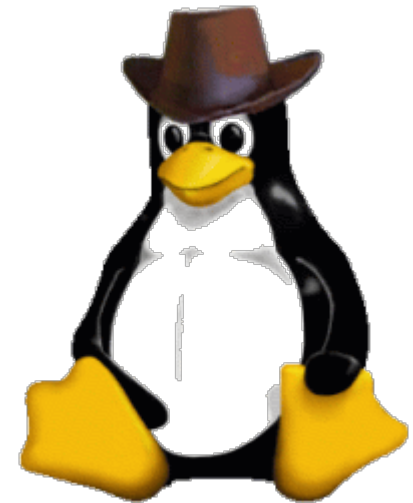# Saddle up, Penguins!
The ICS Admin RHEL7 Primer is Here

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Agenda

- Introduction
- New Features
- Subscription Management
- Systemd
- Journald
- Containers
- A Few Upgrade Tips
- Reference Material
- Your Questions

Introduction

Important Notation

Many of the new features of RHEL 7 are provided through open source projects Red Hat does not run.

Thus, they inherit the work… and the changes.

Finding the Current Release (Good)

This is consistent across all versions

- Handy if you are touching a box built by another admin

- Or if you suspect your documentation is incorrect/incomplete

```
[malchw@localhost ~]$ cat /etc/redhat-release
Red Hat Enterprise Linux Server release 7.2 (Maipo)
```

But... This is <u>Better</u>

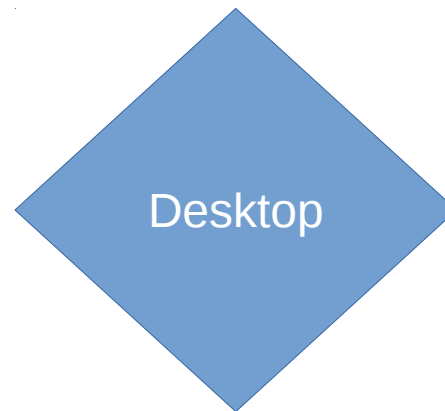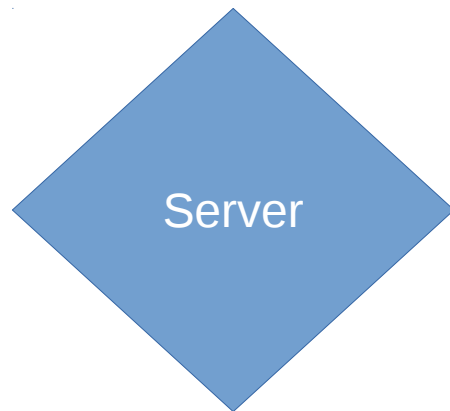The *redhat-release* file can be edited to install some third party apps, destroying accuracy

Instead, doublecheck with RPM

```
[root@localhost ~]# rpm -q redhat-release-server
redhat-release-server-7.2-9.el7.x86_64
```

New Features

"We Only Do x64 (on Intel/AMD) Now!"

A Few Useful Tidbits

- *Ext4* supports 50TB file system size

- *Snapper* creates, deletes, labels, and organizes snapshots for LVM logical volumes

- *OpenLMI* is a project for remote management through a common infrastructure with both physical and virtual systems

- *Live Media Creator* for customized Kickstart files - great for enterprise deployments

In-place Upgrade v Clean Install

Red Hat offers *Preupgrade Assistant*

- Assesses the current system

- Provides list of potential issues

"An in-place upgrade requires a lot of troubleshooting and planning and should only be done if there is no other choice."
--*RHEL 7 Installation Guide, Chapter 3, "Planning for Installation..."*

In-place Upgrade v Clean Install

In case the last slide wasn't clear... go clean!

Updated Linux Lexicon

RHEL7 provides new terminology to better capture what technology offers

Old Term	New Term
Runlevels	Target units
Tasks	Units
init scripts	Systemd service units

New RHEL 7.2 Changes

- RHSM - registering now displays the subscription server URL utilized

- RHSM - can use *syslog* now, set here -> `/etc/rhsm/logging.conf`

- Firstboot now includes RHSM; Initial Setup's main menu

- NetworkManager supports Wake On LAN

Security: Bye, Bye Iptables

- RHEL7 utilizes *firewalld* - new Dynamic Firewall

  Project homepage: http://www.firewalld.org/

- Beginners Guide

  https://www.certdepot.net/rhel7-get-started-firewalld/

- Red Hat's Thomas Woerner's Training Video

  https://www.youtube.com/watch?v=XhwvT05Puhs

Falling Back to Iptables

Firewalld can be disabled for *iptables*

- CertDepot has an article with the full command set to install iptables, enable it, and disable the firewalld unit

- https://www.certdepot.net/rhel7-disable-firewalld-use-iptables/

Security: Securing the systemd Journal

- Enter *Forward Secure Sealing* or FSS

    - Disabled by default

    - Enabled when setting up the Journal's Keys

        #**journalctl --setup-keys**

- Still some controversy over whether this is a good idea, or trustworthy

- Listed as a placeholder, for future discussion

New RHEL 7.2 Changes

- If "rescue" appears on kernel command line, system automatically enters rescue (rescue.target or runlevel 1)

- systemd updated to version 219 with several new changes

    - https://access.redhat.com/articles/1611383

For Example, Version 219 Changes

New systemd commands

- Check overall system state

    #**systemctl is-system-running**

- List installed timer units with elapse next

    #**systemctl list-timers**

- Display unit's original unit file to display full configuration

    #**systemctl cat {unit_pattern}**

Systemctl -is-system-running Output Table

Table 2. Manager Operational States

Name	Description
initializing	Early bootup, before basic.target is reached or the maintenance state entered.
starting	Late bootup, before the job queue becomes idle for the first time, or one of the rescue targets are reached.
running	The system is fully operational.
degraded	The system is operational but one or more units failed.
maintenance	The rescue or emergency target is active.
stopping	The manager is shutting down.

New RHEL 7.2 Changes

Atomic Host and Containers release notes are separate now, for easier updating

- https://access.redhat.com/documentation/en/red-hat-enterprise-linux-atomic-host/7/single/release-notes/

New RHEL 7.2 Changes

Full major feature list, via Release Notes

- https://access.redhat.com/documentation/en-US/Red_Hat_Enterprise_Linux/7/html/7.2_Release_Notes/new-features.html

Patience is Rewarded...

Two Major Features Deprecated

RHN

SysV init

Additional Areas of Deprecation

- Windows guest virtual machine support limited

    Runs only under Advanced Mission Critical programs (AMC)

- Older Device drivers: Full deprecated list

    https://access.redhat.com/documentation/en-US/Red_Hat_Enterprise_Linux/7/html/7.2_Release_Notes/chap-Red_Hat_Enterprise_Linux-7.2_Release_Notes-Deprecated_Functionality-in-RHEL-7.html

What Broke Between Point Releases - NFS

- With all the new changes in RHEL7.0, it took time to settle

- Versions 7.1. to 7.2 broke more features

- NFS: *nfs-secure-server* service changed functionality as *nfs-idmap* spawned a sibling *nfs-idmapd*

- Kerberos NSF client received *nfs-client.target*

Footnote: CertDepot, "RHEL7:Changes between versions."

What Broke Between Point Releases - NetworkManager

RHEL Version	NFS Command Change
7.0	`# nmcli con mod myConn ipv4.addresses "10.0.0.10/24 10.0.0.1"`

7.1	`Now two steps:`
	`# nmcli con mod myConn ipv4.addresses 10.0.0.10/24`
	`# nmcli con mod myConn ipv4.gateway 10.0.0.1`

Undocumented!

Key	
con	Connection
mod	Modify
/24	Entire Class C network

Footnote: CertDepot, "RHEL7:Changes between versions."

What Broke Between Point Releases - systemd

- RHEL 7.2 provides v219 from v208

- Beware of the new RemoveIPC command

  - Impacts ASM (Oracle), DBs, applications with Shared Memory Segment (SHM) not the entire server

  - Enable and if the UID exceeds 1000

  - C R A S H!

What Broke Between Point Releases - systemd

- Disable in the config file

  - `/etc/systemd/logind.conf`

  - #**systemctl restart systemd-logind**

- Source: "How to kill your database in seconds with OS update - RHEL / OEL 7.1 - mind the RemoveIPC parameter"

  https://www.linkedin.com/pulse/how-kill-your-database-seconds-os-update-rhel-oel-71-maciej-tokar

Subscription Management

Get Ready for Subscription Management

> Red Hat is transitioning to Red Hat Subscription Management (RHSM) for all Red Hat products by July 31st, 2017

- Note: RHEL7, Subscription Asset Manager, CloudForms, Directory Server 9 already use RHSM

- Older products can use the respective product based tools Additional information location below:
  1. https://access.redhat.com/rhn-to-rhsm#guides
  2. https://access.redhat.com/rhn-to-rhsm#learn
  3. https://access.redhat.com/rhn-to-rhsm

Upgrading/Transitioning Enterprise Linux

- Install Missing RPMs (Pre-RHEL7 Systems)

  - #**yum install subscription-manager-migration subscription-manager-migration-data**

- Run this command:

  - #**rhn-migrate-classic-to-rhsm**

- View migration process status and history

  - #**subscription-manager facts --list | grep migration**

    migration.classic_system_id: 12345

    migration.migrated_from: rhn_hosted_classic

    migration.migration_date: 2016-07-24T12:32:01.179408

RHSM Manages Multiple System Tasks

What RHSM Provides	
System registration to a designated subscription service	Product subscriptions for installed products

Key RHSM Directories

Two key directory paths where confirmation information is stored:

- `/etc/pki/{consumer, entitlement, product}/*.pem`
- `/etc/rhsm/{rhsm.conf, facts/}`

Registering Your New Server

Red Hat provides three convenient ways to attach your server to a subscription certificate

Red Hat Subscription Registration

firstboot

kickstart

Manually run RHSM
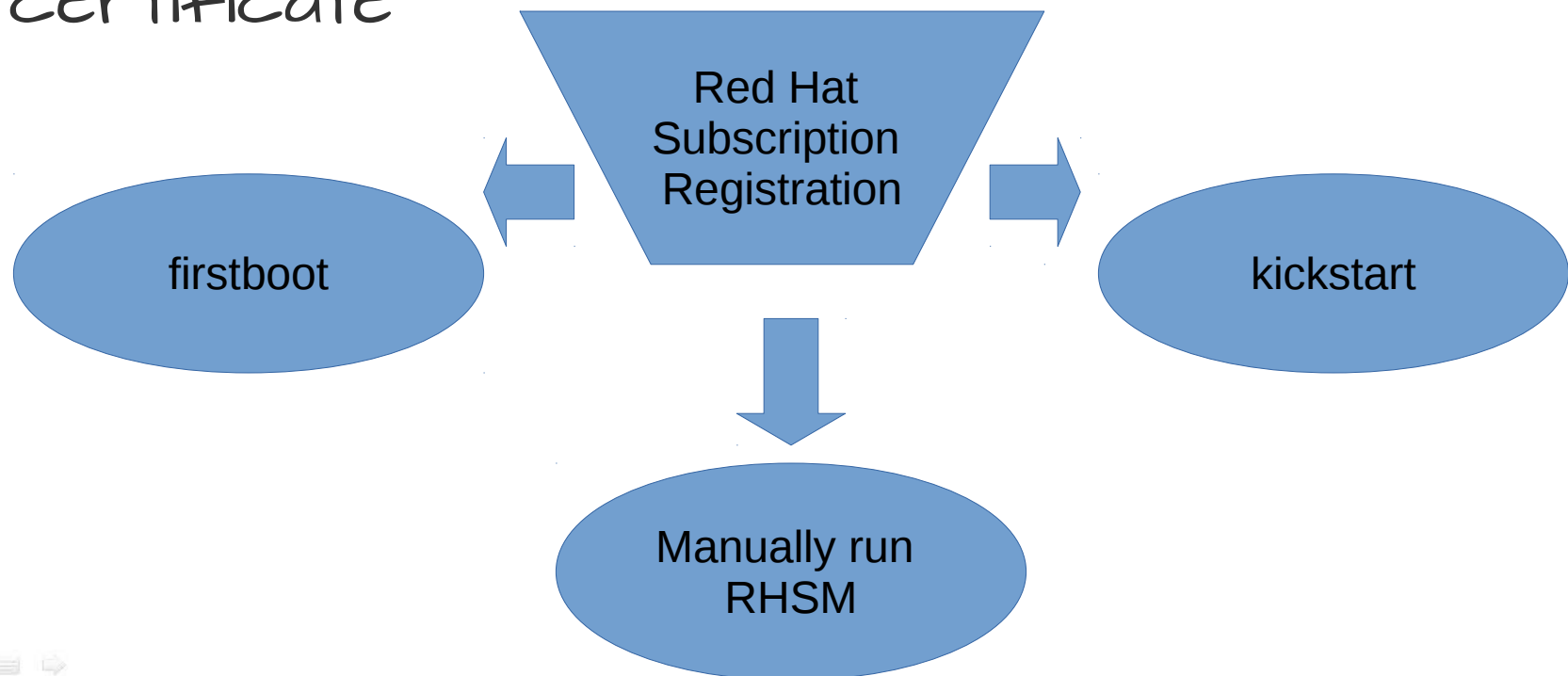
Three Fundamental RHSM Commands

- Basic Registration with or with parameters

  - `#subscription-manager register --username <username> --password <password>`

- List all available subscriptions

  - **`#subscription-manager list --available -all`**

- Attach to appropriate subscription

  - **`#subscription-manager attach --auto`**

    `OR`

  - `#subscription-manager attach -pool=<poolID>`

"How Do I Find my Pool ID?"

Executing the list all available subscriptions commands provides the needed data

```
[root@server1 ~]# subscription-manager list --available
+-------------------------------------------+
     Available Subscriptions
+-------------------------------------------+
ProductName:            RHEL for Physical Servers
ProductId:              MKT-rhel-server
PoolId:                 ff8080812bc382e3012bc3845ca000cb
Quantity:               10
Expires:                2011-09-20
```

Footnote: Output provided via the Red Hat Subscription Manual, Section 4.3.1

Subscription Manager Full Command Set 1-2: Primary Modules

```
[root@localhost ~]# subscription-manager --?
Usage: subscription-manager MODULE-NAME [MODULE-OPTIONS] [--help]

Primary Modules:

  attach       Attach a specified subscription to the registered system
  list         List subscription and product information for this system
  refresh      Pull the latest subscription data from the server
  register     Register this system to the Customer Portal or another subscription management service
  release      Configure which operating system release to use
  remove       Remove all or specific subscriptions from this system
  status       Show status information for this system's subscriptions and products
  unregister   Unregister this system from the Customer Portal or another subscription management service
```

Subscription Manager Full Command Set 2-2: Other Modules

```
Other Modules:

  auto-attach     Set if subscriptions are attached on a schedule (default of daily)
  clean           Remove all local system and subscription data without affecting the server
  config          List, set, or remove the configuration parameters in use by this system
  environments    Display the environments available for a user
  facts           View or update the detected system information
  identity        Display the identity certificate for this system or request a new one
  import          Import certificates which were provided outside of the tool
  orgs            Display the organizations against which a user can register a system
  plugins         View and configure subscription-manager plugins
  redeem          Attempt to redeem a subscription for a preconfigured system
  repo-override   Manage custom content repository settings
  repos           List the repositories which this system is entitled to use
  service-level   Manage service levels for this system
  subscribe       Deprecated, see attach
  unsubscribe     Deprecated, see remove
  version         Print version information
```

Determining the RHSM Version

Relevancy: post version 1.1.9-1, *attach* supersedes the now deprecated *subscribe*

```
[root@localhost ~]# subscription-manager version
server type: This system is currently not registered.
subscription management server: 0.9.51.11-1
subscription management rules: 5.15
subscription-manager: 1.15.9-15.el7  <------
python-rhsm: 1.15.4-5.el7
```

Subscription Manager Notation

Primary commands offer sub-commands

- Access via `-h` or `--help` parameter

- *Attach* and *Register* offer the longest list

```
[root@localhost ~]# subscription-manager attach -h
Usage: subscription-manager attach [OPTIONS]

Attach a specified subscription to the registered system

Options:
  -h, --help              show this help message and exit
  --proxy=PROXY_URL       proxy URL in the form of proxy_hostname:proxy_port
  --proxyuser=PROXY_USER
                          user for HTTP proxy with basic authentication
  --proxypassword=PROXY_PASSWORD
                          password for HTTP proxy with basic authentication
  --pool=POOL             the ID of the pool to attach (can be specified more
                          than once)
  --quantity=QUANTITY     number of subscriptions to attach
  --auto                  Automatically attach compatible subscriptions to this
                          system. This is the default action.
  --servicelevel=SERVICE_LEVEL
                          service level to apply to this system
  --file=FILE             A file from which to read pool IDs. If a hyphen is
                          provided, pool IDs will be read from stdin.
```

Handling Multiple Socket Servers

Powerful option: attach's `--quantity` command

- Allows assignment for multiple subscriptions
  to cover multi-socket servers

- `[root@server1 ~]#` **subscription-manager attach --pool=XYZ01234567 --quantity=2**

Footnote: Output provided via the Red Hat Subscription Manual, Section 4.4

My (Pre-Prod) Server is Not Online

Don't have Internet access, unable to access Red Hat's subscription server, or want to allocate a license before installation? Easy, just *import*

- Get subscription file (.`pem`) via Customer Portal

- Run this command: `# subscription-manager import --certificate {/path/to/file.pem}`

  `# subscription-manager import --certificate=/root/certs/607687452896356798.pem`

  `Successfully imported certificate 607687452896356798.pem`

Removal vs. Unregister

Recycling Subscriptions is easy - ensure you use the correct method

- *Remove* expunges the subscribed certificate(s) assigned to the system, BUT keeps it registered with RHSM

- *Unregister* removes and deletes the system's registration record

Precise Removal

- Each registered product provides an identifying X.509 certificate
  - /etc/pki/entitlement/<serial_number>.pem
- To remove a product's subscription, identify the cerficiate(s)' respective serial number(s)
  - If a product's serial number is "527", then:
  - #**subscription-manager remove --serial=527**
  - #**subscription-manager remove --all**

Error: "No Installed Products Found"

- #**subscription-manager list**

  No installed products to list

  --OR--

```
[root@localhost ~]# ls -l /etc/pki/product
total 0
[root@localhost ~]# subscription-manager list

+---------------------------------------+
       Installed Product Status
+---------------------------------------+
Product Name:    Red Hat Enterprise Linux Server
Product ID:      69
Version:         7.2
Arch:            x86_64
Status:          Unknown
Status Details:
Starts:
Ends:
```

- Check to ensure /etc/pki/product-default has a respective .pem file
- Ensure file permissions:
  ```
  #ls -l /etc/pki/product
  -rw-r--r--. 1 root root 2159 Oct 23 2015
  /etc/pki/product/69.pem
  ```

Finally, to Acquire Additional Information

One of the best methods to learn about RHSM is to RTFM

```
$man subscription-manager
```

Systemd

"What Does systemd Do For Me?"

- The new system and service manager

- Is backwards compatible with SysV init scripts

- On-demand daemon activation

- System state snapshots

- Server boots faster

  - Uses fewer scripts

  - Increased task (unit) parallelization

Systemd's Distributed File Locations

Path	Provides
/etc/systemd	Global systemd configuration
/etc/systemd/system/	System administrator created and managed units Supersedes runtime units (/run/systemd/system)
/run/systemd/system/	Systemd units created at runtime
/usr/lib/systemd/system	Service configuration files
/etc/systemd/system	Custom service configuration files
/usr/lib/systemd/system/	RPM packages' distributed units

Basic Command Set - Systemctl

Command	Provides
# systemctl --version	Systemd version
# systemctl start sshd	Start a service
# systemctl stop sshd	Stop a service
# systemctl {enable, disable} sshd	Enable/disable a service at boot
# systemctl status sshd	Display current sevice status
# systemctl status --all	Display status for all status

Note: You can also include the .service extension above

Basic Command Set – Systemd-analyze

Command	Provides
`# systemd-analyze`	Startup/boot-up duration
`# systemd-analyze critical-chain [<app>.service] | [unit.target]`	Linked list of boot-time tasks & times; examples - service = rcdomino.service target = basic.target
`# systemd-analyze dump`	Provides long human-readable serialization of boot process

Available Systemd Unit Types

Unit Type	File Extension	Description
Service unit	.service	A system service.
Target unit	.target	A group of systemd units.
Automount unit	.automount	A file system automount point.
Device unit	.device	A device file recognized by the kernel.
Mount unit	.mount	A file system mount point.
Path unit	.path	A file or directory in a file system.
Scope unit	.scope	An externally created process.
Slice unit	.slice	A group of hierarchically organized units that manage system processes.
Snapshot unit	.snapshot	A saved state of the systemd manager.
Socket unit	.socket	An inter-process communication socket.
Swap unit	.swap	A swap device or a swap file.
Timer unit	.timer	A systemd timer.

Available Systemd Unit Types -- Annotation

The previous slide's robust table provided as follows:

RHEL 7 System Administration Guide, Table 8.1 →
https://access.redhat.com/documentation/en-US/Red_Hat_Enterprise_Linux/7/html/System_Administrators_Guide/chap-Managing_Services_with_systemd.html#tabl-Managing_Services_with_systemd-Introduction-Units-Types

What Units are Installed on your System

Use the following command:

    #**systemctl list-unit-files**

```
UNIT FILE                                  STATE
proc-sys-fs-binfmt_misc.automount          static
dev-hugepages.mount                        static
dev-mqueue.mount                           static
proc-sys-fs-binfmt_misc.mount              static
sys-fs-fuse-connections.mount              static
sys-kernel-config.mount                    static
sys-kernel-debug.mount                     static
tmp.mount                                  disabled
brandbot.path                              disabled
systemd-ask-password-console.path          static
systemd-ask-password-plymouth.path         static
systemd-ask-password-wall.path             static
session-1.scope                            static
abrt-ccpp.service                          enabled
abrt-oops.service                          enabled
abrt-pstoreoops.service                    disabled
```

Boot Process Time Check

Is this fast?

```
[root@localhost ~]# systemd-analyze
Startup finished in 902ms (kernel) + 2.629s (initrd) + 45.290s (userspace) = 48.821s
```

Boot Process Critical-Chain Time Check

```
[root@localhost ~]# systemd-analyze critical-chain
The time after the unit is active or started is printed after the "@" character.
The time the unit takes to start is printed after the "+" character.

graphical.target @45.279s
└─multi-user.target @45.279s
  └─postfix.service @19.090s +1.386s
    └─network.target @19.070s
      └─network.service @18.487s +580ms
        └─NetworkManager.service @12.874s +381ms
          └─firewalld.service @8.555s +4.308s
            └─basic.target @8.271s
              └─sockets.target @8.270s
                └─dbus.socket @8.254s
                  └─sysinit.target @8.250s
                    └─systemd-update-utmp.service @8.195s +54ms
                      └─auditd.service @7.845s +347ms
                        └─systemd-tmpfiles-setup.service @7.739s +94ms
                          └─rhel-import-state.service @7.504s +230ms
                            └─local-fs.target @7.503s
                              └─boot.mount @5.152s +1.312s
                                └─dev-disk-by\x2duuid-92b7955d\x2d4892\x2d4fe1\x2db2fc\x2d7f0bfc53495b.device @5.149s
```

Note: Some output can provide a false positive as time may be dependent upon socket activation and unit parallel execution

The system event log file - Journald

Searching the systemd Journal

Systemd manages the RHEL7 system log through the Journald program

- Written via `systemd-journald.service`
- #**journalctl**

Useful Journald Query Commands

- Print recent sshd entries, refresh as written

  - #**journalctl `which sshd` -f**

- Print most recent 100 lines

  - #**journalctl -n100**

- Reverse display order

  - #**journalctl -r**

- List time-based subset

  - #**journalctl --since=yesterday**

Useful Journald Query Commands

- Display recent boots
  - #**journalctl --list-boots**

```
[root@localhost ~]# journalctl --list-boots
 0 b6d0a392d8584a1096122adde3c58d24 Sun 2016-08-14 12:22:26 PDT-Thu 2016-08-18 12:23:09 PDT
```

- Display all messages for current user or system
  - #**journalctl --user**
  - #**journalctl --system**

Journald Useful Tips

- Data stored in `/run/log/journal`

    But are purged after each reboot

- If permanency is desired - one way is below:

    - #**mkdir /var/log/journal**

    - #**echo "SystemMaxUse=75M" >> /etc/systemd/journald.conf**

        - Append the parameter to the *journald.conf* file

        - You could use *vi* as well to append the line

    - #**systemctl restart systemd-journald**

Want to Know How Big The Journald Is?

Journald provides a simple command

– #**journalctl --disk-usage**

```
[root@localhost ~]# journalctl --disk-usage
Archived and active journals take up 8.0M on disk.
```

Containers

Containers Conundrum

What are they?

Linux® containers keep applications and their runtime
components together
by combining lightweight application
isolation with an image-based deployment method.
Containers package applications with the files
on which they depend. This reduces the friction between
development and operations, simplifies application deployment,
and accelerates delivery
cycles—allowing
you to deliver value to customers faster.

Footnote: Red Hat, https://www.redhat.com/en/insights/containers

Let's Get Visual

Footnote: Red Hat, https://www.redhat.com/en/insights/containers
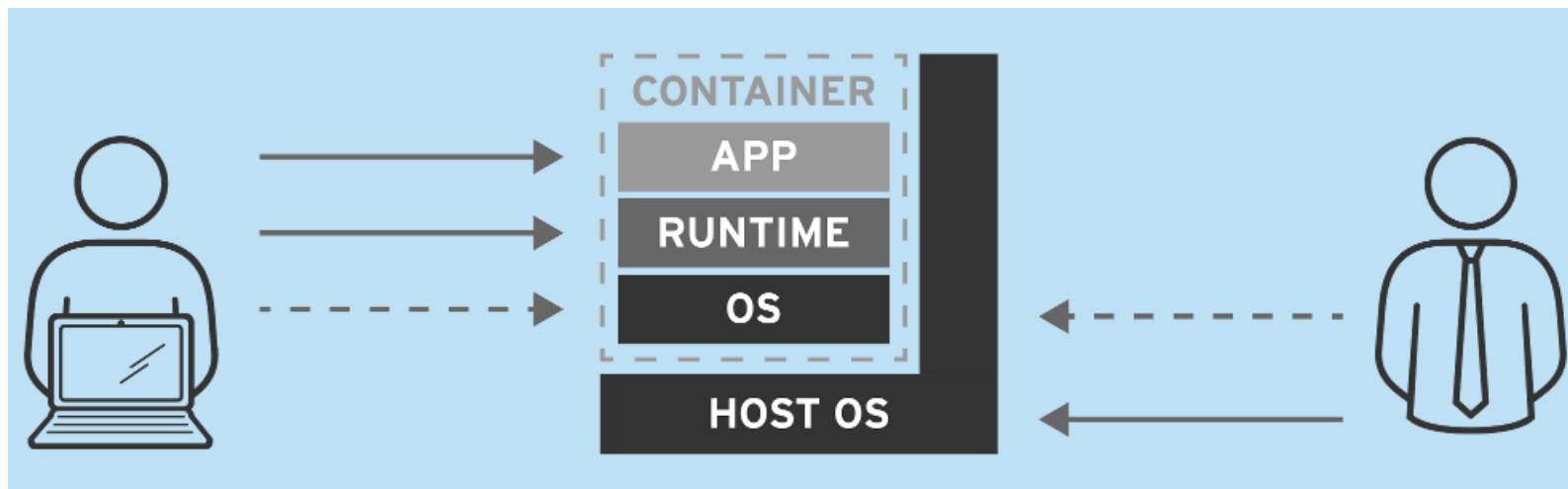
Three Ways Containers Can Help Admins

Collaborate	Compose	Modernize
Dev and Ops get apps in prod faster	Enables microservices deployment and recycling	Avoid maintaining physical environments with traditional applications

Mobile, Social, Web, Cloud
All make good deployment candidates

Footnote: Red Hat, https://www.redhat.com/en/insights/containers

Security is Utmost Performance

Just because an application is contained,
does not imply it is secure...

"Security is just as important
Inside a container as
it is anywhere else
in your Infrastructure."
--Josh Bressers
Red Hat
Security Strategist

Footnote: Red Hat, https://www.redhat.com/en/insights/containers

A Few Upgrade Tips

Creating a firstboot User

- RHEL6+ you are required to create a user with firstboot

- The user attributes are minimized

- Solution: create an ephemeral account

- Login as root

- Create new accounts properly

- Expunge the ephemeral account

Finding Mounted Hardware

- Use *findmnt* to locate a new filesystem (e.g. USB drive

- $**findmnt**

```
[root@localhost ~]# findmnt
TARGET                        SOURCE     FSTYPE     OPTIONS
/                             /dev/sda3  xfs        rw,relatime,
├─/sys                        sysfs      sysfs      rw,nosuid,no
│ ├─/sys/kernel/security      securityfs securityfs rw,nosuid,no
│ ├─/sys/fs/cgroup            tmpfs      tmpfs      ro,nosuid,no
│ │ ├─/sys/fs/cgroup/systemd  cgroup     cgroup     rw,nosuid,no
│ │ ├─/sys/fs/cgroup/perf_event cgroup   cgroup     rw,nosuid,no
│ │ ├─/sys/fs/cgroup/devices  cgroup     cgroup     rw,nosuid,no
│ │ ├─/sys/fs/cgroup/cpu,cpuacct cgroup  cgroup     rw,nosuid,no
│ │ ├─/sys/fs/cgroup/memory   cgroup     cgroup     rw,nosuid,no
│ │ ├─/sys/fs/cgroup/blkio    cgroup     cgroup     rw,nosuid,no
│ │ ├─/sys/fs/cgroup/cpuset   cgroup     cgroup     rw,nosuid,no
│ │ ├─/sys/fs/cgroup/hugetlb  cgroup     cgroup     rw,nosuid,no
│ │ ├─/sys/fs/cgroup/net_cls  cgroup     cgroup     rw,nosuid,no
│ │ └─/sys/fs/cgroup/freezer  cgroup     cgroup     rw,nosuid,no
│ ├─/sys/fs/pstore            pstore     pstore     rw,nosuid,no
│ ├─/sys/fs/selinux           selinuxfs  selinuxfs  rw,relatime
│ ├─/sys/kernel/debug         debugfs    debugfs    rw,relatime
│ └─/sys/kernel/config        configfs   configfs   rw,relatime
├─/proc                       proc       proc       rw,nosuid,no
│ └─/proc/sys/fs/binfmt_misc  systemd-1  autofs     rw,relatime,
├─/dev                        devtmpfs   devtmpfs   rw,nosuid,se
│ ├─/dev/shm                  tmpfs      tmpfs      rw,nosuid,no
│ ├─/dev/pts                  devpts     devpts     rw,nosuid,no
│ ├─/dev/mqueue               mqueue     mqueue     rw,relatime,
│ └─/dev/hugepages            hugetlbfs  hugetlbfs  rw,relatime,
├─/run                        tmpfs      tmpfs      rw,nosuid,no
│ └─/run/user/1000            tmpfs      tmpfs      rw,nosuid,no
├─/boot                       /dev/sda1  xfs        rw,relatime,
```

VMware tips

- Primary vendor documentation

  http://partnerweb.vmware.com/GOSIG/RHEL_7.html

- VMware Knowledge Base articles on RHEL7

  https://kb.vmware.com/selfservice/microsites/microsite.do

Command Reference

Command	Provides
# `lspci -nn`	Hardware PCI IDs
# `tuned-adm`	Server tuning profiles
# `yum install -y tuned`	Package installation for tune-adm

Become Even Smarter Through Reading Reference Material

Container Enablement

- Containers, Microservices, and Orchestrating the Whole Symphony

  https://opensource.com/business/14/12/containers-microservices-and-orchestrating-whole-symphony

- Red Hat Experts Author The Containers Blog

  http://rhelblog.redhat.com/tag/containers/

Container Security

"Securing Containers Before They Take Over the World" - The Stack

https://thestack.com/security/2016/01/21/red-hat-insider-securing-containers-before-they-take-over-the-world/

Red Hat Server Tuning Profiles

Performance Tuning View CertDepot

https://www.certdepot.net/rhel7-apply-tuning-profile-server/

Need Help Burning an ISO Image to USB?

Red Hat has a nice step-by-step guide here

https://access.redhat.com/documentation/en-US/Red_Hat_Enterprise_Linux/7/html/Installation_Guide/sect-making-usb-media.html

Quick Background

- Co-founder of Linuxfest at Lotusphere/Connect

- Speaker at 25+ Lotus® related events/LUGs

- Co-authored two IBM® Redbooks on Linux

- IBM Champion for Collaboration Solutions 2016, 2015, 2014, 2013, 2012, 2011

- Linux aficionado

Follow Up – Contact Information

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