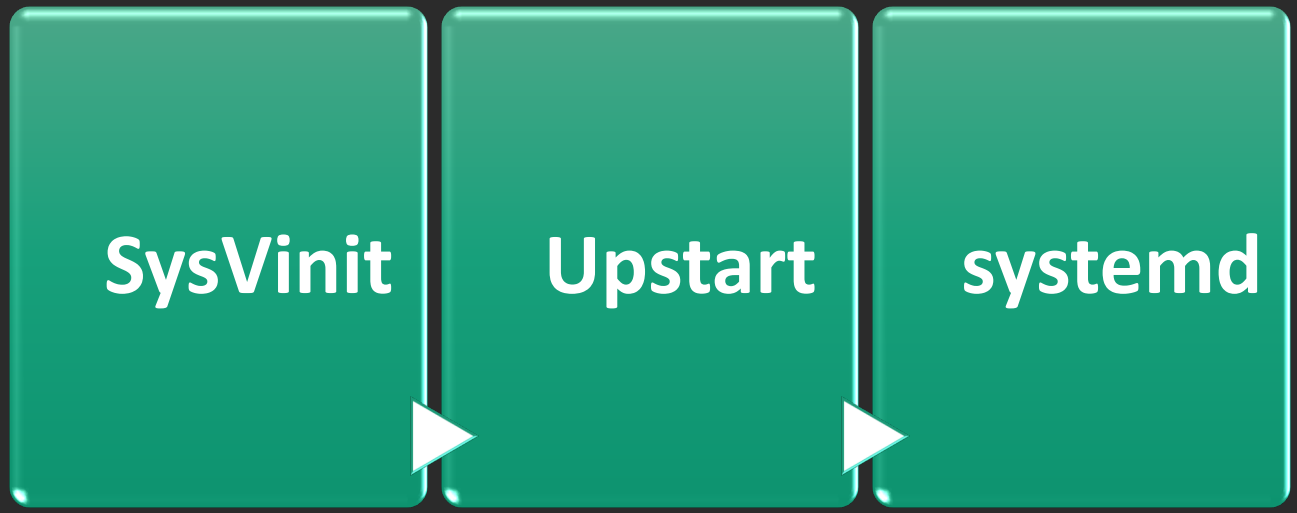
Lesson 6: Booting, Initializing and Virtualizing Linux

Objectives covered

- 101.2 Boot the system (weight: 3)
- 102.2 Install a boot manager (weight: 2)
- **101.3 Change runlevels / boot targets and shutdown or reboot system (weight: 3)**
- **102.6 Linux as a virtualization guest (weight: 1)**

Change runlevels/boot targets and shutdown or reboot system

Initialization systems



SysVinit - Runlevels

Redhat based distros

Runlevel	Description
0	Shut down the system.
1, s, or S	Single-user mode used for system maintenance. (Similar to systemd rescue target.)
2	Multi-user mode without networking services enabled.
3	Multi-user mode with networking services enabled.
4	Custom.
5	Multi-user mode with GUI available.
6	Reboot the system.

Debian based distros

Runlevel	Description
0	Shut down the system.
1	Single-user mode used for system maintenance. (Similar to systemd rescue target.)
2	Multi-user mode with GUI available.
6	Reboot the system.

SysVinit – core files & directories

/etc/inittab

grep :initdefault: /etc/inittab id:5:initdefault:

/etc/init.d

ls -1F /etc/init.d/ anacron*
atd*
[...]
crond*
cups*
[...]
ntpd*
[...]
ypbind* yum-updatesd*

/etc/rc.d

ls /etc/rc.d/
init.d rc0.d rc2.d rc4.d rc6.d rc.sysinit
rc rc1.d rc3.d rc5.d rc.local

SysVinit – working with runlevels

Default runlevel

```
# grep :initdefault: /etc/inittab
  id:5:initdefault:
```

Current runlevel

```
# runlevel
  N 5
```

Change runlevel

```
# init 3
  # runlevel
  N 3
# telinit 3
  # runlevel
  N 3
```

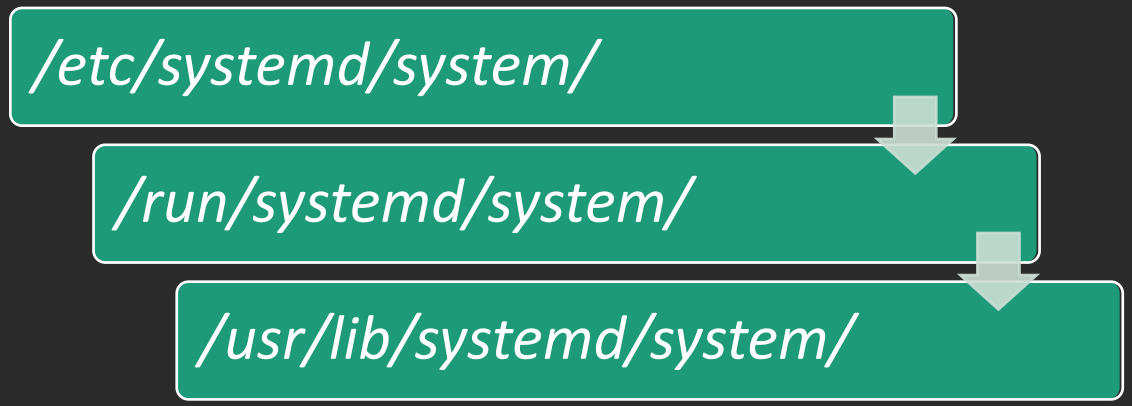
SysVinit – service utilities

Command	Description
`restart`	Stop and immediately restart the designated service. Note that if a designated service is not already started, a `FAILED` status will be generated on the stop attempt, and then the service will be started.
`start`	Start the designated service.
`status`	Display the designated service's current status.
`stop`	Stop the designated service. Note if a designated service is already stopped, a `FAILED` status will be generated on the stop attempt.
`reload`	Load the service configuration file of the running designated service. This allows you to make service configuration changes without stopping the service. Note that if you attempt the reload command on a stopped service, a `FAILED` status will be generated.

systemd – Unit types

Unit types	Description
.service	describes how to manage a service or application on the server
.mount	defines a mountpoint on the system to be managed by systemd
.automount	configures a mountpoint that will be automatically mounted
.swap	describes swap space on the system
.target	describes information about a target unit of systemd, which is used for grouping units and as well-known synchronization points during start-up
.path	defines a path that can be used for path-based activation
.timer	defines a timer that will be managed by systemd, similar to a cron job for delayed or scheduled activation
.snapshot	A .snapshot unit is created automatically by the systemctl snapshot command
.device	describes a device that has been designated as needing systemd management by udev or the sysfs filesystem
others	.slice, .scope, .socket

systemd – Service Unit files




```
$ systemctl list-unit-files
UNIT FILE                                   STATE
[…]
dev-hugepages.mount                         static
dev-mqueue.mount                            static
proc-fs-nfsd.mount                          static
[…]
nfs.service                                 disabled
nfslock.service                             static
ntpd.service                                disabled
ntpdate.service                             disabled
[…]
ctrl-alt-del.target                         disabled
default.target                              static
emergency.target                            static
[…]
```

systemd – Service Unit file sections - Unit

Directive	Description
After	Sets this unit to start after the designated units.
Before	Sets this unit to start before the designated units.
Description	Describes the unit.
Documentation	Sets a list of uniform resource identifiers (URIs) that point to documentation sources. The URIs can be web locations, system files, info pages, and man pages.
Conflicts	Sets this unit to *not* start with the designated units. If any of the designated units start, this unit is not started. (Opposite of Requires.)
Requires	Sets this unit to start together with the designated units. If any of the designated units do not start, this unit is *not* started. (Opposite of Conflicts.)
Wants	Sets this unit to start together with the designated units. If any of the designated units do not start, this unit is *still* started.

```
$ systemctl cat ntpd.service
# /usr/lib/systemd/system/ntpd.service
[Unit]
Description=Network Time Service
After=syslog.target ntpdate.service sntp.service

[Service]
Type=forking
EnvironmentFile=-/etc/sysconfig/ntpd
ExecStart=/usr/sbin/ntpd -u ntp:ntp $OPTIONS
PrivateTmp=true

[Install]
WantedBy=multi-user.target
```

systemd – Service Unit file sections - Service

Directive	Description
ExecReload	Indicates scripts or commands (and options) to run when unit is reloaded.
ExecStart	Indicates scripts or commands (and options) to run when unit is started.
ExecStop	Indicates scripts or commands (and options) to run when unit is stopped.
Environment	Sets environment variable substitutes, separated by a space.
Environment File	Indicates a file that contains environment variable substitutes.
RemainAfterExit	Set to either no (default) or yes. If set to yes, the service is left active even when the process started by ExecStart terminates. If set to no, then ExecStop is called when the process started by ExecStart terminates.
Restart	Service is restarted when the process started by ExecStart terminates. Ignored if a systemctl restart or systemctl stop command is issued. Set to no (default), on-success, on-failure, on-abnormal, on-watchdog, on-abort, or always.
Type	Sets the startup type.

systemd – Service Unit file sections - Install

Directive	Description
`Alias`	Sets additional names that can denote the service in `systemctl` commands.
`Also`	Sets additional units that must be enabled or disabled for this service. Often the additional units are socket type units.
`RequiredBy`	Designates other units that require this service.
`WantedBy`	Designates which target unit manages this service.

systemd – Target Unit files

Name	Description
graphical.target	Provides multiple users access to the system via local terminals and/or through the network. Graphical user interface (GUI) access is offered.
multi-user.target	Provides multiple users access to the system via local terminals and/or through the network. No GUI access is offered.
runlevel*n*.target	Provides backward compatibility to SysVinit systems, where n is set to 1–5 for the desired SysV runlevel equivalence.

```
$ systemctl get-default
graphical.target
$
$ systemctl cat graphical.target
# /usr/lib/systemd/system/graphical.target
[…]
[Unit]
Description=Graphical Interface
Documentation=man:systemd.special(7)
Requires=multi-user.target
Wants=display-manager.service
Conflicts=rescue.service rescue.target
After=multi-user.target rescue.service rescue.target display-manager.service
AllowIsolate=yes
```

Steps to modify systemd configuration files

Copy config file to /etc/systemd/system/ to modify (overridden) or create a subdirectory named as *<unit name>*.d (Eg: /etc/systemd/system/ntpd.d/) and create a config file with .conf extension (extended)

Edit or adding new configuration to the config file

Running the following command to review the overridden or modified unit files

systemd-delta

Reload the systemd daemon with following command to make those changes effective

systemctl daemon-reload

systemd – systemctl utilities

systemctl [OPTIONS] COMMAND [NAME]

Command	Description
daemon-reload	Load the unit configuration file of the running designated unit(s) to make unit file configuration changes without stopping the service. Note that this is different from the reload command.
disable	Mark the designated unit(s) to *not* be started automatically at system boot time.
enable	Mark the designated unit(s) to be started automatically at system boot time.
mask	Prevent the designated unit(s) from starting. The service cannot be started using the start command or at system boot. Use the --now option to immediately stop any running instances as well. Use the --running option to mask the service only until the next reboot or unmask is used.
restart	Stop and immediately restart the designated unit(s). If a designated unit is not already started, this will simply start it.
start	Start the designated unit(s).
status	Display the designated unit's current status.
stop	Stop the designated unit(s).
reload	Load the service configuration file of the running designated unit(s) to make service configuration changes without stopping the service. Note that this is different from the daemon-reload command.
unmask	Undo the effects of the mask command on the designated unit(s).

systemd – systemctl other commands

Command	Descriptions
list-units	list of the units currently loaded in the Linux system
list-unit-files	List of the available unit files and their enablement state
cat	Display the unit file content
get-default	Show the default target of the Linux system
is-active	Displays active for running services and failed for any service that has reached a failed state.
is-enabled	Displays enabled for any service that is configured to start at system boot and disabled for any service that is *not* configured to start at system boot.
is-failed	Displays failed for any service that has reached a failed state and active for running services.

systemd – systemctl other commands

Command	Descriptions
is-system-running	Determine system's operational status
isolate	Change to different target unit

Available oerational statuses

Status	Description
running	System is fully in working order.
degraded	System has one or more failed units.
maintenance	System is in emergency or recovery mode.
initializing	System is starting to boot.
starting	System is still booting.
stopping	System is starting to shut down.

```
# systemctl isolate emergency
Welcome to emergency mode! After logging in, type "journalctl -xb" to view
system logs, "systemctl reboot" to reboot, "systemctl default" or ^D to
try again to boot into default mode.
Give root password for maintenance
(or type Control-D to continue):
#
# systemctl is-system-running
maintenance
```

Shutdown the system

shutdown [OPTION] TIME [WALL-MESSAGE]

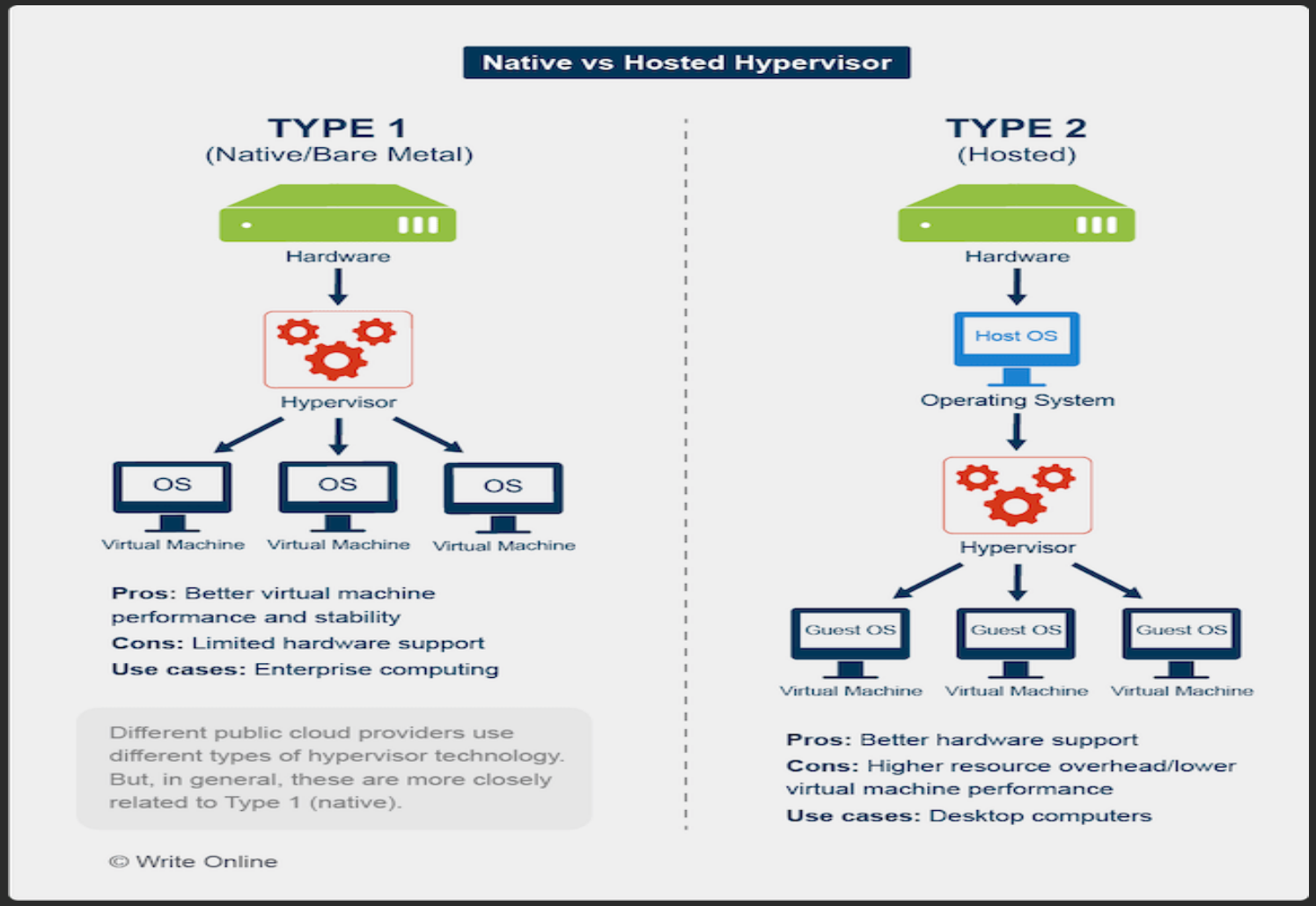
shutdown option	Descriptions
-r	Restarting system after shutting down
-P	Power off the system
-H	Halt the system
-c	Cancel the previous shutdown command

Notifying users

Method	Descriptions
/etc/issue	Contains text to be displayed on the tty terminal login screens
/etc/issue.net	Contains logon screen messages for remote logins
/etc/motd	Message of the Day file, contains text that is displayed after a user has logged into a tty terminal
notify-send command	Sends messages to a user employing the GUI
wall	ends messages (called *wall messages*) to users logged into a tty terminal or who have a GUI terminal emulator open and have their message status set to “yes.”

Linux as a virtualization guest

Virtualization concepts



Virtualization concepts

Notes:

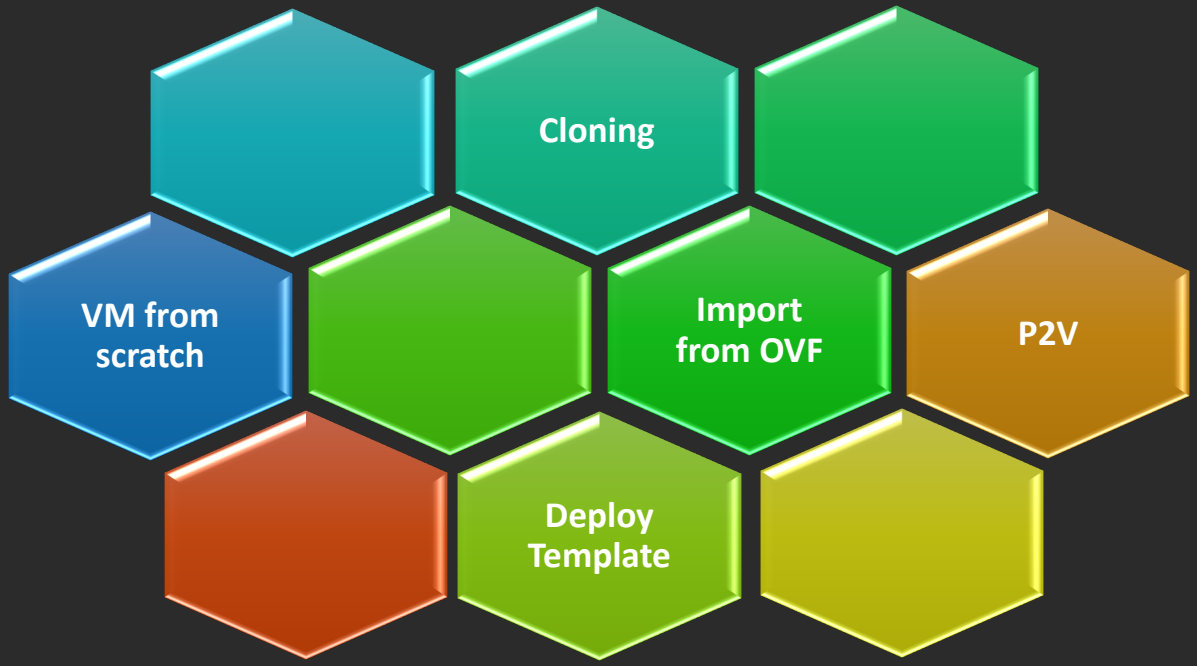
- Enable virtualization feature on your CPU
- Some hypervisor require x64 CPU

To specify your CPU feature:

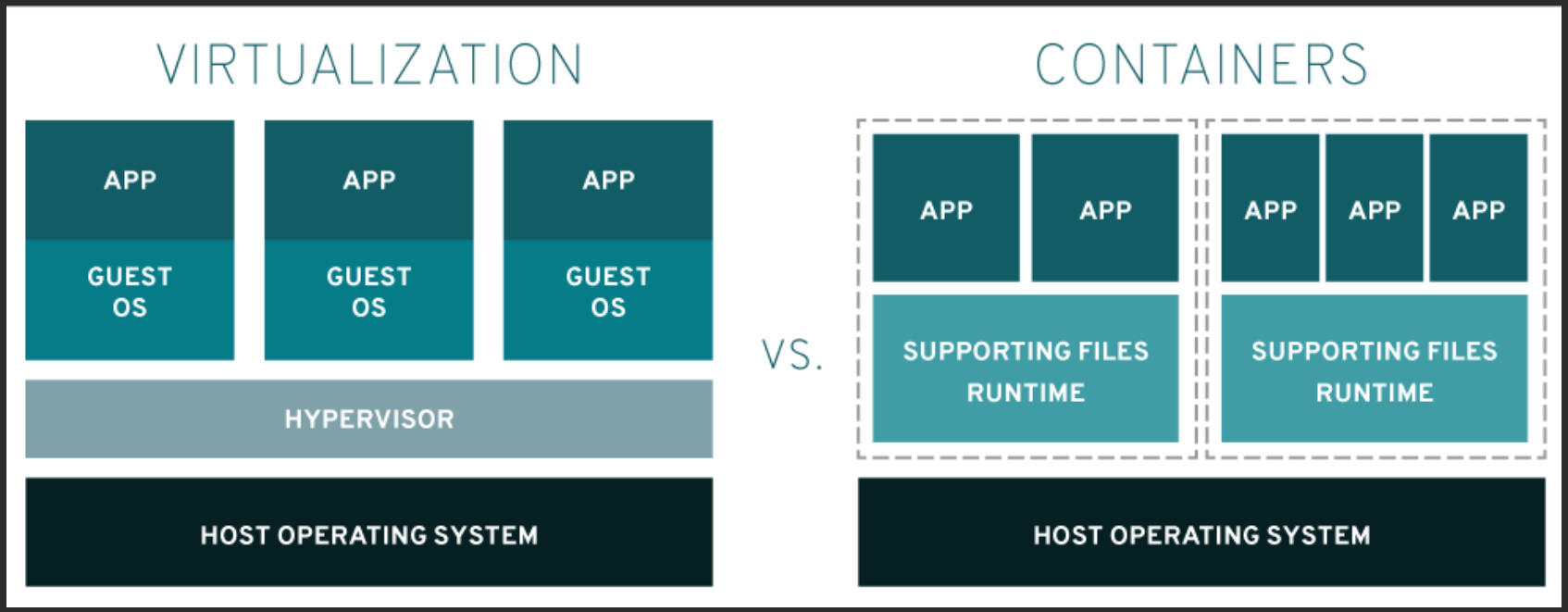
```
# grep ^flags /proc/cpuinfo
```

- Intel based need: vmx
- AMD based need: svm

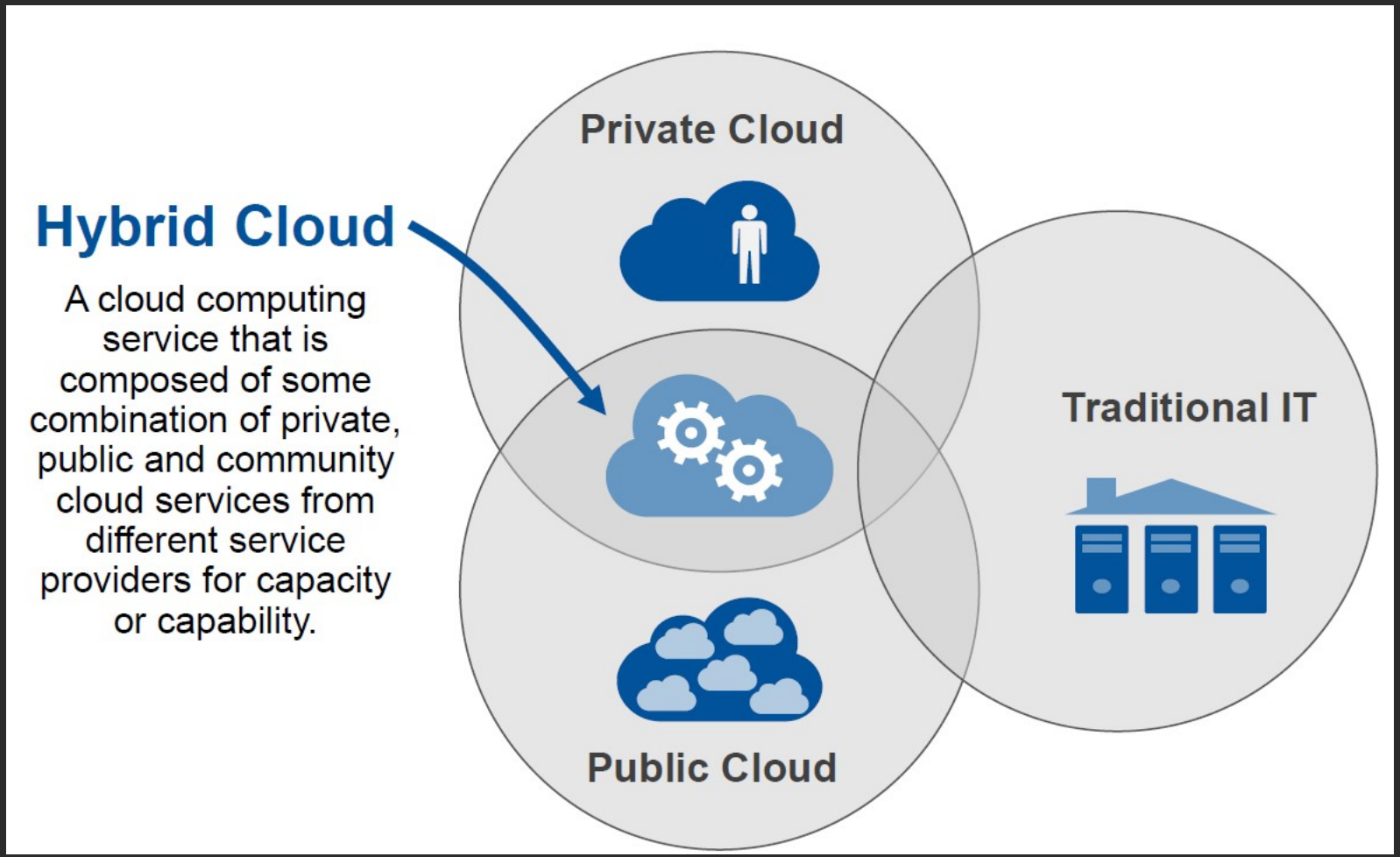
Creating VM methods



Container vs VM



Cloud computing – Infrastructure as a Service



Question...