Oracle Private Cloud Appliance X9-2 Workload Import

How to migrate virtual machine workloads into PCA X9-2

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PURPOSE STATEMENT

This document provides a guide to importing virtual machine workloads to Oracle Private Cloud Appliance (PCA) with software version release 3.01. It is intended solely to help you plan migration to PCA. 3.01 and later from other cloud and virtualization platforms.

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INTRODUCTION

This Technical Brief provides best practices and guidance for importing virtual machines from legacy hypervisor platforms to Oracle Private Cloud Appliance X9-2 (abbreviated to "PCA" in this document except when making distinction with previous PCA versions) in "lift and shift" migration.

The Oracle Private Cloud Appliance (PCA) has emerged as the premier platform for WebLogic, Fusion Middleware and other application tier software, often in conjunction with Oracle Exadata - the premier database platform. Many of those applications have been deployed on other servers and are now being deployed on PCA for increased performance, scale, and manageability.

SCOPE AND CONTENTS

This document provides a methodology and workflow that architects and system administrators can use to migrate virtual machine workloads to PCA X9-2, including:

- Planning steps applicable for any migration to PCA
- Details specific to migration from specific platforms, in particular Oracle VM, Private Cloud Appliance X8-2 and earlier, Oracle VM VirtualBox, KVM, and VMware
- Details for different operating systems, with instructions for Oracle Linux and other Linux distributions, Microsoft Windows, and Oracle Solaris
- Description of how to move workloads between Oracle Cloud Infrastructure (OCI) and PCA

This document illustrates manual methods for moving virtual machines running different operating systems on simple VM configurations. It does not cover bare-metal instance migration or complex configurations. Automation and scale will be discussed in subsequent documents.

ADVANTAGES OF PRIVATE CLOUD APPLIANCE

The Oracle Private Cloud Appliance (PCA) is an Oracle Engineered System designed for application tier. PCA is an integrated hardware and software system that reduces infrastructure complexity and deployment time for virtualized workloads in private clouds. It is a complete platform for a wide range of application types and workloads, with built-in management, compute, storage and networking resources. PCA provides excellent performance and other system properties for a broad range of applications.

PCA X9-2 is the latest member of the Oracle Private Cloud Appliance product family. PCA provides cloud and administrative services for general purpose laaS (Infrastructure as a Service) for a broad range of workloads including modernized Cloud Native applications. It provides an excellent foundation to layer PaaS (Platform as a Service) and SaaS (Software as a Service) solutions on top of the infrastructure. Under the covers, it makes use of modern micro-services architecture, Kubernetes and related technologies, for a refreshed future-proofed software stack.

The key new feature of PCA X9-2 compared to previous PCA versions is that it delivers private cloud infrastructure and architecture consistent with Oracle Cloud Infrastructure (OCI). Core laaS services use the same APIs, methods, tools and interfaces familiar to OCI users, delivered on a modernized infrastructure, capable of high levels of scale and performance.

PCA X9-2 brings services compatible with Oracle Cloud Infrastructure’s (OCI) to an on-premises implementation at rack scale, making workloads, user experience, tool sets and skills portable between private and public clouds. PCA can be paired with Oracle Exadata to create an ideal infrastructure for scalable, multi-tier applications. Customers using the Oracle Private Cloud Appliance X9-2 realize the operational benefits of cloud deployments for customers preferring or requiring an on-premises solution

DEFINITIONS

This document uses the following terms:

- The ***source*** system is the platform where the virtual machine is currently running, and the ***target*** is the PCA system it will be moved to.
- An ***instance*** is a virtual machine on the PCA. An instance has a ***lifecycle***: it can be created, started ("launched"), stopped, and terminated (removed from the PCA system). Oracle Cloud Infrastructure (OCI) uses the term instance instead of virtual machine because an instance could potentially be on bare metal. PCA conforms to the same definition.
- Every instance has a ***shape***, which describes its CPU, memory, network and disk configuration. PCA has a list of standard shapes shown below in Appendix 1.
- An ***image*** is the template of a virtual disk, containing the operating system and pre-installed applications, plus descriptive metadata.
- An instance is created by creating a ***boot volume*** from an image, and immediately launched. Other disks belonging to the instance are called ***block volumes*** and are created after the instance is launched.
- PCA provides ***platform images*** for Oracle Linux 7, Oracle Linux 8, and Oracle Solaris 11.4.
- ***Custom images*** can be created from an instance running on PCA, making it possible to use an image as the basis for cloned instances with customized contents.
- ***Bring Your Own Image (BYOI)*** images are imported from a different platform.

For further description of these terms, see the PCA Concepts Guide sections 7.1 (Compute Services) and 7.2 (Compute Images).

This document focuses on BYOI using a "lift and shift" approach in which an OS instance is moved to PCA with as few OS and configuration changes as possible, It focuses on the steps needed to make an OS instance boot and operate on PCA X9-2 with details based on the operating system and source platform. Application migration is referred to but out of scope.

> **Note**: For purposes of this document, instructions for Linux mostly apply to Oracle Linux, Red Hat and other Red Hat based distributions. Other Linux types such as Debian-based or SUSE are out of scope.
>
> **Note**: If you have installation media (a USB or DVD ISO image) for an operating system, you can create an OS instance using a hypervisor and then follow the steps in this guide to create a PCA image. Oracle VM VirtualBox provides a convenient platform for this, or you could use a hypervisor you already have. If you use KVM you have the benefit of installing with the same hypervisor as on PCA.

Another approach is to create entirely new images based on the latest version of the desired operating system and application software. This is used in "technology refresh" situations where the entire hardware and software stack is modernized. Both approaches are valid and widely used, depending on an institution's business and technical needs.

LICENSING

PCA provides platform images for Oracle Linux 7, Oracle Linux 8, and Oracle Solaris 11.4

> **Note**: You must comply with all licensing requirements when you upload and start instances based on OS images that you supply.

MIGRATION WORKFLOW

Moving to PCA X9-2, as with movement to any platform, is similar to performing a datacenter migration. It requires planning and multiple operational steps. The workflow contains these steps:

1. Preparation: data collection on source system.
2. Preparation: updates to instances on source system before they are exported.
3. Export: make the virtual machine boot disk image available outside the hypervisor environment.
4. Transform the boot disk image for operation with PCA X9-2, if needed.
5. Import image into PCA.
6. Create and launch instance from the imported image.

7. Post-install data migration and configuration.
8. Parallel test and switchover.

PREPARATION: DATA COLLECTION

The first phase of migrating workloads to PCA X9-2 is to collect information about the VM to be moved. This must be done using the source platform management tools or directly within each source virtual machine.

Collect the information described in the following sections. Some parts require logging into the VM, while you can gather others from the hypervisor environment or management framework such as VMware vSphere or Oracle Enterprise Manager. Not all of this information will be needed immediately but will be needed to complete the migration process. Commands mentioned below are not intended to be exhaustive. A system administrator for each source environment can easily find those details

VM Shape

Collect the number of cores and memory size assigned to the source VM. This will determine the corresponding PCA shape for the VM's requirements. See Appendix 1 for the list of PCA shapes. Notice the 1:16 ratio of cores to RAM.

Select a shape that meets the instance's capacity needs, adjusting for CPU speed and resource utilization, and accommodating future growth plans. You may be able to select a smaller shape if peak CPU utilization is low, or if memory is over-allocated. That would help maximize the number of instances that can be hosted.

> **Note:** The shape also determines the maximum number of virtual NICs the instance can have. You may need a larger shape than the CPU and memory requirements dictate. See Appendix 1 for details.

Tools in the source environment and operating system can be used to collect this information. For example, with PCA 2 and Oracle VM, the VM's shape is directly visible from the Oracle VM Manager browser interface, or by issuing the Oracle VM CLI command `”show vm name=VMNAME”.` Oracle VM VirtualBox provides this information with the graphical interface or by using the command `”vboxmanage showvminfo VMNAME”.` On KVM use the command `”virsh dominfo VMNAME”`.

You can also obtain shape information within the guest operating system:

- On Linux, issue commands: `awk '($1 == "processor")' /proc/cpuinfo | wc -l ; mpstat -P ALL` for CPU count, and "`free -h`" or "`cat /proc/meminfo |grep MemTotal`" for memory size.
- On Oracle Solaris issue "`psrinfo -vp`" for CPU count and "`prtconf|grep Mem`" for memory size.
- On Windows, depending on the version of Windows, right click on This PC or select Settings->System→About or use Control Panel, or enter Task Manager to get the number of CPUs and memory size.

Storage Configuration

Collect the number and sizes of disks owned by the VM.

> **Note**: This document exclusively describes moving the boot disk, referred to as the boot volume on PCA. Disks containing data, swap, `/tmp`, application binaries are not transferred as part of this process. Their sizes will be needed after the boot volume is transferred and the instance is created. Data disks are referred to as *block volumes* and are defined and populated after the instance is created.

As with CPU and memory size this can be determined from the source platform hypervisor. In PCA 2 and Oracle VM the details are visible from Oracle VM Manager browser interface and CLI as described above.

Alternatively, from within the VM:

- On Linux issue "`df -h; lsblk; mount`".

- On Solaris issue "`df -h; zpool list; zpool status`".
- On Windows, use the same method as above for CPU and memory.

Filesystem mounts (NFS and SMB/CIFS) and iSCSI block storage

Though not part of the instance definition, you will need details on NFS and SMB mounts and iSCSI targets accessed by the VM. If the new platform has access to the same storage platform they may still be used. Use the same "within the VM" commands as in the Storage configuration section above.

> **Note**: Changing the virtual machine will change its iSCSI IQN, and continued access to the same iSCSI block storage will require adjustment within the VM instance and at the iSCSI SAN storage layer.

Network Configuration

For each virtual NIC in the VM, collect its IP address, netmask, MTU, routing, DNS and NTP settings. The list below is not intended to be exhaustive, as system administrators have multiple tools to obtain this information.

- On Linux `use ifconfig -a; ip a; netstat` commands and `'cat /etc/resolv.conf'`. You can also use graphical tools: on GNOME you can use the desktop navigation System→Preferences→Internet and Network→Network Connections and then display IP settings.
- On Solaris use `ifconfig -a; dladm show-link; ipadm show-if; ipadm show-addr`, and `netstat` comments.
- On Windows, use the `ipconfig` command or display via Control Panel/Settings

PREPARATION: PRE-EXPORT UPDATES

It is advisable and sometimes necessary to prepare a VM for PCA by making changes to the VM on the original source system.

Operate on a clone of the production image on the source system. This protects the production environment and provides a known fallback if the process needs to be repeated. Use a method provided by your source system for cloning a VM. For example, in Oracle VM and PCA 2.4, select the VM in the Servers and VMs tab, right click and select Clone. In all cases, the source VM should be stopped to ensure that the clone has consistent disk contents.

Perform the following steps on the clone, not the original VM. **Use a clone!**

Patch to current level of the OS

Update the clone VM to the current patch level of the same OS. The instructions depend on the guest operating system. For example, `'yum update'` to the latest patch level for Oracle Linux 7 or 8, or `'pkg update'` on Solaris 11.4, or Windows Update on Microsoft Windows. Reboot after patching to ensure proper operation post-patching.

This ensures that the most recent device drivers are available and prevents risk from recently closed bugs and security exposures.

Change virtual network devices to DHCP

Several changes may be needed to the guest VM's virtual network in order for it to work after being installed on PCA.

PCA X9-2 uses DHCP to provide a network address to the new instances. Since multiple instances can be cloned from the same image, it makes sense to assign new MAC and IP addresses when each instance is created.

> **Note**: The IP address acquired by DHCP when the instance is created is stable.

> **Note:** the IP address visible to the instance is a private IP address on a virtual cloud network (VCN). The instance is accessed from outside the PCA via a Network Address Translation (NAT) layer. See the Network tab in the Compute Enclave's instance description to see both private and public IP addresses.

On Linux, edit the file `/etc/sysconfig/network-scripts/ifcfg-NICNAME` and remove `HWADDR` or `MACADDR` lines and set `BOOTPROTO="dhcp"`. Alternatively, you can use the graphical tool provided with your distribution. Additionally, remove the files `/etc/udev/rules.d/70-persistent-ipoib.rules` and `/etc/udev/rules.d/70-persistent-net.rules` if present. Those files contain MAC addresses that won't match the new instance, and are recreated automatically if needed.

On Solaris use the `ipadm` command, with a sequence of commands like

```
# ipadm delete-addr net0/v4
# ipadm create-addr -T dhcp net0/v4
```

On Windows, use the Control Panel or Settings.

Remove VMware, Oracle VM, or Oracle VM VirtualBox tools/drivers

If you are migrating from VMware or Oracle VM or VirtualBox, remove associated paravirtualization drivers and tools from the clone. For example, you can remove the Oracle VM Paravirtualization (PV) drivers for Microsoft Windows by locating the drivers in Control Panel, then right-clicking and selecting Uninstall. See https://docs.oracle.com/en/virtualization/oracle-vm-pv-drivers/3.4.5/winpv/vmwpv-uninstall.html for further details.

The image will work with the tools and drivers installed, though you may see error messages at boot time or when logging in, so this is optional.

Install kernel and driver features for PCA

The operating system may need to have VirtIO device drivers explicitly included at boot time. The method for this depends on the operating system.

> **Note**: If the source hypervisor is KVM you will already have the right drivers for PCA.

Linux

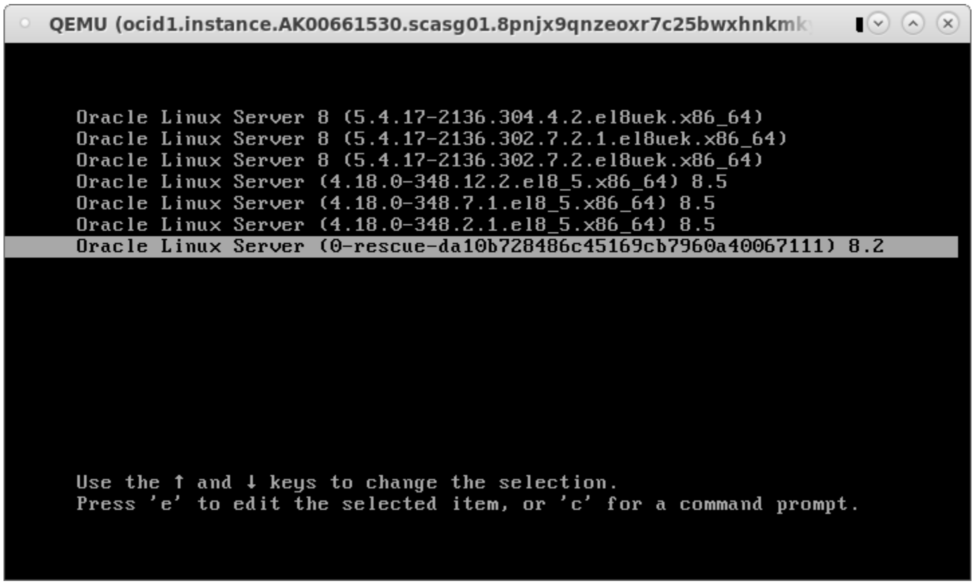
Use the `dracut` command to add device drivers to initramfs: "`dracut --force -N`" or "`dracut -N --regenerate-all`”.

- The `-N` option disables hostonly mode, which creates an `initramfs` only for the current host. This option produces a generic image.
- If you are running on a very old version of Linux that does not have the "-N" option, specifically list the kernel modules needed for PCA X9-2. Use a command like "`dracut --add-drivers 'sg sd_mod virtio virtio_pci virtio_ring virtio_scsi'`"
- The `--regenerate-all` option regenerates `initramfs` for all kernel versions in `/boot`, not just the one currently booted. This is useful for Oracle Linux to ensure that both UEK and RHCK kernels get the needed drivers, regardless of which is currently booted
- The option `--force` overlays the current `initramfs` file already present.

You can see the updated `initramfs` files in `/boot` - they will be larger than previous versions because of the added device drivers.

You can optionally backup kernels before running `dracut`, e.g.: `mv /boot/initramfs-$(uname -r).img /boot/initramfs-$(uname -r).img.bak`

Note: If the `dracut` step is omitted, it can be performed the first time the instance is launched on PCA X9-2: Log into the Compute Enclave, select the instance, connect to the console, and select the rescue line in the Grub menu. If boot fails before you can select the rescue boot, issue a Reset action on the instance from the Compute Enclave. After the instance boots, login and issue the `dracut` commands described above .



```
QEMU (ocid1.instance.AK00661530.scasg01.8pnjx9qnzeoxr7c25bwxhnkmk

      Oracle Linux Server 8 (5.4.17-2136.304.4.2.el8uek.x86_64)
      Oracle Linux Server 8 (5.4.17-2136.302.7.2.1.el8uek.x86_64)
      Oracle Linux Server 8 (5.4.17-2136.302.7.2.el8uek.x86_64)
      Oracle Linux Server (4.18.0-348.12.2.el8_5.x86_64) 8.5
      Oracle Linux Server (4.18.0-348.7.1.el8_5.x86_64) 8.5
      Oracle Linux Server (4.18.0-348.2.1.el8_5.x86_64) 8.5
      Oracle Linux Server (0-rescue-da10b728486c45169cb7960a40067111) 8.2




      Use the ↑ and ↓ keys to change the selection.
      Press 'e' to edit the selected item, or 'c' for a command prompt.
```

Solaris

Update Solaris 11.4 to the latest SRU by using the "`pkg update`" command and booting into the new boot environment. VirtIO drivers in Solaris 11.4 are described in the blog "Introducing VirtIO Drivers with Oracle Solaris on OCI" at https://blogs.oracle.com/solaris/post/introducing-virtio-drivers-with-oracle-solaris-on-oci

Procedures for earlier versions of Solaris will be described in a separate document. Solaris 11 users are strongly urged to upgrade to Solaris 11.4, which is an easy procedure and highly compatible. Move Solaris 10 environments by creating Solaris 10 branded non-global zones in a Solaris 11.4 instance. That lets the Solaris 10 environment benefit from the modern kernel and device drivers.

Windows

Add the Virtio drivers needed to operate Windows, as described in User Guide section 5.3.2. The release number shown below may change.

You can download from My Oracle Support (MOS) or from the Oracle Software Delivery Cloud (OSDN).

If downloading from OSDN

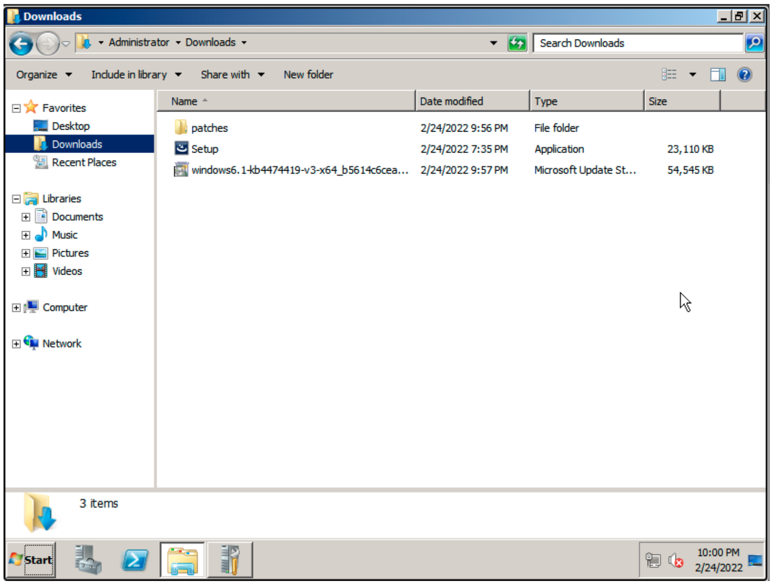
1. Log into the Oracle Software Delivery Cloud
2. In the All Categories List, select **Release**.
3. Type "**Oracle Linux**" and click Search.
4. Select "**REL: Oracle Linux N.N.0.0.0 (Oracle Linux)**". The values of N will be different as new releases are made available.
5. Click on the "**Add to Cart**" button and then click on "**Checkout**" in the right upper corner. On the following window, select "**x86-64**" and click on the "**Continue**" button
6. Accept the "Oracle Standard Terms and Restrictions" to continue and, on the following window, click on "**VNNNNNNN.zip - Oracle VirtIO Drivers Version for Microsoft Windows N.N.N**" to download the drivers. The current version at this writing is V1009702-01.zip. The version number will change as new releases are delivered).

7. Download the zip file to your Windows VM,

If downloading from MOS:

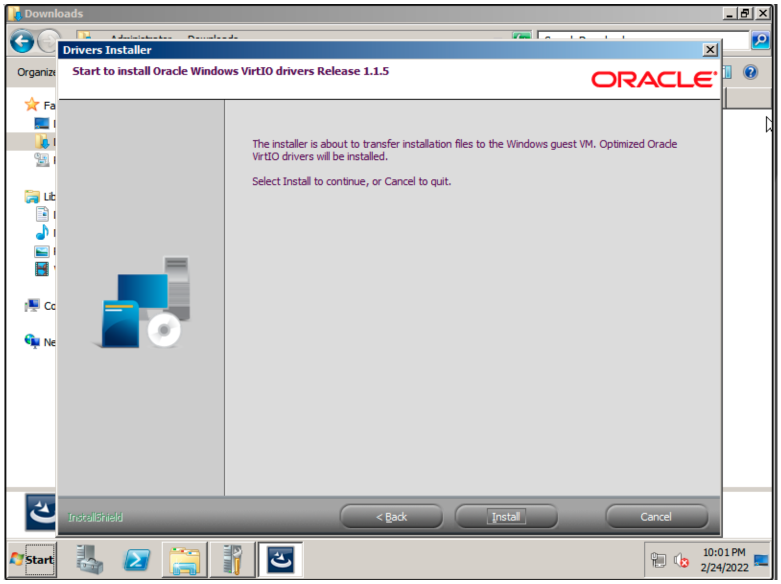
1. Sign into https://support.oracle.com/portal/
2. Click on Patches & Updates tab.
3. In the Patch Search page's Patch Name or Number field, enter 27637937
4. Click the Patch Name to the left of "Oracle VirtIO driver version 1.1.7" for Release 7.9.0.0.0
5. Click the Download button and download p27637937_79000_MSWIN-x86-64.zip

Install the drivers by double clicking on the Setup file. When complete, restart and shutdown.



Name	Date modified	Type	Size
patches	2/24/2022 9:56 PM	File folder	
Setup	2/24/2022 7:35 PM	Application	23,110 KB
windows6.1-kb4474419-v3-x64_b5614c6cea...	2/24/2022 9:57 PM	Microsoft Update St...	54,545 KB

3 items



Start to install Oracle Windows VirtIO drivers Release 1.1.5

The installer is about to transfer installation files to the Windows guest VM. Optimized Oracle VirtIO drivers will be installed.

Select Install to continue, or Cancel to quit.

Prepare cloud-init or cloudbase-init (optional)

Customers are encouraged to install the `cloud-init` (Linux) or `cloudbase-init` (Solaris, Windows) toolkits. They are the industry-standard, vendor agnostic methods for cross-platform instance initialization that identify the cloud the instance is running on during boot, read any provided metadata from the cloud and initialize the system accordingly. It has a number of capabilities, among which is converting from password-based `ssh` to using a key pair exchange as described in section 6.4 of the User Guide and at https://cloudinit.readthedocs.io/en/latest/

On Linux, install the `cloud-init` and `oci-utils` packages suitable for your Linux distribution. For Oracle Linux 8 this is:

```
# dnf install yum-utils
# yum-config-manager --enable ol8_addons
# dnf install cloud-init oci-utils
```

On Solaris, issue '`pkg install cloudbase-init`' as described in the Solaris 11.4 document https://docs.oracle.com/cd/E37838_01/html/E60974/gpxcg.html

In both Linux and Solaris you would then `ssh` into the launched instance with userid **`opc`** without a password, using the key pair exchange described in the references cited above.

The preceding steps disable password-based authentication. If you want to continue using password based ssh authentication on the target system to keep it more like how it operated on the source platform, it can be re-enabled before export by editing `/etc/cloud.cfg` and adding the line:

```
    ssh_pwauth:   1
```

Alternatively, this can be done before export by commenting out the following line in `/etc/ssh/sshd_config`:

```
    # PasswordAuthentication no
```

On Windows instances, use cloudbase-init, as described at https://cloudbase-init.readthedocs.io/en/latest/

Prepare startup and file system

The image only contains the boot disk, so disable any boot-time services and applications that require other disks. References to non-boot file systems must be removed until re-created later. If the boot image refers to other disks for swap, `/tmp`, or `/var/logs` they must be temporarily moved to the boot volume.

On Linux: edit `/etc/fstab` and remove entries to file system mounts that are not on the boot disk. Ensure any boot disk partitions are not directly referenced by device names such as `/dev/xvda`. Instead use "`LABEL=`" or "`UUID=`". References to LVM devices don't need to be modified if referring to the boot disk. Run the 'pvs' command to ensure that the only LVM physical volume (PV) is the boot volume. If a volume group (VG) is on other physical volumes it should be commented out of `/etc/fstab`. If a logical volume consists of both the boot and other disks then the migration is more complicated and out of the scope of this document.

On Solaris: edit `/etc/vfstab` to remove any mounts not on the boot disk, and perform "`zpool export $POOLNAME`" for non-root ZFS pools. Typically, those are ZFS pools other than "`rpool`".

In all cases, disable any services or applications that launch at boot time and require full configuration, since the initial launch on PCA X9-2 will not have the complete operational environment.

EXPORT BOOT DISK

Copy the boot disk from the source environment to a utility server that will be used to prepare the image for upload to PCA. Use a method that depends on the source hypervisor and management platform.

For example, on Oracle VM or PCA 2.4 obtain the `.img` file for the boot disk by copying it from the storage repository shown in the VM's `vm.cfg` file. The command would be run on the compute node or Oracle VM Server (OVS) and look like

```
      cd /OVS/Repositories/0004fb00000300007b2cd14ca0d48e8b/VirtualDisks
      scp 0004fb0000120000fcd80512881d4979.img
      utilityhost:/data/0004fb0000120000fcd80512881d4979.raw
```

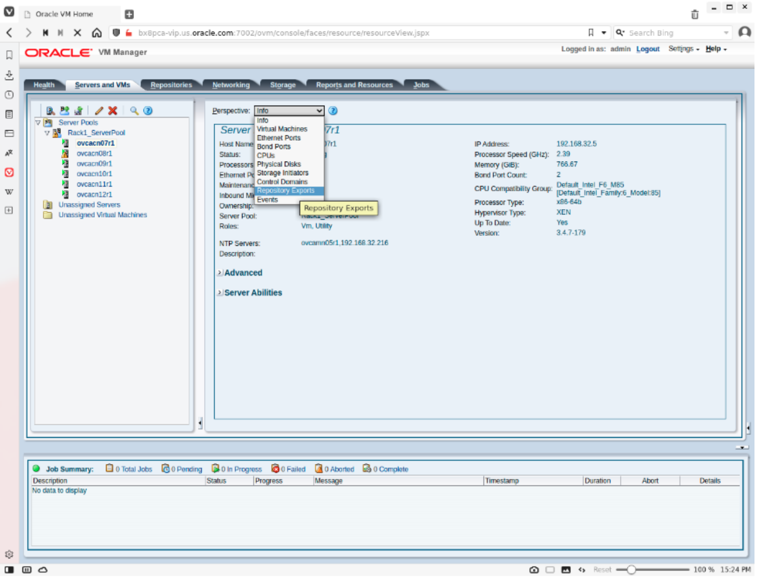
In the above example, the output file is renamed with the file extension .raw, an optional change that indicates that the Oracle VM `.img` file uses 'raw disk' image format.

PCA 2.x Details

On PCA 2.4, storage repositories are mounted to the compute nodes, which by default are on PCA's private networks and do not have a plumbed network connection to the datacenter. In that case, you can scp the .img file to either of the two management nodes or create a read-only Oracle VM repository export to the management nodes, and then scp to an external host.

That process, excerpted here, is described in the technical paper Oracle Private Cloud Appliance Backup Guide at https://www.oracle.com/technetwork/server-storage/private-cloud-appliance/documentation/pca-backup-x8-0-6-5676918.pdf This can be used to bulk export all the VMs in an Oracle VM storage repository.

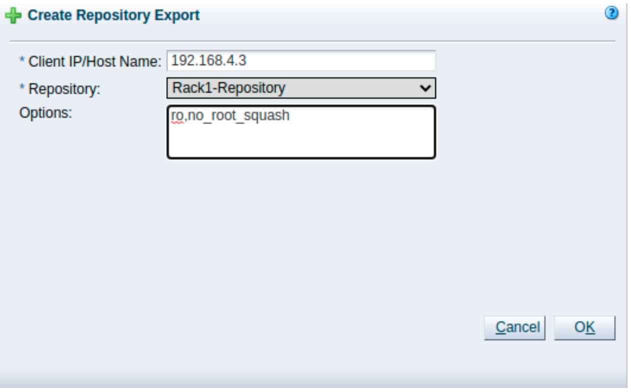
Navigate in the Oracle VM Manager User Interface to the Servers and VMs tab. Under Server Pools, expand the server pool name to show the server names, and highlight one of the servers to select it. Select Repository Exports from the Perspective view in the management panel.



Roles: Vm, Utility
NTP Servers: ovcamn05r1,192.168.32.216
Description:

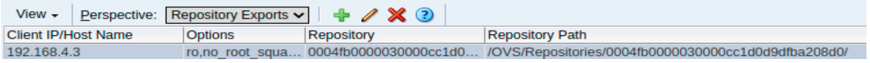
IP Address: 192.168.32.5
Processor Speed (GHz): 2.39
Memory (GiB): 766.67
Bond Port Count: 2
CPU Compatibility Group: Default_Intel_F6_M85 [Default_Intel_Family:6_Model:85]
Processor Type: x86-64b
Hypervisor Type: XEN
Up To Date: Yes
Version: 3.4.7-179

Click on the "+" icon to create a repository export, select the repository to be exported, the IP address or hostname of the host that will mount the NFS share, which would be the address of either of the management nodes, and specify the options "`ro,no_root_squash`".



* Client IP/Host Name: 192.168.4.3
* Repository: Rack1-Repository
Options: ro,no_root_squash

Click on the OK button and view the export.



Client IP/Host Name	Options	Repository	Repository Path
192.168.4.3	ro,no_root_squa…	0004fb0000030000cc1d0…	/OVS/Repositories/0004fb0000030000cc1d0d9dfba208d0/

Copy the Repository path and issue a mount command using the selected compute node as the NFS server. The management node will have a read-only view of the storage repository and you can copy disk images directly from the repository's VirtualDisks directory without having to scp it from a compute node first.

```
[root@ovcamn05r1 ~]# mount 192.168.4.5:/OVS/Repositories/0004fb0000030000cc1d0d9dfba208d0/
/mnt
```

```
[root@ovcamn05r1 ~]# ls -la /mnt
total 2077
drwxr-xr-x   8 root root  3896 Aug 10  2019 .
dr-xr-xr-x. 22 root root  4096 Jan  5 20:10 ..
drwx------   9 root root  3896 Jan 24 14:10 Assemblies
drwx------   2 root root  3896 Dec  9 14:23 ISOs
drwxr-xr-x   2 root root  3896 Aug  8  2019 lost+found
-rw-------   1 root root 15014 Mar  9 11:48 .ovsmeta
-rw-------   1 root root   151 Sep 10  2020 .ovsrepo
drwx------  11 root root  3896 Nov 25 16:12 Templates
drwx------   2 root root  8192 Mar  9 11:48 VirtualDisks
drwx------  53 root root  3896 Mar  9 11:48 VirtualMachines
```

If you wish, you can optimize the mount options, for example "`mount -o ro,bg,hard,rsize=524288,wsize=524288,nfsvers=3,tcp 192.168.4.5:/OVS/Repositories/0004fb0000030000cc1d0d9dfba208d0 /mnt`"

Oracle VM VirtualBox disk images

Oracle VM VirtualBox usually stores disk images in the directory "`VirtualBox VMs`" in a subdirectory with the same name as the VM. The VM information from the user interface provides the complete path.

```
$ vboxmanage showvminfo "Solaris 11.4"|more
Name:                        Solaris 11.4
Groups:                      /
Guest OS:                    Oracle Solaris 11 (64-bit)
UUID:                        3a4ce795-d6b1-44f8-a16b-8b7fb0fbb4a8
Config file:                 /Users/jeff/VirtualBox VMs/Solaris 11.4/Solaris 11.4.vbox
Snapshot folder:             /Users/jeff/VirtualBox VMs/Solaris 11.4/Snapshots
Log folder:                  /Users/jeff/VirtualBox VMs/Solaris 11.4/Logs
… snip …
```

Look inside that folder for the `.vdi` or `.vmdk` disk image for the VM's boot disk, and `scp` that to the utility host.

KVM disk images

Virtual machine disk images can be located by issuing the command shown below. Locate the disk image for the VM you want to export to PCA, and `scp` that to the utility host.

```
$ virsh vol-list default
 Name                    Path
------------------------------------------------------------------------------
 guest-ol8-minimal-serial.qcow2 /home/admin/.local/share/libvirt/images/guest-ol8-minimal-
serial.qcow2
 guest-ol8-minimal.qcow2 /home/admin/.local/share/libvirt/images/guest-ol8-minimal.qcow2
 guest-ol8.qcow2 /home/admin/.local/share/libvirt/images/guest-ol8.qcow2
 guest-ovsx54-ol7.qcow2 /home/admin/.local/share/libvirt/images/guest-ovsx54-ol7.qcow2
 juniper-kvm-ol7.qcow2 /home/admin/.local/share/libvirt/images/juniper-kvm-ol7.qcow2
```

VMware disk images

VMware images can be exported to a "virtual appliance" which is actually a tar file containing the disk image. Use a similar procedure to obtain the virtual appliance, then use the `tar` command to extract the `.vmdk` file from the `.ova` file, and copy it to the utility host.

Speed up export by compressing disk image files

Disk image files are large and copying them to other hosts can take a long time. This may go much faster if you use compression, especially for sparse disk images. You can optionally compress the disk image file using a command like `gzip` or `lzop` to reduce the time to copy to the utility host. Here is an example that uses `lzop` and pipes output to `scp`:

```
lzop -1 < 0004fb0000120000fcd80512881d4979.img | ssh utilityhost 'lzop -d >
/data/0004fb0000120000fcd80512881d4979.raw'
```

We use `lzop` for compression in this case because a fast network is available, so compression speed was more important than compression ratio. If you have a slower network, you may opt for another approach such as using `gzip` or `bzip2`.

```
gzip 0004fb00001200008190ce0329fdacdf.img
scp 0004fb00001200008190ce0329fdacdf.img.gz utilityhost:/data/
```

All of these methods, or using no compression at all, are equally valid and depends on the administrator's preferences.

SET UP THE UTILITY HOST (ONE TIME OPERATION)

Create a utility host that runs Oracle Linux. This can be a virtual machine or a bare metal instance. Prepare the utility host by installing the OCI CLI, as described in section 1.2 of the User Guide.

Also, use the following commands to install `qemu-img` and `virt-sparsify`. This example assumes an Oracle Linux 7 host:

```
$ sudo yum upgrade
$ sudo yum-config-manager --enable ol7_kvm_utils
$ sudo yum install qemu-img libguestfs-tools
```

TRANSFORM BOOT DISK

The boot disk may need to be converted into the open standard `qcow2` format used by the PCA hypervisor. Perform this on the utility host that has access to OCI CLI, `qemu-img` command and other optional utilities.

> **Note**: It is recommended, but not strictly necessary, to convert disk images already in `vmdk` or `qcow2` format and package it in a `.oci` file. The `.oci` file includes the disk image in `qcow2` format and image metadata. That ensures the correct metadata for the image is provided with the disk contents.

Process the boot disk

Perform this operation on the boot disk being prepared for PCA. This is necessary for disk images from Oracle VM or PCA 2.x, and optional for disk images in `.vmdk` format (VMware or Oracle VirtualBox). Files in `qcow2` format from KVM do not need to be converted.

On the utility node, issue commands like:

```
$ qemu-img convert -f raw -O qcow2 0004fb0000120000fcd80512881d4979.raw output.QCOW2

$ qemu-img convert -f vdi -O qcow2 ol8.vdi output.QCOW

$ qemu-img convert -f vmdk -O qcow2 myVMwareVM.vmdk output.QCOW2
```

Use `"-f raw"` for virtual disks from Oracle VM and PCA 2.x, use `"-f vdi"` for `.vdi` files from Oracle VM VirtualBox, and use `"-f vmdk"` for `vmdk` images coming from VMware. It is recommended but not necessary to convert a `.vmdk` image because PCA can use that file type. See below in the Import section.

> **Note:** The output file must be named `output.QCOW2`.

> **Note:** The qemu-img command can take a substantial time to run depending on the image file size and the system speed. You can use the flag "-p" to show progress displayed as a percentage in the form (nn.nn/100%).

You may be able to reduce the size of the disk image by using the virt-sparsify tool. This tool works on many file systems: ext2/3/4. xfs, btrfs, NTFS, LVM. and reduces sparse disk image size by eliminating disk blocks not owned by a file. The amount of reduction varies based on the contents of the disk image before exporting. Depending on your utility environment, you may have to also issue "export LIBGUESTFS_BACKEND=direct" before running the command:

```
$ virt-sparsify --in-place output.QCOW2
```

Preparing for import: the OCI file type

This step is optional but recommended.

PCA X9-2 image and Oracle Cloud Infrastructure (OCI) images use the file type .oci, which has two components: an image_metadata.json file that describes the image in JSON format, and the actual disk image named output.QCOW2 prepared in the previous step. The image_metadata.json file describes the image's settings (BIOS vs. UEFI, how virtual devices are implemented), and what operating system it runs. The examples shown in Appendix 2 can be used with little change. Select the BIOS or UEFI version based on the source and (for neatness sake) change the operating system description.

```
$ tar zcf MyImage.oci image_metadata.json output.QCOW2
```

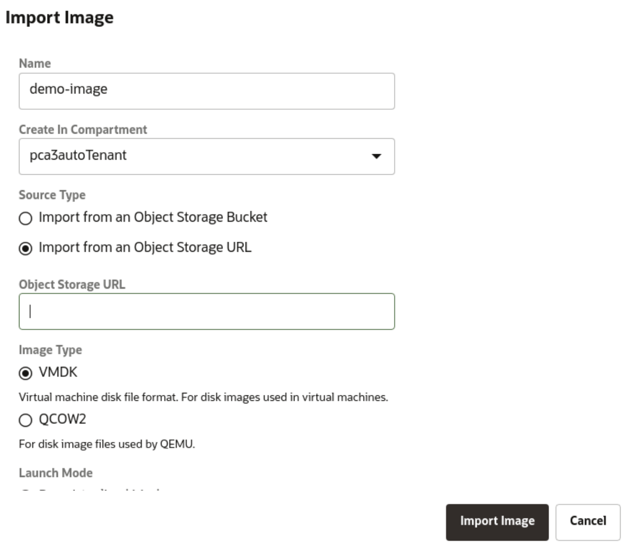
IMPORT TO PCA

Once the vmdk, qcow2 or oci file is available, it can be imported into PCA without further change. Upload it from any web server that has network connectivity to the PCA management nodes. The file can be copied to an existing web server or you can create an impromptu web server using a Python command similar to the following (adjusting for port number as needed). If using Python 2.x use python -m HTTPSimpleServer 8080 and If using Python 3.x use python3 -m http.server 8000

Images are imported into PCA using either the PCA Compute Enclave browser user interface (BUI) or the OCI command line interface (CLI). See the User Guide section 5.1 for a full description.

Import using browser interface

If using the browser interface, log into the Compute Enclave, go to the Compute Images page, click on 'Import Image', and then fill in details on the pop-up:



Import Image

Name
demo-image

Create In Compartment
pca3autoTenant

Source Type
○ Import from an Object Storage Bucket
● Import from an Object Storage URL

Object Storage URL

Image Type
● VMDK
Virtual machine disk file format. For disk images used in virtual machines.
○ QCOW2
For disk image files used by QEMU.

Launch Mode

Select 'Object Storage URL' and enter the URL to the file containing the boot image. Specify VMDK if it is a `.vmdk` file. Use QCOW2 if this is either a `.qcow2` file or a `.oci` file containing both metadata and the `output.QCOW2` disk image file. Click on the 'Import image' button to start the import. This will take you to a page showing the status of the image, initially 'Importing' and then 'Available' when the import completes.

NOTE: The user interface only has one Launch Mode – "Paravirtualized". If you import a UEFI image via the browser interface it might be imported with BIOS instead of UEFI. The workaround in the PCA Release Notes 3.5.10 is to use the CLI to launch the instance and specify the launch options there. See the details below on the section describing instance launch with CLI.

The time to perform the import depends on the size of the image and the speed of the network between the PCA system and the web server. The user interface is not locked during the import so you can proceed to other tasks or log off. Check on the status of the image by viewing the image's display.

Import using OCI CLI

If using the OCI CLI, use a line similar to the example below, substituting in the image URL and the OCID for your tenancy. The import command produces a display of the import work unit, and you can use a 'get' command to display its status.

```
$ oci compute image import from-object-uri --uri http://mynfs/shares/export/images/mydemo.oci
--display-name "demo-image" --compartment-id $OCI_CLI_TENANCY
{
  "data": {
    "agent-features": null,
    "base-image-id": null,
    "compartment-id":
"ocid1.tenancy.AK00661530.scasg01.lk0p5dyyyrdctdo3vvb9vdgr8zvdwznk7tcqtfmvzv1xxym66oak0009014
6",
    "create-image-allowed": true,
    "defined-tags": {},
    "display-name": "demo-image",
    "freeform-tags": {},
    "id":
"ocid1.image.AK00661530.scasg01.lt0xzicgaiv9plkwurk2xswia4x00e4ds2vyxa78d1xmk17b1indxamf6i4h"
,
    "launch-mode": "PARAVIRTUALIZED",
    "launch-options": null,
    "lifecycle-state": "IMPORTING",
    "operating-system": "UNAVAILABLE",
    "operating-system-version": "UNAVAILABLE",
    "size-in-mbs": 0,
    "time-created": "2022-02-03T00:41:24.982617+00:00"
  },
  "etag": "ae01e390-eab5-449c-b78d-c655235af23f",
  "opc-work-request-id": "ocid1.workrequest.AK00661530.scasg01.storage-
1qsyui8onuv2q9evycdrnwtp13nj9l3eko37fzvhpahbobbav18r"
}
```

You can view the import via the browser interface, or check in its status via the CLI, using the OCID displayed in the import-image command.

```
$ oci compute image get --image-id
ocid1.image.AK00661530.scasg01.lt0xzicgaiv9plkwurk2xswia4x00e4ds2vyxa78d1xmk17b1indxamf6i4h
{
  "data": {
    "agent-features": null,
    "base-image-id": null,
    "compartment-id":
"ocid1.tenancy.AK00661530.scasg01.lk0p5dyyyrdctdo3vvb9vdgr8zvdwznk7tcqtfmvzv1xxym66oak0009014
6",
    "create-image-allowed": true,
    "defined-tags": {},
    "display-name": "demo-image",
    "freeform-tags": {},
    "id":
"ocid1.image.AK00661530.scasg01.lt0xzicgaiv9plkwurk2xswia4x00e4ds2vyxa78d1xmk17b1indxamf6i4h"
,
    "launch-mode": "CUSTOM",
    "launch-options": {
      "boot-volume-type": "PARAVIRTUALIZED",
      "firmware": "BIOS",
      "is-consistent-volume-naming-enabled": false,
      "is-pv-encryption-in-transit-enabled": false,
      "network-type": "PARAVIRTUALIZED",
      "remote-data-volume-type": "PARAVIRTUALIZED"
    },
    "lifecycle-state": "AVAILABLE"
    "operating-system": "Fedora Linux"
    "operating-system-version": "35"
    "size-in-mbs": 512000
    "time-created": "2022-02-03T00:41:24.982617+00:00
  }
  "etag": "d96dda18-e10b-4d87-83ab-425bb5cf582e
}
```

Import vmdk or qcow2 file via CLI without .oci file

PCA supports .vmdk and `.qcow2` file types so you can import them directly without creating a `.oci` file by adding **`--source-image-type VMDK`** or **`--source-image-type QCOW2`**, We recommend creating the `.oci` file as above, but this is supported:

For example:

```
$ oci compute image import from-object-uri --uri http://mywebsever/images/myimage.vmdk --
display-name "myimage" --compartment-id $OCI_CLI_TENANCY \
    --source-image-type VMDK
{
  "data": {
    "agent-features": null,
    "base-image-id": null,
    "compartment-id":
```

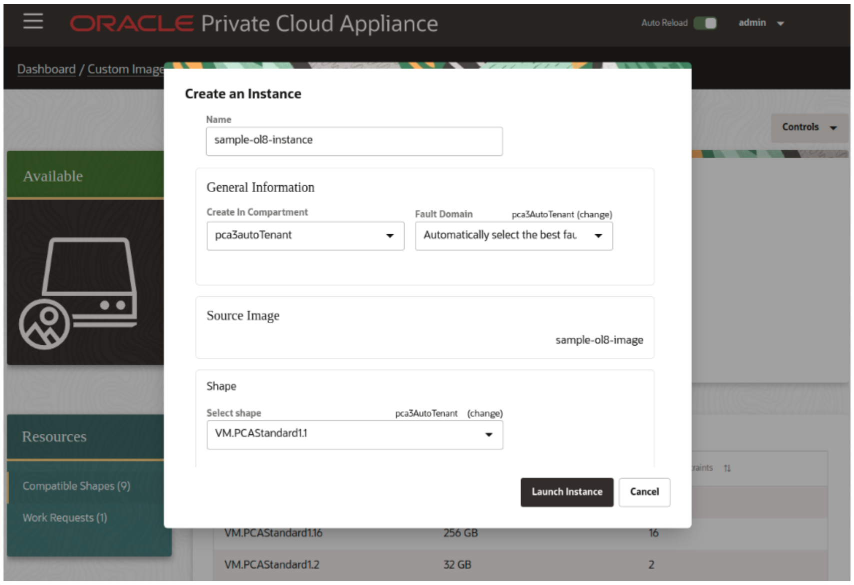
```
"ocid1.tenancy.AK00661530.scasg01.lk0p5dyyyrdctdo3vvb9vdgr8zvdwznk7tcqtfmvzv1xxym66oak0009014
6",
    "create-image-allowed": true,
    "defined-tags": {},
    "display-name": "myimage",
    "freeform-tags": {},
    "id":
"ocid1.image.AK00661530.scasg01.sn6x8ba80rhymybtfiv6wkyeyy5fuubvhpb9mba8ofzscfpinsopq6eg4nf4"
,
    "launch-mode": "PARAVIRTUALIZED",
    "launch-options": null,
    "lifecycle-state": "IMPORTING",
    "operating-system": "UNAVAILABLE",
    "operating-system-version": "UNAVAILABLE",
    "size-in-mbs": 0,
    "time-created": "2022-02-03T01:31:12.529239+00:00"
  },
  "etag": "fa3c71ec-004b-4907-8952-828904b69aac",
  "opc-work-request-id": "ocid1.workrequest.AK00661530.scasg01.storage-
iodkxug2l436mp84gz5x5meeqw2w00l6c6ftijx44998p1kmda23"
}
$ oci compute image get --image-id
ocid1.image.AK00661530.scasg01.sn6x8ba80rhymybtfiv6wkyeyy5fuubvhpb9mba8ofzscfpinsopq6eg4nf4
{
  "data": {
    "agent-features": null,
    "base-image-id": null,
    "compartment-id":
"ocid1.tenancy.AK00661530.scasg01.lk0p5dyyyrdctdo3vvb9vdgr8zvdwznk7tcqtfmvzv1xxym66oak0009014
6",
    "create-image-allowed": true,
    "defined-tags": {},
    "display-name": "myimage",
    "freeform-tags": {},
    "id":
"ocid1.image.AK00661530.scasg01.sn6x8ba80rhymybtfiv6wkyeyy5fuubvhpb9mba8ofzscfpinsopq6eg4nf4"
,
    "launch-mode": "PARAVIRTUALIZED",
    "launch-options": {
      "boot-volume-type": "PARAVIRTUALIZED",
      "firmware": "BIOS",
      "is-consistent-volume-naming-enabled": false,
      "is-pv-encryption-in-transit-enabled": false,
      "network-type": "PARAVIRTUALIZED",
      "remote-data-volume-type": "PARAVIRTUALIZED"
    },
    "lifecycle-state": "AVAILABLE",
    "operating-system": "CUSTOM",
    "operating-system-version": "CUSTOM",
    "size-in-mbs": 512000,
    "time-created": "2022-02-03T01:31:12.529239+00:00"
  },
  "etag": "6564352c-4fea-4335-bad4-b6c9efeb05cd"
}
```

INITIAL LAUNCH ON PCA

You can launch the image without any special additional steps, as illustrated below. See section 6 of the User Guide for further details.

Instance launch using browser interface

From the page describing the image, click on the Controls drop-down menu, then click on 'Create Instance'. Fill in the pop-up window with details on the instance's name, fault domain, shape and virtual network and subnet. If using `cloud-init`, fill in the public key to permit password-free `ssh`.



Create an Instance

Name: sample-ol8-instance

General Information

Create In Compartment: pca3autoTenant

Fault Domain (pca3AutoTenant (change)): Automatically select the best fau

Source Image: sample-ol8-image

Shape

Select shape (pca3AutoTenant (change)): VM.PCAStandard1.1

VM.PCAStandard1.16	256 GB	16
VM.PCAStandard1.2	32 GB	2

The instance will be in Provisioning state while it is being created, and then is automatically launched. After the instance is provisioned you can create a console connection to connect to the instance console, as described in the User Guide.

Instance launch using OCI CLI

You can also use OCI CLI with a pattern similar to this, substituting in desired values for the variables displayed, shape, source details, subnet, keys and names:

```
$ oci compute instance launch -c $OCI_CLI_TENANCY \
   --availability-domain ad1 \
   --shape VM.PCAStandard1.2 \
   --source-details '{"boot-volume-size-ingbs"
:100,"imageId":"$MYIMAGEID"},"sourceType":"image"}' \
   --subnet-id $MYSUBNET_OCID \
   --metadata '{"ssh_authorized_keys":"ssh-rsa ...$RESTOFMYKEY myuserid@mydesktop"}' \
   --display-name "myinstance" \
   --assign-public-ip true
```

The advantage of the CLI is that it is scriptable and can be repeated in bulk with fewer manual steps.

If you need to override the launch mode or parameters, you can specify them on the command line:

```
$ oci compute instance launch [...] \ --launch-options '{"boot-volume-
type":"PARAVIRTUALIZED","firmware":"UEFI_64", "is-consistent-volume-naming-
enabled":false,"is-pv-encryption-in-transit-enabled": false, "network-
type":"PARAVIRTUALIZED","remote-data-volume-type": "PARAVIRTUALIZED"}'
```

POST-LAUNCH: COMPLETE THE INSTANCE

Add block volumes (non-boot disks)

Previous steps created the boot environment on the PCA X9-2. Review the data collected in the preparation steps to size disks that needed to complete the image. Use the PCA Compute Enclave navigation to create block volumes and add them to the instance. Then, create file systems on the block volumes using the tool appropriate to the guest operating system, and copy contents from the source system. The approach will depend on the applications and nature of the data, so details are out of scope for this document.

If the VM on the source system uses NFS, SMB/CIFS or iSCSI targets for its data, it may be possible to expose them to the new instance without having to create new storage resources. Permissions and iSCSI parameters may need to be changed on the storage device.

Note: PCA X9-2 does not support Fibre Channel devices.

IMPORTING FROM ORACLE CLOUD INFRASTRUCTURE (OCI) TO PCA AND VICE-VERSA

PCA X9-2 is highly compatible with OCI, which simplifies the migration process, so is separately described here.

OCI to PCA

Before exporting from OCI, run `'cloud-init clean'` on a clone of the instance, so the next boot runs the services as a fresh instance. Then, in the OCI console, select the instance, click on More Actions, and then Create Custom Image. Once the image has been created, go to your list of images, select that image and click Export and the name of the object bucket you want to use. Then, go to the Object Store, select the exported image file, and click Download. Rename it to have a `.oci` extension if you didn't specify that in the download step. If you use the OCI CLI the command would look like

```
oci os object get \
  --namespace-name <object_storage_namespace> \
  --bucket-name <bucket_name> \
  --name <object_name> \
  --file <file_location
```

Once you have downloaded the file you need to make two changes to `the image_metadata.json` file. Untar the file, edit `image_metadata.json` using an ASCII text editor like vi, pluma, gedit or Notepad, and set the value *false* for the variables *`pvEncryptionInTransitEnabled`* and *`consistentVolumeNamingEnabled`*.

Then re-create the `.oci` file using the `tar` command (`tar zcvf myimage.oci image_metadata.json output.QCOW2`) and directly import it into PCA using the browser interface or command line. No further transformation is required.

PCA to OCI

Moving the image in the other direction is very similar: run `'cloud-init clean'`, create a custom image from the image, export the image via an object bucket, download it, and then import into OCI. There is no need to change the JSON file. The command to download from PCA, if using the CLI, is the same as the example above.

Then log into OCI, go to Object Storage → Buckets and to the bucket you use for this procedure. Click Objects then Upload, and then specify the path to the `.oci` file. Once the file has been uploaded you can import it as a custom image into OCI: go to Compute → Custom Images and select Import, and then point to the bucket you used, selecting OCI as the file type.

TAKE A BACKUP

Create a backup after first successful boot for fallback after any further changes. See the Users Guide for details on creating a new custom image and taking boot and block volume backups

DATA MIGRATION, ACCEPTANCE TESTING AND CUTOVER

At this point you have a running instance on PCA. Copy over the application data using the tools appropriate to the operating system and application (e.g.: rsync or scp for file data in Linux or Solaris) and conduct user acceptance testing in parallel with undisturbed operation in the source system. Once acceptance testing is successful, perform a final data synchronization from the source stem to the new environnment. The procedures for this last, essential, step will be specific to the operating system and applications.

SUMMARY

This document provides a guide with instructions and process for moving workloads from source system to PCA X9-2. Architects and administrators transitioning virtual machines to PCA can use this as a basis for their migrations.

APPENDIX 1: STANDARD SHAPES

PCA X9-2 supports the following shapes. When sizing an instance, select the shape that provides sufficient CPU and memory capacity. If the source VM's CPU speed is slower than the X9-2 server is or is overprovisioned with more capacity than it needs, you can select a smaller shape.

Note that the shape also includes a maximum number of virtual network devices, so if an instance needs more than provided by the smallest shape meeting its CPU cores and memory requirements you'll have to promote to a larger shape

Shape Name	Cores	Memory (GB)	Virtual NICs
VM.PCAStandard1.1	1	16	2
VM.PCAStandard1.2	2	32	2
VM.PCAStandard1.4	4	64	4
VM.PCAStandard1.8	8	128	8
VM.PCAStandard1.16	16	256	16
VM.PCAStandard1.24	24	384	24
VM.PCAStandard1.32	32	512	24
VM.PCAStandard1.48	48	768	24
VM.PCAStandard1.Max	60	960	24

APPENDIX 2 IMAGE_METADATA.JSON EXAMPLES

The contents below can be used as the basis of `the image_metadata.json` file included in a .oci bundle for upload. Select the BIOS or UEFI version as determined by the source environment Values for "`operatingSystem`" and "`operatingSystemVersion`" should be set to the values for the imported image, and other fields should be left as shown.

BIOS images

```
{
  "version": 2,
  "externalLaunchOptions": {
    "firmware": "BIOS",
    "networkType": "PARAVIRTUALIZED",
    "bootVolumeType": "PARAVIRTUALIZED",
    "remoteDataVolumeType": "PARAVIRTUALIZED",
    "localDataVolumeType": "PARAVIRTUALIZED",
    "launchOptionsSource": "CUSTOM",
    "pvAttachmentVersion": 1,
    "pvEncryptionInTransitEnabled": false,
    "consistentVolumeNamingEnabled": false
  },
  "imageCapabilityData": null,
  "imageCapsFormatVersion": null,
  "operatingSystem": "Oracle Linux",
  "operatingSystemVersion": "8.5"
}
```

UEFI images

```
{
  "version": 2,
  "externalLaunchOptions": {
    "firmware": "UEFI_64",
    "networkType": "PARAVIRTUALIZED",
    "bootVolumeType": "PARAVIRTUALIZED",
    "remoteDataVolumeType": "PARAVIRTUALIZED",
    "localDataVolumeType": "PARAVIRTUALIZED",
    "launchOptionsSource": "CUSTOM",
    "pvAttachmentVersion": 1,
    "pvEncryptionInTransitEnabled": false,
    "consistentVolumeNamingEnabled": false
  },
  "imageCapabilityData": null,
  "imageCapsFormatVersion": null,
  "operatingSystem": "Oracle Linux",
  "operatingSystemVersion": "7.9"
}
```

REFERENCES

See these reference documents for additional information:

- Oracle PCA 3.01 documentation library: https://docs.oracle.com/en/engineered-systems/private-cloud-appliance/
  - Oracle PCA Concepts Guide: https://docs.oracle.com/en/engineered-systems/private-cloud-appliance/3.0/concept-3.0.1/index.html
  - Oracle PCA User Guide: https://docs.oracle.com/en/engineered-systems/private-cloud-appliance/3.0/user-3.0.1/index.html
- Bring Your Own Image page for Oracle Cloud Infrastructure: https://docs.oracle.com/en-us/iaas/Content/Compute/References/bringyourownimage.htm
- "Introducing VirtIO Drivers with Oracle Solaris on OCI" at https://blogs.oracle.com/solaris/post/introducing-virtio-drivers-with-oracle-solaris-on-oci
- "Announcing Oracle VirtIO Drivers 1.1.5 for Microsoft Windows" at https://blogs.oracle.com/linux/post/announcing-oracle-virtio-drivers-115-for-microsoft-windows
- Removing Oracle VM Paravirtualization Drivers for Windows https://docs.oracle.com/en/virtualization/oracle-vm-pv-drivers/3.4.5/winpv/vmwpv-uninstall.html
- Oracle VM Server for x86 and Oracle VM Manager documentation library at https://docs.oracle.com/en/virtualization/oracle-vm/index.html
- Oracle VM VirtualBox documentation at https://docs.oracle.com/en/virtualization/virtualbox/index.html
- Oracle Linux KVM User's Guide https://docs.oracle.com/en/operating-systems/oracle-linux/kvm-user/
- cloud-init documentation https://cloudinit.readthedocs.io/en/latest/
- Solaris 11.4 documentation on cloudbase-init https://docs.oracle.com/cd/E37838_01/html/E60974/gpxcg.html
- "Introducing VirtIO Drivers with Oracle Solaris on OCI" at https://blogs.oracle.com/solaris/post/introducing-virtio-drivers-with-oracle-solaris-on-oci
- Windows cloudbase-init documentation https://cloudbase-init.readthedocs.io/en/latest/
- Oracle Private Cloud Appliance 2.4 Backup Guide at https://www.oracle.com/technetwork/server-storage/private-cloud-appliance/documentation/pca-backup-x8-0-6-5676918.pdf

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