ORACLE

Migrating Exalytics and Oracle Analytics Server Workloads to Oracle PCA / PCC

Oracle Private Cloud Appliance / Private Cloud at Customer Provides the Ideal Platform for Hosting Analytic Workloads

PURPOSE STATEMENT

This document describes how to migrate workloads from Oracle Exalytics systems and Oracle Analytics Server (OAS) environments to Oracle Private Cloud Appliance (PCA). It focuses on methodology and best practices for migrating these analytic applications to PCA. Private Cloud at Customer (PCC) is functionally equivalent to PCA in these scenarios.

DISCLAIMER

This document in any form, software or printed matter, contains proprietary information that is the exclusive property of Oracle. Your access to and use of this confidential material is subject to the terms and conditions of your Oracle software license and service agreement, which has been executed and with which you agree to comply. This document and information contained herein may not be disclosed, copied, reproduced or distributed to anyone outside Oracle without prior written consent of Oracle. This document is not part of your license agreement nor can it be incorporated into any contractual agreement with Oracle or its subsidiaries or affiliates.

This document is for informational purposes only and is intended solely to assist you in planning for the implementation and upgrade of the product features described. It is not a commitment to deliver any material, code, or functionality, and should not be relied upon in making purchasing decisions. The development, release, and timing of any features or functionality described in this document remains at the sole discretion of Oracle.

Due to the nature of the product architecture, it may not be possible to safely include all features described in this document without risking significant destabilization of the code.

TABLE OF CONTENTS

INTRODUCTION

The Oracle Private Cloud Appliance (PCA) and Oracle Private Cloud at Customer (PCC) have emerged as the premier platform for Oracle Business Intelligence, Essbase, EPM, Oracle Analytics Server (OAS) and other application tier software, often in conjunction with Oracle Exadata - the premier database platform. Many of those applications have been deployed on Oracle Exalytics or commodity x86 servers, and are now being deployed on PCA for increased performance, scale, and manageability.

This white paper discusses the advantages of moving those applications to PCA, describes how to migrate them, with emphasis on Exalytics Essbase workloads, and describes deployment methods and best practices. This paper emphasizes platform and performance characteristics of the PCA X8 over previous PCA versions. The methodology and architectural principles apply to all versions.

Advantages of the 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.

The Oracle Private Cloud Appliance is also available as the Oracle Private Cloud at Customer (PCC), a solution for on-premises private cloud that includes the PCA and Oracle services. Customers acquire PCC on a subscription basis, with Oracle operating the infrastructure so the customer can focus on applications. Except where noted, 'PCA' will be used in this document to describe either form of the product.

The PCA platform is ideal for both Oracle and third party applications, with benefits especially suitable for Analytic software and similar application tier products. There are several reasons why this is so effective:

- PCA provides 'quick time to value' for a robust virtualization platform, going from first power-up to starting VMs in a matter of hours. PCA automatically discovers hardware components and configures them to work with one another, reducing design and administrative effort, eliminating potential errors, and speeding time to application deployment. PCA's automated configuration implements Oracle best practices for optimal performance and availability.
- PCA provides high performance high speed 100Gb Ethernet, Oracle ZFS Storage Appliance ZS7-2, and Oracle X8-2 compute nodes, providing performance and scale improvements over previous product generations. See sections below for further description of the physical infrastructure.
- PCA design eliminates single points of failure on management, network, storage, and compute resources, and permits 'zero-downtime' rolling upgrades to system infrastructure.
- Pre-built Oracle VM virtual appliances and templates quickly enable application instances. This is complementary to Private Cloud Appliance quickly provisioning physical infrastructure. You can see a list of pre-built virtual appliances at https://www.oracle.com/virtualization/technologies/virtual-appliances.html
- High performance inter-VM networking using the Private Cloud Appliance internal networks permits low-latency, high bandwidth, private communication between VMs in a clustered application. This is especially useful for clustered applications like WebLogic and Coherence, and frameworks like Kubernetes. Multiple private networks based on VLANs or custom PCA networks can provide independent isolated networks, and are ideal for hosting multiple application clusters on the same PCA. Each network carries traffic private to each cluster, without need to prevent IP address collision or data leakage between applications.
- PCA provides load balancing (Dynamic Resource Scheduling - DRS) and High Availability (HA) features that provide higher performance and automates recovery from outages.
- PCA can provide Infrastructure as a Service (IaaS) cloud function via Oracle Enterprise Manager 13c.
- Application orchestration and automated workload deployment can be performed with Ansible, the Oracle VM API, the Oracle Enterprise Manager API, and the scriptable command line interface.
- Customers can use Trusted Partitioning or Hard Partitioning to manage software license costs.

Oracle Private Cloud Appliance and Oracle Private Cloud at Customer fully support Oracle Linux Cloud Native Environment, including Oracle Container Runtime for Docker and Oracle Container Services for Use with Kubernetes. They provide an ideal runtime for Oracle WebLogic Server applications to run in Docker and Kubernetes with full, integrated system support from Oracle. We recommend that customers running analytics applications on Oracle Exalytics Elastic Cloud systems, and wishing to adopt cloud native infrastructure and DevOps practices, migrate to Oracle Private Cloud Appliance and Oracle Private Cloud at Customer.

The following sections discuss these items in further detail, and describe how to migrate applications from Exalytics to PCA.

Virtualization and Cloud Platform

The Private Cloud Appliance provides virtualization life cycle management using Oracle VM. Oracle VM consists of two parts: Oracle VM Manager and Oracle VM Server. These are included and pre-installed on PCA without additional license fees, representing a substantial cost savings over other virtualization platforms.

Oracle VM Manager is an advanced and widely used virtualization management product for controlling multiple servers, VMs, networks and storage resources under a graphical browser user interface. Oracle VM Manager also provides programmable REST APIs and command line interfaces to permit automation. Each PCA has one active instance of Oracle VM Manager used as a central control plane to administer the entire PCA.

Oracle VM Server is a high performance hypervisor that runs virtual machines, based on commands sent from Oracle VM Manager. Oracle VM Server is automatically installed and configured on every compute node, both when a PCA rack is installed, and when additional compute nodes are added. Oracle VM efficiently runs virtual machines, which may run Oracle Linux, Oracle Solaris, other Linux versions, and Microsoft Windows, and the applications these operating systems support.

Oracle VM provides advanced functions that benefit applications:

- Administrators can set anti-affinity rules to ensure that virtual machines comprising a clustered application such as Oracle Analytics Server do not run on the same physical server, insulating them from single points of failure.
- High Availability (HA) settings can automatically reboot VMs if they or the server they are running on crash. For example, HA can bring up a WebLogic administrative instance or Kubernetes master after an outage.
- Live migration allows you to move running VMs from one server to another without stopping the VM and interrupting its applications. This is typically used for load balancing and to perform compute node maintenance without virtual machine outage,
- Dynamic Resource Scheduling (DRS) policies can provide load balancing among server based on several parameters, including CPU and network utilization according to policy settings. DRS automatically live migrates VMs from heavily loaded servers to less loaded ones to permit optimal performance.
- Resource management policies control CPU allocation for differential service between applications sharing the same servers, including CPU caps, and share-based priorities. This permits higher degrees of CPU oversubscription without affecting the service level objectives for production applications running alongside less-critical applications.
- Administrators can define tenant groups to dedicate PCA compute nodes to different clients. This ensures dedicated resources for applications or departments. PCA tenant groups leverage standard Oracle VM server pools, with additional automation and default configuration.

PCA customers can use Oracle Enterprise Manager 13c to provide Infrastructure as a Service (IaaS) cloud capabilities, Oracle Enterprise Manager provides comprehensive management capabilities, including role-based access control, monitoring and chargeback. A single Enterprise Manager instance can be used to manage multiple PCAs and PCCs as your environment expands. Oracle EM can have complete functional control over PCA, since all functional aspects of OVM are reproduced in the EM user interface. The PCA can also leverage Ansible to provide "infrastructure as code".

Private Cloud Appliance Components

PCA Management Nodes

PCA uses two latest generation Oracle servers X8-2 that function as the management nodes for Oracle Private Cloud Appliance X8. They serve as an active-passive cluster for management operations, providing resiliency in case of planned outage or server failure. Oracle VM Manager and other management functions run on the active management node. When a management node assumes the active role it takes over a virtual IP address (VIP) address, so clients of the management interface do not need to know which management node is currently active.

PCA Integrated ZS7-2 Storage

Oracle Private Cloud Appliance features a fully integrated, enterprise-grade Oracle ZFS Storage Appliance ZS7-2 for centrally storing the management environment, virtual machine images and application data, providing superior performance and efficiency.

With dual ZS7-2 controllers in a high-availability (HA) configuration and one high-capacity DE-24C storage shelf, Oracle Private Cloud Appliance now includes 100 TB of customer usable storage in the rack. This storage can scale to 6PB (petabytes) raw capacity (3PB mirrored), using a combination of (24) DE3-24C or all-flash DE3-24P expansion storage trays depending on capacity and performance requirements. Further details on the Oracle ZFS Storage Appliance are at https://www.oracle.com/storage/nas/zs7-2/.

PCA Compute Nodes

Oracle Server X8-2 compute nodes in the Private Cloud Appliance provide the virtualization platform. Compute nodes run Oracle VM Server and provide processing power and memory capacity for virtual machines under Oracle VM Manager's control.

Each X8-2 compute node server has two 24-core Intel Xeon 8260 processors and can be ordered in three different memory configurations - 384 GB, 768 GB, and 1.5 TB. With a 45% performance improvement over the previous compute node generation, Oracle Server X8-2 provides the optimal balance of CPU cores, memory, and I/O throughput for mission-critical enterprise applications. Customers can scale from 2 to 25 compute nodes in the same rack.

An automated provisioning process orchestrated by the active management node configures compute nodes into the Oracle VM environment. Private Cloud Appliance software installs Oracle VM Server software on each compute node, defines their network configurations, and places all compute nodes into an Oracle VM server pool.

Best practice: Oracle VM only uses a small percentage of the memory and CPU on each compute node, leaving the remainder for virtual machines. For capacity planning purposes, consider each X8-2 compute node as providing 48 cores for virtual machines and applications. CPU cores can be over-subscribed, with more virtual CPUs than physical CPUs on the server, which permits higher VM density for cloud operations, especially if VMs have different idle and peak periods. If CPUs are oversubscribed, administrators should use resource controls like DRS (Dynamic Resource Scheduling) to ensure that important VMs can be moved to free compute nodes and get preferential service during periods of high CPU consumption.

Best practice: Spare CPU capacity should be provisioned for peak loads and to provide "N+1" redundancy to provide sufficient capacity when a server is down for maintenance or other reasons.

PCA administrators can optionally define "tenant groups", which isolate compute and storage resources in separate Oracle VM server pools that can be assigned to different customers, to provide dedicated resources.

Network Infrastructure

The PCA network is an important differentiator from previous systems. The Private Cloud Appliance relies on "wire once" Software Defined Networking (SDN) that permits multiple isolated virtual networks to be created on the same physical network hardware components.

PCA Physical Networking

PCA networking uses 100Gb Ethernet leaf and spine switches. These offer 100Gb Ethernet connectivity for communication between internal PCA components and allow flexible 10/25/40/100GbE connectivity to customer data center networks. This provides a performance improvement over the 40Gb InfiniBand internal networks on earlier Oracle engineered systems, including earlier PCA generations, and faster networking to external hosts. PCA networks exceed the performance of the 1Gb or 10Gb Ethernet networks typically seen on commodity servers.

PCA uses redundant physical network hardware components, pre-cabled at the factory, to help ensure continuity of service during maintenance or in case of a failure.

Network Connectivity

The Private Cloud Appliance provides external network access for connectivity to a datacenter's networks. The PCA connects to the datacenter network via a pair of next-level switches, also referred to spine switches. These switches connect redundantly to the customer's ToR (Top of Rack) switches. This provides resiliency against a single point of failure. Software Defined Networks (SDN) based on the physical network devices connect virtual machines to networks, storage and other virtual machines, maintaining the traffic separation traditionally provided by hard-wired connections. Optional custom external networks further isolate traffic and maximize bandwidth.

The PCA uses private, "internal" networks that are not exposed to the customer's datacenter network. This provides isolation, security, and the ability to use pre-defined IP address ranges for each networked component without conflict with existing datacenter network addresses. PCA uses internal networks for appliance management, storage access, and inter-VM communication. Every PCA rack component has a predefined IP address. Oracle storage, management and compute nodes have a second IP address for Oracle Integrated Lights Out Manager (ILOM) connectivity.

Compute nodes connect to the internal networks and to the customer datacenter networks. Oracle VM Server on each compute node communicates over Private Cloud Appliance internal networks for management, storage, heartbeat and live migration. By default, compute nodes do not have IP addresses on the customer datacenter network, which increases their isolation and reduces attack surface.

For an in-depth guide on PCA X8's custom networks and many other networking topics, a PCA and PCC Networking Guide is now available. This guide should be reviewed prior to any PCA X8 deployment, or if changes to networking are being contemplated. The PCA and PCC Networking Guide is published here: https://www.oracle.com/a/tech/docs/networking-the-oracle-pca-and-pcc.pdf.

Virtual Machine Networking

Guest virtual machines access the customer datacenter network using an Oracle VM network named "default_external", An additional virtual machine network named "default_internal" is internal to the Private Cloud Appliance and used for private network traffic between virtual machines. In previous PCA versions, the corresponding networks were named `vm_public_vlan` and `vm_private`. These networks are pre-defined in Oracle VM Manager with the "Virtual Machine" function (also called a "channel") - indicating they are used for guest VM TCP/IP traffic and not cluster management, storage, or live migration. This ensures that guest VMs do not see infrastructure network traffic.

PCA administrators can define VLANs based on the interfaces used for these networks, to comply with a datacenter's network standards and to permit traffic isolation. For example, a datacenter standard might require VM traffic be on VLANs 100 to 150, and an administrator would define separate networks with those VLAN tags. Private VLANs can also be built to isolate traffic between different virtual machines. Virtual machines do not have to be configured to use VLANs – the use of VLANs is transparent to the virtual machine. This makes it easy to clone VMs or move them to different VLAN networks without having to change the virtual machines' internal VLAN configuration.

Best Practice: Application clusters such as WebLogic, Coherence, Kubernetes, and Oracle Real Application Clusters (RAC) benefit from PCA's internal VM networks, which provide high-performance, low-latency networking. Perform network traffic between members of an application cluster over a virtual network device based on default_internal. That is faster than sending inter-VM traffic to datacenter switches and provides better performance and isolation. This is ideal for Coherence and Java application servers like WebLogic, which have high rates of message traffic and depend on fast message delivery. This offers an improvement over the 40Gb networks available on Exalytics.

Best Practice: If there are several application clusters, define VLAN-based internal virtual machine networks for each application based on the bond used for default_internal. That provides fast, low latency communication between members of an application cluster and insulates them from IP address collision or data leakage. You can have multiple independent application clusters without having to coordinate their IP address assignments or host names.

The result is that the PCA infrastructure stack replaces the Exalytics infrastructure stack.

MIGRATING ANALYTIC APPLICATIONS FROM EXALYTICS TO PCA

There are two approaches to migrating analytic applications from Exalytics to PCA: fresh OS install and "lift and shift", described later in this document. The result is that the Exalytics infrastructure stack is replaced by the PCA infrastructure stack.
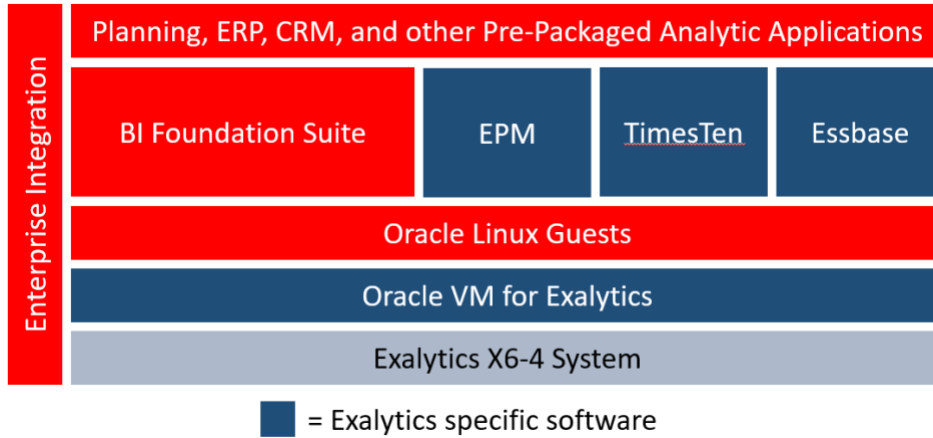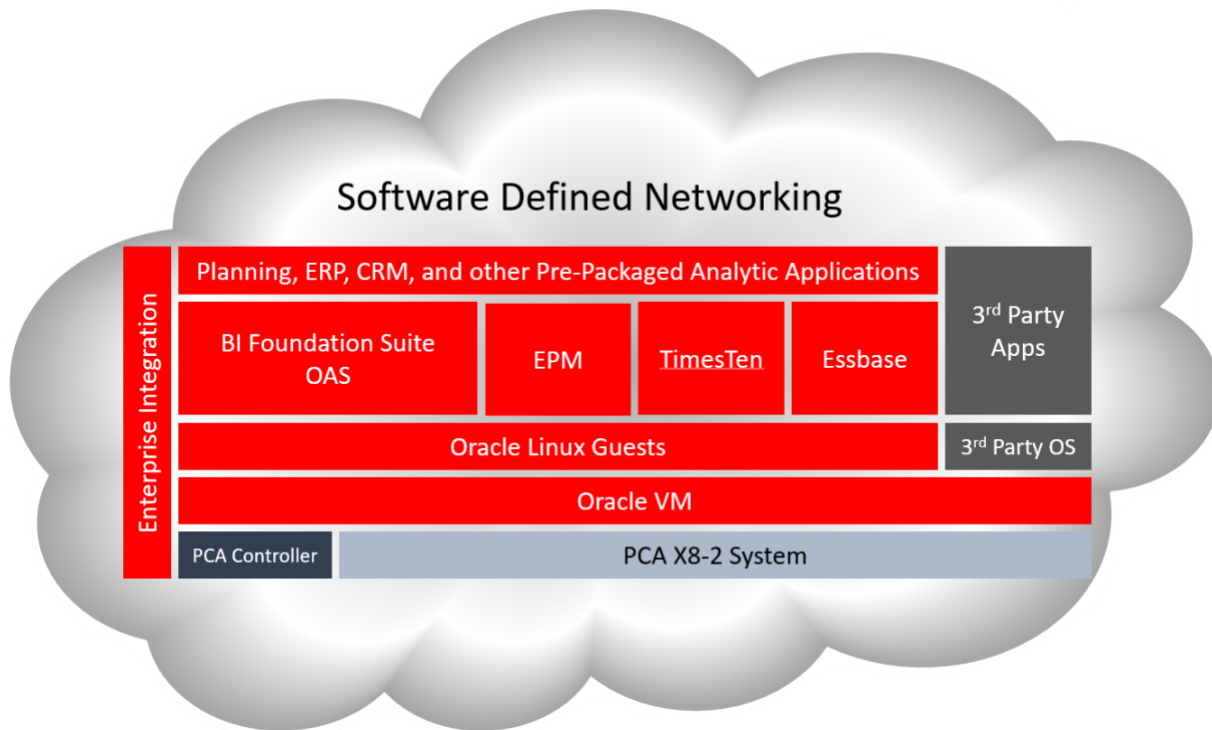
Figure 1 - Exalytics Stack

Figure 2 - PCA infrastructure stack with Oracle VM and Enterprise Manager

In general, Exalytics applications can be migrated without changes to the VM. Customers should however consider the following general comparisons between the environments when planning migrations and evaluate whether they want to create a new environment that matches the old one as much as possible, or use the migration as an opportunity for an application and OS technical refresh as well as a hardware refresh. These considerations apply:

- The migration will change the underlying compute infrastructure used by applications.
- Access to external systems via HTTP and T3 protocol is supported, including access to databases, and Oracle RAC clusters running in Oracle Exadata systems. SDP protocols are not supported on Oracle Private Cloud Appliance, so any existing

usage of SDP within domains running on Oracle Exalytics systems must be removed. That is consistent with current recommendations for applications running on Exalytics. Note that the use of SDP would only be a consideration on Exalytics systems that were given an exception for use of InfiniBand by Exalytics Product Managers.

- For more information on Oracle Exalytics Software licenses, consult the Licensing Information User Manual at https://docs.oracle.com/cd/E41246_01/bip.1/e47816/toc.htm.
- If deploying to Kubernetes, see the white paper "Oracle WebLogic Server on Oracle Private Cloud Appliance and Kubernetes" at https://www.oracle.com/a/ocom/docs/engineered-systems/oracle-webLogic-server-on-pca.pdf.

Fresh OS Install Methodology

This method deploys new virtual machines running OAS/OBIEE, Essbase, EPM, or other application software, and then the application data (scripts, tools, etc.) is migrated from current instances. This also applies to applications currently running on commodity servers.

The advantage of this approach is that it is a software technology refresh to complement the hardware technology refresh. The administrator would download the latest Oracle Linux OS and application versions from Oracle Software Delivery Network at https://edelivery.oracle.com and copy the applications onto it.

This methodology also provides the opportunity to modernize applications by installing them inside Docker containers and using Kubernetes. This represents the modern trend for how application systems are delivered, and is fully supported on the PCA.

Although this preferred method brings the software stack fully up to date, this may require additional analysis of the current environment to capture the current system's contents.

Customers will therefore often prefer to move application environments to new hardware with as few changes as possible, as described in the next section.

Migrating to PCA with "Lift and Shift" Methodology

This paper focuses on a method often described as "lift and shift", which moves existing environments to PCA with as few changes as possible. This section describes how to download existing physical or virtual machines on Exalytics, then upload and transform them to operate on PCA.

STEP 1: Collect configuration from running system

First, collect userids and passwords to permit logging into the current OS instance. While logged in, collect network and disk mount details by issuing commands "`ifconfig –a`" and "`df –h`". Note details of any NFS shares or naming service (NIS, LDAP) in use, since they will be needed after the image is implemented on PCA. If those services were private to the Exalytics, they would need to be replaced by services available to the PCA, potentially in virtual machines.

STEP 2: Obtain OS Image

The next step is to copy the OS images and descriptive information from the current Exalytics system.

Physical OS images

Use the Oracle VM Physical to Virtual (p2v) utility to create an uploadable VM image from a physical OS instance. The utility is described in the Oracle VM Administrator's Guide for Release 3.4 at https://docs.oracle.com/cd/E64076_01/E64083/html/vmadm-ptov-intro.html.

Cleanly shut down the OS instance. Then boot the Oracle VM install CD or ISO image on the physical server and enter 'p2v' at the first boot prompt. The utility will start up and present a panel asking the administrator which disks to include in the VM image. Select all of them unless you know there are unused disks in the physical machine.

The P2V utility will prompt for network information, and will present a screen requesting details about the new VM, as shown in **Figure 3**.

Figure 3 - Virtual Machine Parameters
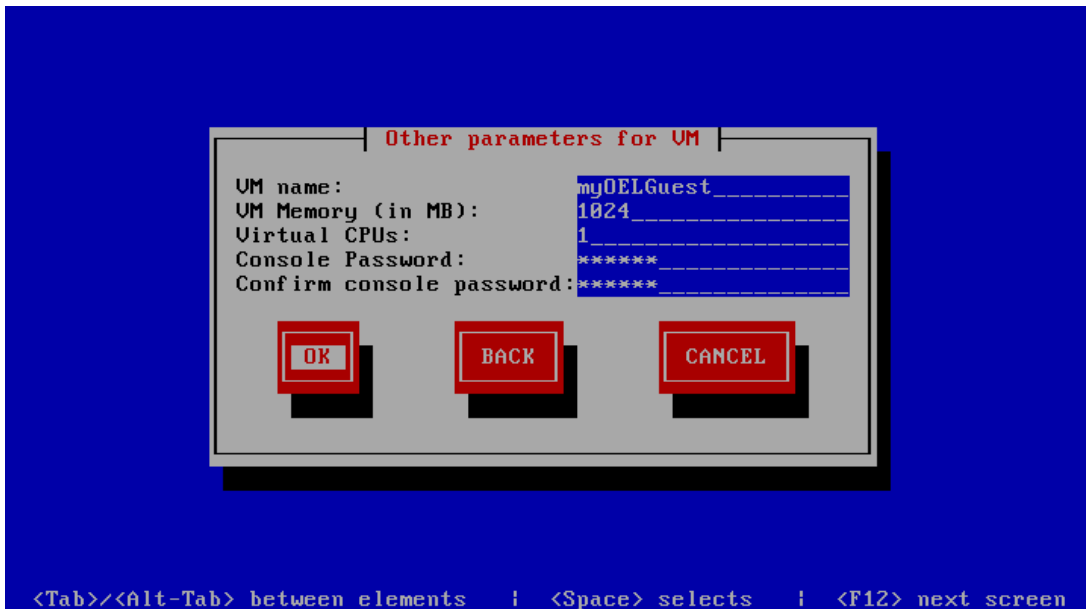
P2V will then display the network address of a web server it creates. Point a web browser to the IP address to download the `vm.cfg` file and disk image "`.img`" files that will comprise the VM. When that is complete, continue with Step 2 below, to upload the VM image into the Private Cloud Appliance.

Virtual OS images

When obtaining a virtual Exalytics image, start by logging into Oracle VM Manager that serves the Exalytics machine. Obtain the virtual machine details from the VM's `vm.cfg` file, and locate the VM's disk images that are described there.

Next, from the Oracle VM Manager user interface, collect the VM descriptive information, as shown in Figure 4 and the text in Example 1 below. This includes the VM name, shape (number of virtual CPUs, memory size), disk and network devices.

Figure 4 - Virtual machine details on the OVM Server managing Exalytics

Figure 4 shows the `vm.cfg` location under "Config File Mounted Path". In OVM, the `vm.cfg` file is usually located on Oracle VM Server at the `/OVS/Repositories/<Repository GUID>/VirtualMachine/<Virtual Machine GUID>/vm.cfg` location. Log into one of the Exalytics compute nodes and display its contents by moving to the directory specified and using the `cat` command to show the contents of `vm.cfg`. Note the highlighted lines, which describe the virtual disk and network configurations and Exalytics-specific details. The example shows the VM with the name "exalyticsvm01", a single Ethernet virtual NIC, 102GB of RAM, 10 virtual CPUs, and a single virtual disk.

Example 1 - Sample VM description file (vm.cfg) for a VM on Exalytics

```
[root@x6-4cap-h004 0004fb0000060000f0de95282b2382bd]# cat vm.cfg
vif = ['mac=00:21:f6:3c:55:e9,bridge=0a888400']
OVM_simple_name = 'exalyticsvm01'
vnclisten = '127.0.0.1'
vncconsole = 1
cpuid = ['1:edx=xxxxxxxxxxxxxxxxxxxx0xxxxxxxxxxxx']
serial = 'pty'
disk = ['file:/OVS/Repositories/0004fb000003000071eaae55c0063261/VirtualDisks/
0004fb000012000066efcc259120eddb.img,xvda,w', 'phy:/dev/disk/by-id/nvme-CVMD512100NE1P6NGN-
part1,xvdb,w']
vncunused = 1
uuid = '0004fb00-0006-0000-f0de-95282b2382bd'
on_reboot = 'restart'
boot = 'c'
cpu_weight = 27500
pae = 1
memory = 102400
cpu_cap = 0
maxvcpus = 10
OVM_high_availability = False
acpi = 1
timer_mode = 2
on_poweroff = 'destroy'
vnc = 1
OVM_description = 'Import URLs: [http://zs3-2cap-
2018.us.osc.oracle.com/shares/export/images/Exalytics_EL6_VMTemplate_2.2.0.0.0.el6.tgz]'
OVM_os_type = 'Oracle Linux 6'
on_crash = 'restart'
apic = 1
guest_os_type = 'linux'
name = '0004fb0000060000f0de95282b2382bd'
usbdevice = 'tablet'
device_model = '/usr/lib/xen/bin/qemu-dm'
builder = 'hvm'
vcpus = 10
keymap = 'en-us'
OVM_cpu_compat_group = ''
OVM_domain_type = 'xen_hvm_pv'
```

Note the lines that describe the VM's network ("`vif=`"), virtual disks ("`disks=`"), CPU configuration, and OVM domain type.

Stop the VM to ensure stable disk contents, then use `scp` or `rsync` to copy disk image files listed in the "`disk =`" line to a host that has a web server and is on a network reachable from PCA. If you don't have a web server, select a system that hosts Python, open a terminal window, '`cd`' to the directory used for the copied VM disk ".`img`" files and issue the command "`python SimpleHttpServer 8000`" as shown in **Example 2** below. That creates a web server you can use in the import step. Port 8000 is used arbitrarily in this example since it is unlikely to be in use. If that port number is in use, you will see an error message that says, "`Address already in use`". Just pick another port number and adjust the import URL accordingly.

Example 2 - Using Python for an impromptu web server

```
$ ls vm.cfg *img
0004fb000012000066efcc259120eddb.img  vm.cfg
$ python -m SimpleHTTPServer 8000
Serving HTTP on 0.0.0.0 port 8000 ...
10.80.108.245 - - [26/Dec/2019 12:39:57] "GET 0004fb000012000066efcc259120eddb.img HTTP/1.0" 200
10.80.108.245 - - [26/Dec/2019 12:51:38] "GET /vm.cfg HTTP/1.0" 200 -
```

### STEP 3: Upload Exalytics Virtual Machine into PCA

There are several ways to upload the Exalytics VM image into PCA. One way is to upload it as a template, which can be cloned to make multiple VMs.

NOTE: InfiniBand was only fully supported on Exalytics bare metal installations. Installations that were virtualized with OVM never fully supported InfiniBand due to the version of OVM (3.2.9) that shipped with Exalytics. There were some exceptions requested, however, the vast majority of virtualized Exalytics installations will not have InfiniBand interfaces presented to VMs.

The first step in preparing the `vm.cfg` is to remove Exalytics-specific details from the file. Copy the `vm.cfg` to the same directory as the VM disk image files. Then use an ASCII text editor to edit the file to remove the "vif" line in `vm.cfg` (noted above) because it describes a network on Exalytics, not on the PCA. If the "vif" line is not removed, there will simply be an "undefined" network in Oracle VM Manager, which can be removed after import.

After the files have been edited, saved, and put in a directory presented by the web server, next log into Oracle VM Manager on the PCA. Click on the Repositories tab, expand the desired target repository (typically Rack1-Repository) and click on "VM Templates". Then click on the "Import" icon and fill in details for the configuration and images files in the pop-up box, as shown in **Figure 5**.

### Figure 5 - Import VM image as a Template
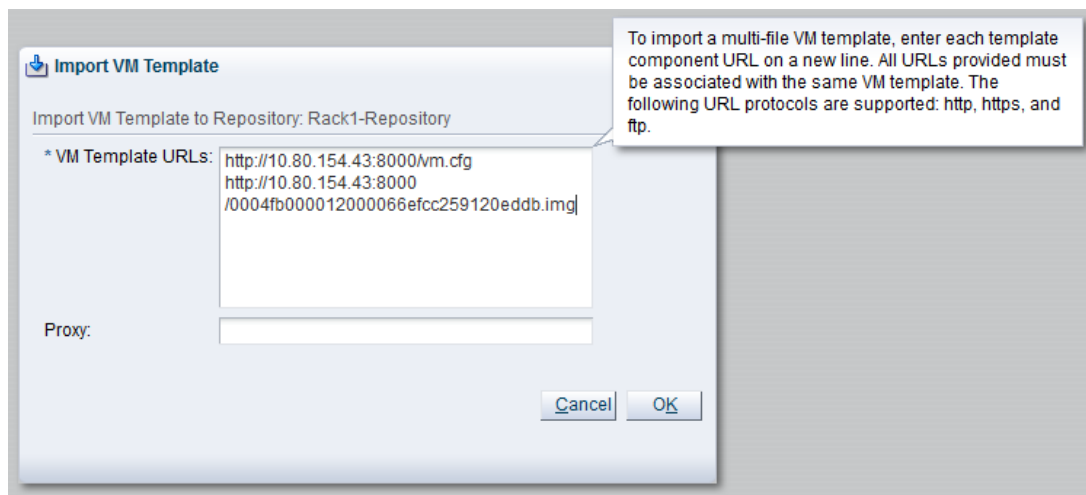
This uploads the files named in the pop-up box. When this job completes, you will have a VM template you can use as the basis for creating VMs, shown in **Figure 6**.

Figure 6 - Imported Template
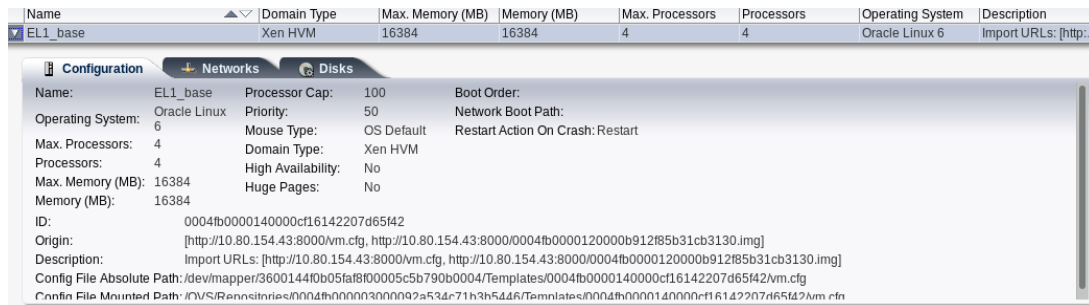
Edit the template using the Oracle VM user interface to match the source configuration, in particular the network names. The convention used in this paper is that the first virtual network interface is used for external networks, and the second virtual network will be used for private, inter-VM communication. **Figure 7** shows the "edit template" popup dialogue from Oracle VM Manager

Figure 7 - Pop-up dialogue to select networks for template
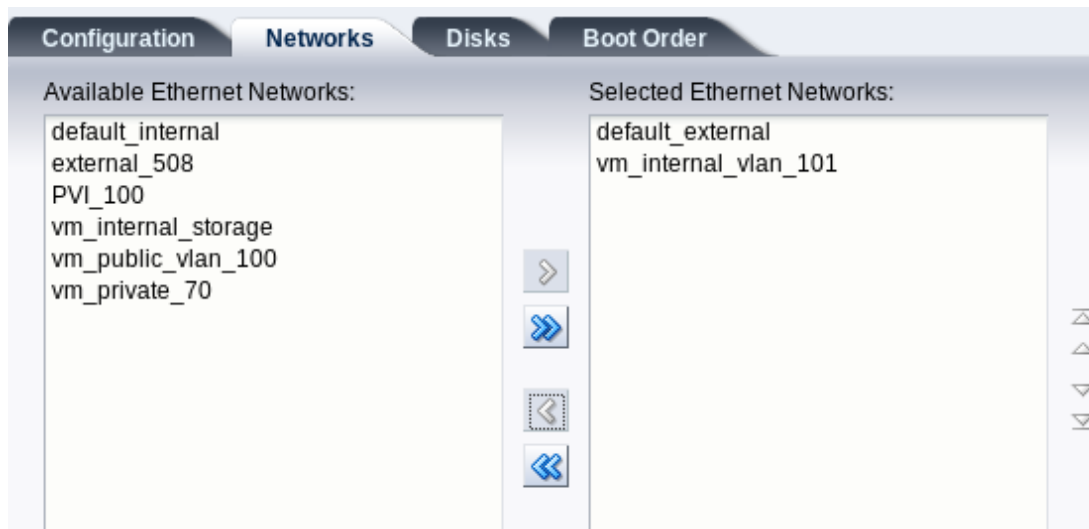
The resulting template can now be cloned to create new virtual machines. See the Oracle VM Administrator's Guide at https://docs.oracle.com/cd/E64076_01/E64083/html/index.html for information on cloning VMs.

An alternative method is to import the virtual disk images and then create new virtual machines that use them. In that case, use a similar import step to upload the disk images, then go to the "Servers and VMs" tab, select the desired server pool (typically Rack1_ServerPool) and click on the "Create VM" icon. In the dialogue there, use the same VM shape (number of CPUs, memory size) and networks as in the original VM, and select the just-uploaded virtual disk images.

A useful method that applies to both alternatives is to add an Oracle Linux boot CD ROM ISO image to the virtual machine, and boot into it to perform the transformation step below. Edit the VM, move to the Disks tab and add a CDROM ISO image as shown in Figure 8. Use the Boot Order tab to make CD/DVD the first boot device. It may be more convenient to create a utility VM running Oracle Linux, and temporarily add the imported Exalytics VM's disks to it: add the disks to the utility VM. Then you would mount the imported VM's disks by hand (for example, assuming the imported boot disk is the utility VM's second disk: `mkdir /mnt/sysimage ; mount /dev/xvdb1/ /mnt/sysimage`).

Figure 8 - Disk tab showing CD-ROM image
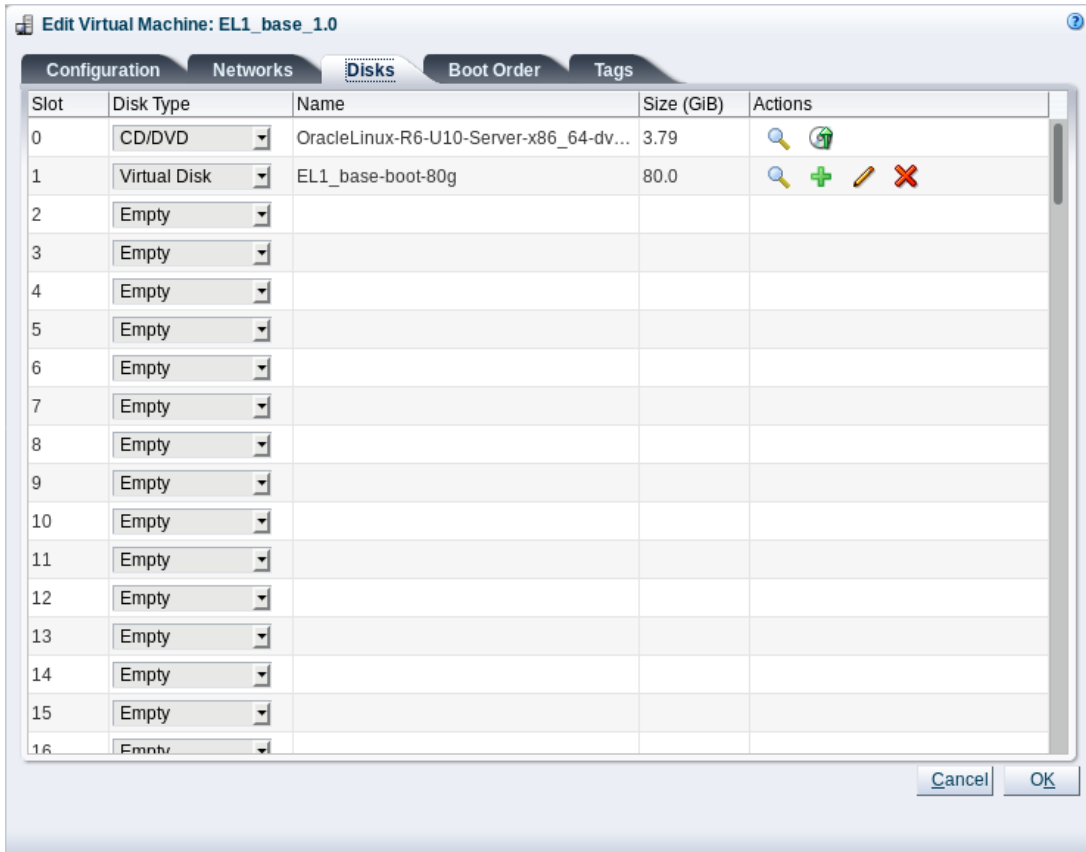
At this point, you have a VM that corresponds to the VM on Exalytics.

STEP 4: Configure VM Networks

Bring up the virtual machine and configure virtual networks to your datacenter standards, creating `/etc/sysconfig/network-scripts/ifcfg-eth*` files to bring up the VM's public and private networks. They should be different from the Exalytics VMs to permit parallel testing.

If WebLogic is in use in OBIEE, connect to the WLS console, and turn off any Exalytics enhancements4, in particular Socket Direct Protocol (SDP). Disabling SDP is a current best practice for Exalytics, and is not supported for PCA.

When Exalytics VMs are identical other than hostname and IP address, you can stop the VM and clone it for additional members of the application cluster. Boot each VM up in turn to change its hostname and address to make them unique.

When this is finished, the migration process is complete and testing of the new PCA/PCC environment can begin.

BEST PRACTICES FOR APPLICATIONS MIGRATED FROM EXALYTICS TO PCA

This section describes best practices for applications migrated from Exalytics. These recommendations also apply to applications migrated from other platforms, and completely new applications.

General

- Keep software levels up to date with current versions, to reduce security exposures and incorporate bug fixes. This is a general Best Practice, but sometimes omitted when moving an application to a new platform since there is often a goal to "change as little as possible". At the very least, current patch levels should be installed. For example, if Exalytics applications use Oracle Linux 6 virtual machines, update them to the most recent Oracle Linux 6 version if upgrading to a later release of Oracle Linux is not planned during migration.
- Use the Unbreakable Enterprise Kernel on Oracle Linux guests for best performance, and install the Oracle VM Guest Additions to improve operational flexibility. Guest Additions are described at https://docs.oracle.com/cd/E64076_01/E64083/html/vmadm-guestadd.html.
- Use PCA internal networks for inter-VM communication. This provides better performance and isolation. Use different VLANs for independent applications so they can operate without interference or the need to coordinate network design.
- Be aware of NUMA scenarios with BI applications. The best performance was seen when VM CPU and Memory were not extended past a single socket (48 cores in PCA X8). Up to a 15%, performance hit has been observed if more are used.
- Set HA attributes on key virtual machines. HA settings automatically bring the VMs up after an outage. Note that HA settings require that administrators stop virtual machines from Oracle VM Manager or Oracle Enterprise Manager rather than performing a VM shutdown from within the guest. That prevents a "false positive" in which Oracle VM considers a VM stop as an outage.
- Establish anti-affinity rules to ensure that virtual machines that comprise an application cluster are not on the same compute node. This prevents "Single Point of Failure" where a cluster member and its backup are on the same server and can be impacted by the same failure
- Consider oversubscribing virtual CPUs onto physical CPU resources if that is consistent with your service level requirements and the resource demands of your applications. This is very useful for increasing VM density on private clouds, but requires understanding application requirements and monitoring performance.
- If oversubscribing CPUs, use Oracle VM resource controls to ensure the most important virtual machines get sufficient CPU access.
- Provision sufficient physical capacity to support expected compute needs, and leave headroom to handle loss of capacity in case of outage or server maintenance.

Essbase

- The version of Essbase that ships with Exalytics (v11.1.2.4) is only certified for Oracle Linux 6. If later versions of Oracle Linux are planned, it is recommended to evaluate an upgrade to Essbase 20c when available.
- Essbase 20c will be the next on-prem version of Essbase that is released. Essbase 19c is only available in Oracle Cloud deployments.
- This is a good time to look at memory usage statistics in the existing Exalytics platform and resize accordingly if warranted.
- More information can be found in the Essbase 11.1.2.4 release notes, located here: https://docs.oracle.com/cd/E61380_01/index.htm

TimesTen

- It is not recommended that customers migrate binaries for TimesTen. Instead, customers are advised to perform a new install on the PCA and simply move over the database configuration files.
- If the TimesTen database is just being used as an aggregate store then you could simply rebuild the aggregate store from the source data after migration.
- If you want to avoid that step, or if the TimesTen database is being used as more than just an aggregate store, then you can move the database across using the TimesTen ttMigrate utility.
- The customer will currently be running a TimesTen 11.2.2.x.y release; as part of the migration, you should consider moving the customer up to the most recent TimesTen 11.2.2 patch set (11.2.2.8.48) or even perhaps the latest major release (18.1.3.2.0).
- This would also be a good time for the customer to evaluate using the Oracle DB In-Memory option as an alternative to TimesTen.

OBIEE and OAS

- OBIEE has been retired, and customers should actively plan to move from OBIEE to OAS.
- If you plan on using the Fresh install methodology outlined in this paper, the installation guides for OAS can be found here: https://docs.oracle.com/en/middleware/bi/analytics-server/install-config-oas/index.html
- If you plan on using the "Lift and Shift" methodology outlined in this paper, instructions on how to upgrade OBIEE 11g to OAS can be found here: https://docs.oracle.com/en/middleware/bi/analytics-server/migrate-upgrade-oas/upgrading-oracle-business-intelligence-11g-release.html
- For clarity in differentiating between the old OBIEE naming and the new OAS product please see this reference: https://docs.oracle.com/en/middleware/bi/analytics-server/known-issues-oas/index.html#OASKB-GUID-CA33C05D-34F1-40F2-8A4F-74C709770CC6

PERFORMANCE CONSIDERATIONS

Sizing PCA systems to replace Exalytics, or any system, depends on measuring the current system to understand its resources, and adjusting for changes in platform and expected growth. Regarding performance, Oracle has performed internal tests on an Essbase test suite that was originally developed to compare generational difference between Exalytics platforms. This test suite compared Exalytics X6-4 and its previous generations to PCA X8 and saw performance improvements of roughly 20%.

Figure 10 - Comparison of Benchmark Scores across Exalytics Generations vs PCA X8
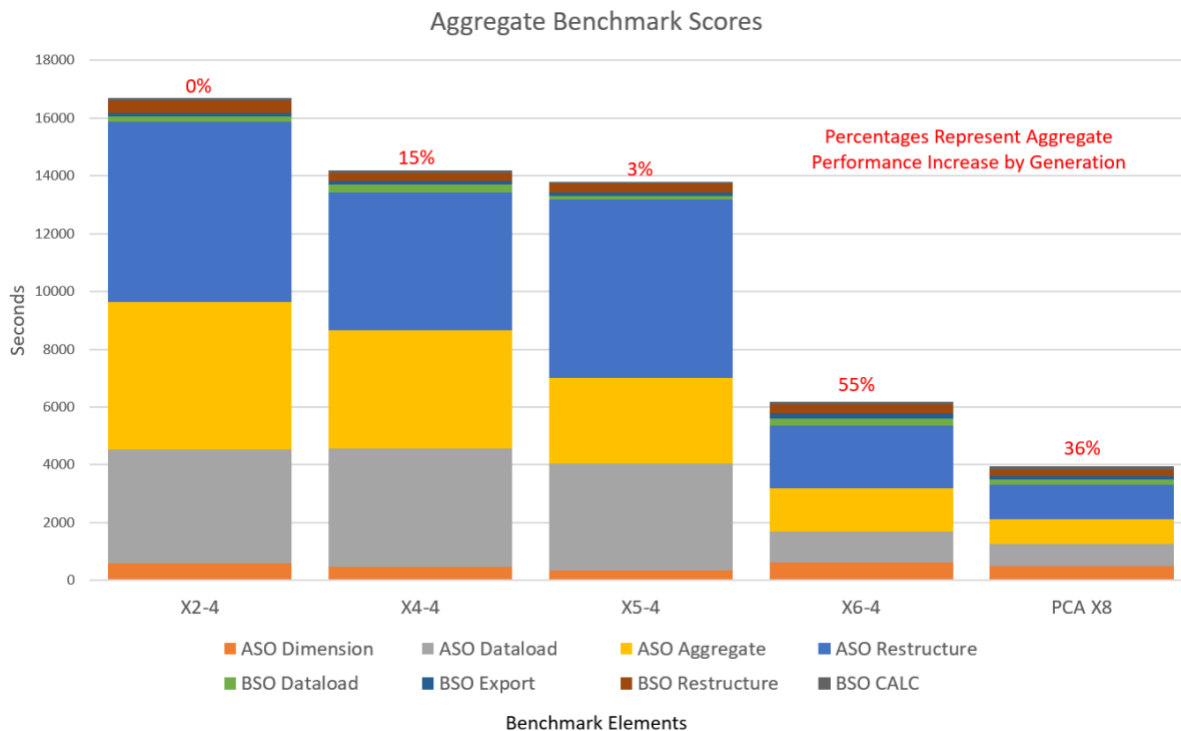
This degree of improvement seen in Figure 10 may not occur on all migrations, but indicates that PCA works very well as a replacement for Exalytics. In these tests, the engineers used the "Fresh Install" method described above. Many existing customers and Oracle Partners have already moved from Exalytics and commodity servers to PCA and have shown excellent results. It is generally observed that:

- The performance increase from Exalytics X6 to PCA X8 can be attributed to two factors: a) increased network bandwidth, and b) increased performance between Oracle X6 and X8 server generations.
- The 100Gb Ethernet networks on PCA provide substantially higher performance than InfiniBand for applications with high network traffic between members of an application cluster.
- Applications with high message traffic to external hosts also benefit from the faster external connectivity PCA has to datacenter networks. PCA network connections can be 100, 40, 25 or 10Gb Ethernet, and can use LACP for load balancing. If throughput between Exalytics and other hosts was the gating factor for performance, PCA provides the opportunity for

much higher throughput. This includes connectivity to database servers like Exadata. If doing so, consider adding additional high-speed network connections to move this traffic off the default_external network, which is fixed at 10GbE.

- For CPU-bound components of workload, factor in the relative CPU speeds of the current platform and PCA X8. PCA X8 has more and faster cores than predecessor systems like Exalytics, and the CPU component of application performance – the application payload – should be proportionally faster. Calculate the number of cores on PCA from the number of cores on the current system adjusted by their performance ratio, and factor in peak CPU utilization if it is available.
- In our testing, the faster CPU speeds in PCA X8 were one of the main reasons for the better benchmark results. Take advantage of this when sizing for CPU-intensive workloads.
- PCA compute nodes offer more memory than Exalytics – up to 1.5TB RAM per server. However, most Exalytics installations are not as memory intensive as some think. If consolidating several Exalytics to PCA X8, evaluate the actual memory usage of your Exalytics VMs. It might be possible to achieve a much greater VM density on PCA X8.
- In the workloads tested on the PCA X8, we had access to both disk and flash storage resources in the ZS7. Very little performance difference was seen between the use of disk and flash. This was attributed to the large amount of flash cache and memory in the ZS7 that ships in the PCA X8. However, as with any environment, sizing your storage is fundamental to reaching performance objectives. Additional disk or flash DEs can be added to the PCA X8's ZS7 as needed. The storage pool created with these DEs to support your production workloads should be properly sized for the capacity and performance requirements that are expected.
- There was a performance differential observed between the NVMe in Exalytics and the ZS Storage in PCA X8, as would be expected. However, the difference was not as great as expected, and in most cases was mitigated by the increased CPU performance of PCA X8.
- In general, Exalytics VMs migrated to PCA can use the same CPU and Memory parameters as they were defined on the Exalytics hardware as a starting point.

SIZING CONSIDERATIONS

For sizing assistance, customers should work with their Oracle Sales Consultant to characterize workload requirements and establish the correct PCA configuration. PCA will allow for a large degree of Exalytics consolidation, as indicated in the following table:

Figure 11 - Comparison of VM Limits in Exalytics X6-4 vs PCA X8

Feature	Exalytics X6-4 Limits	PCA X8 Limits
VMs per System	10	>2500
vCPUs per Single VM	28	96
RAM per VM	800GB	>1TB

It is recommended to use the Oracle Solution Center ("OSC") to test customer applications on actual Oracle facilities. Using actual customer data in this way will yield the most accurate representation of performance. At the OSC, Oracle customers can collaborate with Oracle specialists and a dynamic community of partners, independent Software Vendors (ISVs) and Systems Integrators. The OSC offers state-of-the-art systems, software, and expertise to support the customer's solution development requirements. Oracle experts work with customers to prototype their solution architectures and prove those solutions will work in realistic scenarios on real-world systems. This service is available for On-Premise, Cloud at Customer and Public Cloud platforms. For more information about the OSC, please visit https://www.oracle.com/OSC.

MIGRATION CONSIDERATIONS

The migration process outlined here might not reflect the complexity of a production Exalytics virtual environment. Oracle's Advanced Customer Services (ACS) offer a comprehensive migration service from Exalytics virtual environments to PCA and PCC ("Oracle Transition Service for Exalytics workloads to PCA/OPCC"). For these virtual Exalytics environment migrations, ACS offers the following service features:

- Exalytics to Private Cloud Appliance or Oracle Private Cloud at Customer with OVM (virtual)
  - Applications: Using OVM Manager—exporting virtual machine (OVM) and importing into Private Cloud Appliance or Oracle Private Cloud at Customer
  - Databases: Oracle Database Data Pump
  - Additional applications: Re-install options on Private Cloud Appliance or Oracle Private Cloud at Customer
- Discover the Exalytics workload and distribute to Private Cloud Appliance or Oracle Private Cloud at Customer installation.
- Use Oracle VM Manager and/or Oracle Enterprise Manager (OEM) to discover the workloads.

ACS services are designed to give Oracle customers access to expert transition planning, an optimal transition with as little downtime as possible, and a safe transition through resilience features and testing.

To find out more about this service and other complimentary ACS services, please visit https://www.oracle.com/support/advanced-customer-services/.

CONCLUSION

The Oracle Private Cloud Appliance is the ideal platform to host applications, which formerly ran on Exalytics and commodity servers. This paper describes the advantages of PCA and techniques to migrate applications from earlier platforms to PCA.

ABOUT THE AUTHORS

This paper was produced by the Engineered Solutions team, part of Oracle's System Product Management organization.

CONNECT WITH US

Call +1.800.ORACLE1 or visit oracle.com.
Outside North America, find your local office at oracle.com/contact.

🅱 blogs.oracle.com   f facebook.com/oracle   🐦 twitter.com/oracle

Migrating Exalytics and Oracle Analytics Server Workloads to Oracle PCA / PCC
June 2020