

Hybrid Cloud Management from within the Oracle Cloud

Oracle Enterprise Manager 13c within Oracle Cloud Infrastructure
managing Oracle Private Cloud Appliance

WHITE PAPER / JULY 15, 2019

PURPOSE STATEMENT

This document provides an approach for hybrid cloud management of infrastructure within and outside the Oracle Cloud. The management engine is Oracle Enterprise Manager 13c running within Oracle Cloud Infrastructure using Terraform to rapidly provision the management engine.

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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.

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INTRODUCTION

Oracle Enterprise Manager 13c is the recommended management framework for managing Oracle Infrastructure Software and Oracle Engineered Systems. Oracle Enterprise Manager is a complete, integrated and business-driven enterprise cloud management solution.

Oracle Cloud Infrastructure is a set of complementary cloud services that enable us to build and run a wide range of applications and services in a highly available hosted environment. Oracle Cloud Infrastructure offers high-performance compute capabilities and storage capacity in a flexible overlay virtual network that is securely available from an on-premises network.

Oracle Cloud Marketplace is an online store for Oracle and partner-built business applications and services, which exists within Oracle Cloud Infrastructure. Applications and services available on Oracle Cloud Marketplace are effectively packaged or turnkey services.

Oracle Private Cloud Appliance (PCA) is an Oracle Engineered System designed for virtualization. Compute resources, network hardware, storage providers, operating systems and applications are engineered to work together but managed and operated as a single unit.

Terraform is open-source software that allows users to define complex data centre infrastructure in a high-level configuration language used within a supported public cloud using API's.

This paper will discuss the following approach to provide Hybrid Cloud Management of the Oracle Private Cloud Appliance from an Oracle Enterprise Manager 13c instance running within Oracle Cloud Infrastructure:

- Use Terraform to create the supporting entities of Oracle Cloud Infrastructure such as Dynamic Groups, Policy, Virtual Cloud Networks, Subnets, Security Lists, Virtual Private Networks and the Oracle Enterprise Manager 13c instance using Oracle Cloud Marketplace

BUILDING THE ORACLE ENTERPRISE MANAGER 13C INSTANCE USING INFRASTRUCTURE AS CODE WITH TERRAFORM

Infrastructure as code is the process of provisioning and managing infrastructure using declarative files. Terraform is a widely used open-source tool for Infrastructure as Code, which we recommend for use within Oracle Cloud Infrastructure. Terraform uses the concept of providers and has an integration for Oracle Cloud Infrastructure where users do not have to install any additional code for operation. Install Terraform on your local workstation or laptop; Terraform runs on all major operating environments. For Oracle Linux the Terraform binary is within the `ol7_developer` channel on public yum or `ol7_x86_64_developer` on the Oracle Unbreakable Linux Network (ULN). For Oracle Linux, Terraform install and update is easy using yum.

For each project, we recommend creating a directory on our local workstation or laptop and within that directory create Terraform configuration files. You can use a single file; however, it is easier to segment the configuration files into meaningful build steps such as `create_virtual_cloud_network.tf`. You can number these files again for ease of reference; however, Terraform does not look at the numbers but knows which steps to run when.

Firstly, Terraform is initialized using the `terraform init` command, which we run on an initial installation, or following an upgrade. The `terraform plan` command looks at our configuration and variable files and checks they are valid. The output of the plan command details the steps that will run and any errors, which need fixing. The `terraform apply` command asks for approval to run (this can be overridden using the `-auto-approve` switch) then executes the steps to build the required infrastructure modelled as code. Terraform captures state and provides the `destroy` command which will tear down what it has created. This is a very useful feature along with the ability to recreate a build if a user changes the build configuration via the UI.

Terraform uses a variables file (usually `terraform.tfvars`) where key variables are stored and then referenced from individual or a single terraform script(s). Examples of key variables are:

- Tenancy and User id's
- Fingerprint and private key locations
- Compartment and region information
- Availability domain and instance image id's
- Bootstrap and ssh key locations

Local directories within the main structure are useful to store access keys, bootstrap and supporting script files, referenced in the main terraform files.

As an example to create the Oracle Enterprise Manager 13c instance three terraform (*.tf) files could be used:

01_auth.tf

This file loads from the variables file all the information required for access and location of key location data. This also sets the provider to be Oracle Cloud Infrastructure.

02_vcn.tf

This file sets the Availability domain and creates all the networking and security components required to support the Oracle Enterprise Manager 13c instance.

03_instance_em13.tf

This file chooses the shape of the instance and effectively attaches the instance to networking and security settings defined in `02_vcn.tf`. Lastly, displays access details for us to connect to the instance displaying IP address and private ssh key information.

Enabling Hybrid Cloud Networking

Oracle Cloud Infrastructure provides a Dynamic Routing Gateway (DRG), which connects networks outside Oracle Cloud Infrastructure Virtual Cloud Networks (VCN). The main choices for DRG's are IPsec VPN and Oracle Cloud Infrastructure FastConnect. The main difference between the two main choices are that IPsec VPN traverses via the internet where FastConnect requires a dedicated network link. Using IPsec VPN needs no additional cost, however performance may vary dependent upon global internet traffic. FastConnect has a variety of options with respect to connecting to Oracle Cloud Infrastructure from colocation or an oracle provider; further details are available from the Oracle Cloud Infrastructure documentation.

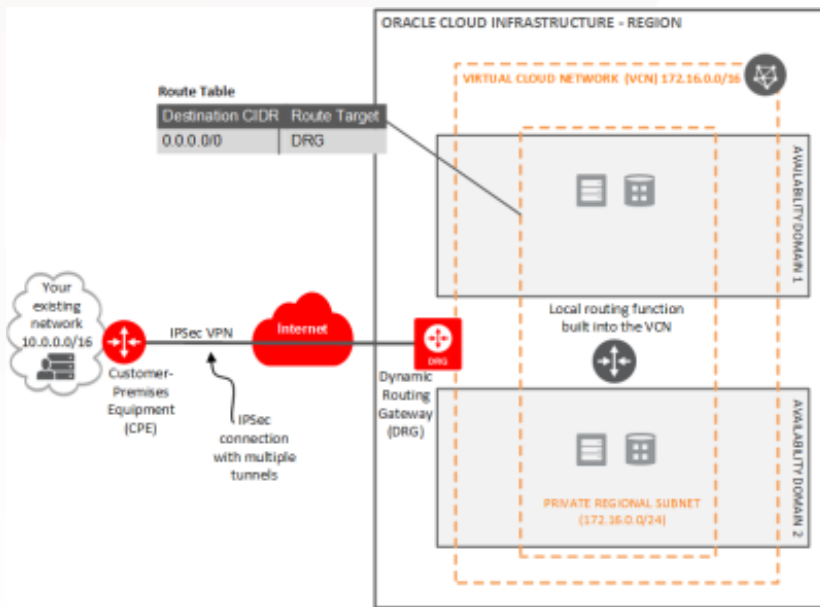
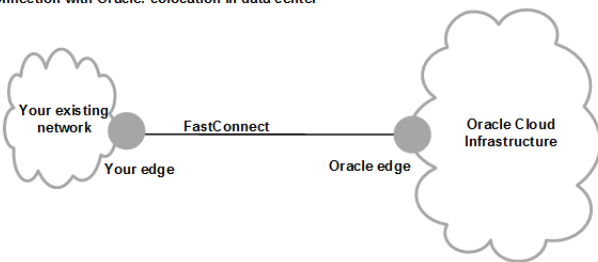


Figure 1. IPsec VPN overview

Connection with Oracle: colocation in data center



Connection with Oracle: through Oracle provider

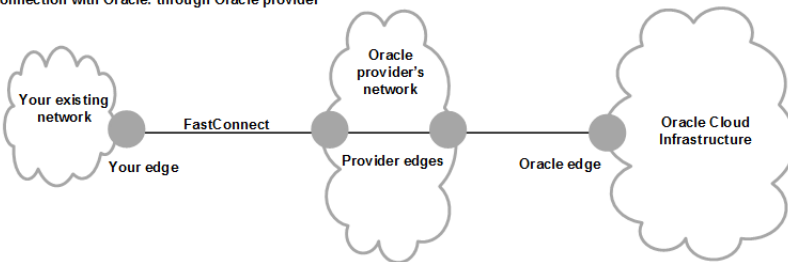


Figure 2. FastConnect options

In both cases, the end-result is network subnets in Oracle Cloud Infrastructure appear as an extension to your on-premises network. The Oracle Enterprise Manager 13c instance within Oracle Cloud Infrastructure is using a private on-premises IP address with no requirement for public internet IP addresses. From our private on-premises network, we can access the Oracle Enterprise Manager 13c instance and push agents from the instance to our targets within our private and Oracle Cloud Infrastructure routable subnets. For both choices, (IPSec VPN or FastConnect) local configuration is required (IPSec physical or virtual device or FastConnect router) as well as any firewalls. As expected, care is required to ensure subnets do not overlap.

Terraform is able to create and configure all the Oracle Cloud Infrastructure components (excluding any local configuration) including:

- Creating the DRG
- Creating the VCN
- Attach the DRG to the VCN
- In the case of IPSec VPN, create a Customer Premises Object (CPE, which is the public IP address of the IPSec device located on-premises)

Using the example Terraform files above, the DRG creation and configuration would be within the 02_vcn.tf file or separated into two network / security files.

For further information on how to start with Terraform and Oracle Linux refer to this Oracle Linux community [document](#).

ORACLE ENTERPRISE MANAGER 13C INITIAL CONFIGURATION

The install of the Oracle Enterprise Manager should take around one hour to complete. The version is currently at 13.3 based upon an Oracle Linux 7.6 instance with DB version 12.1.0.2 (with latest Critical Patch Update (CPU)) for the Oracle Enterprise Manager repository.

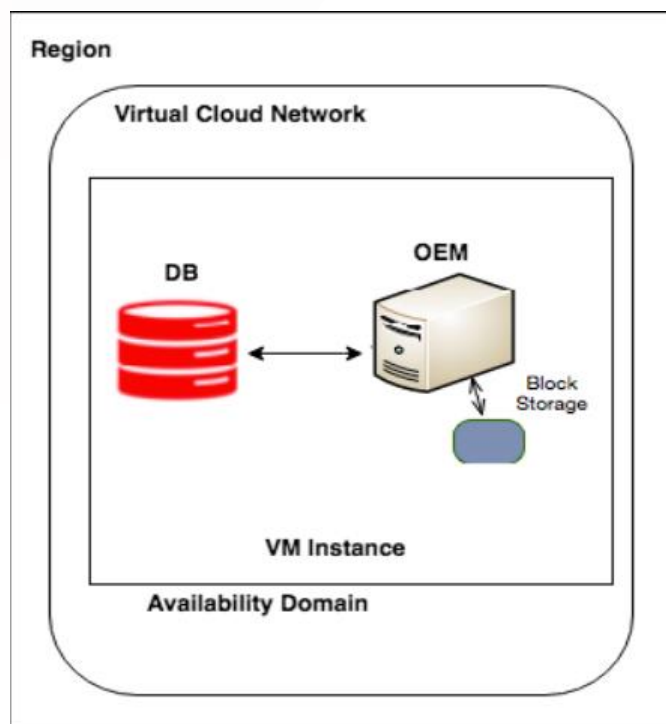


Figure 3. Oracle Enterprise Manager (OEM) Architecture

Once Terraform has finished the build and advised via the output from terraform apply, ssh into the VM instance using your private ssh key and IP address. The following steps are needed and contained within the marketplace [documentation](#):

- As the oracle user check the status of Oracle Enterprise Manager
- Review the set passwords for the key accounts and if needed change the sysman (super user) password
- Use the on-premises IP address to login into the UI console, ideally this IP address should be part of local hostname resolution

Oracle Cloud Infrastructure will show us the newly created Oracle Enterprise Manager instance as well as any other instances previously created. While terraform apply runs, it is possible to watch the build as it happens using the Oracle Cloud Infrastructure UI. The screenshot below shows an example terraform built (tf-XX) Oracle Enterprise Manager 13c and Oracle Linux 7 instance using the Oracle Cloud Infrastructure UI:

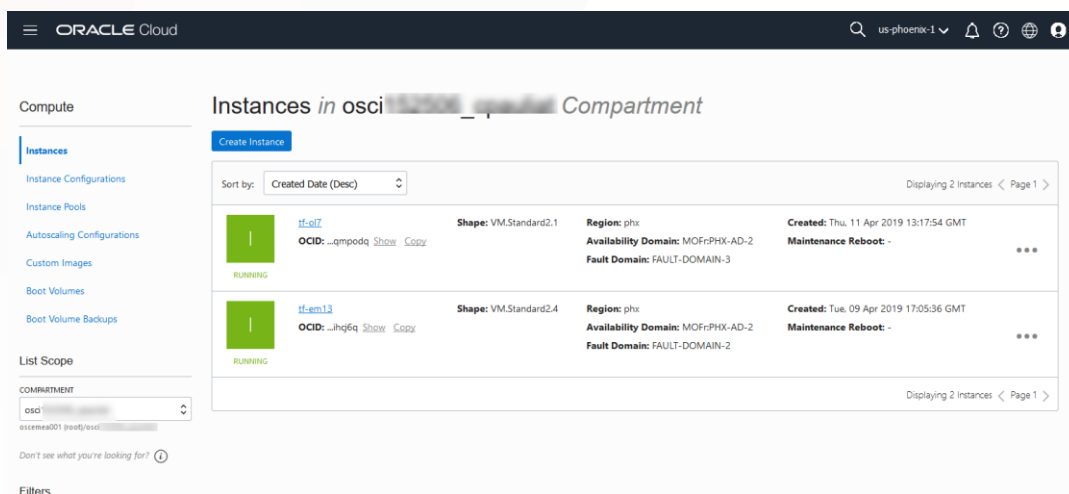


Figure 4. OL7 & Oracle Enterprise Manager instances

From the Oracle Cloud Infrastructure UI we can see useful information by clicking on an instance:

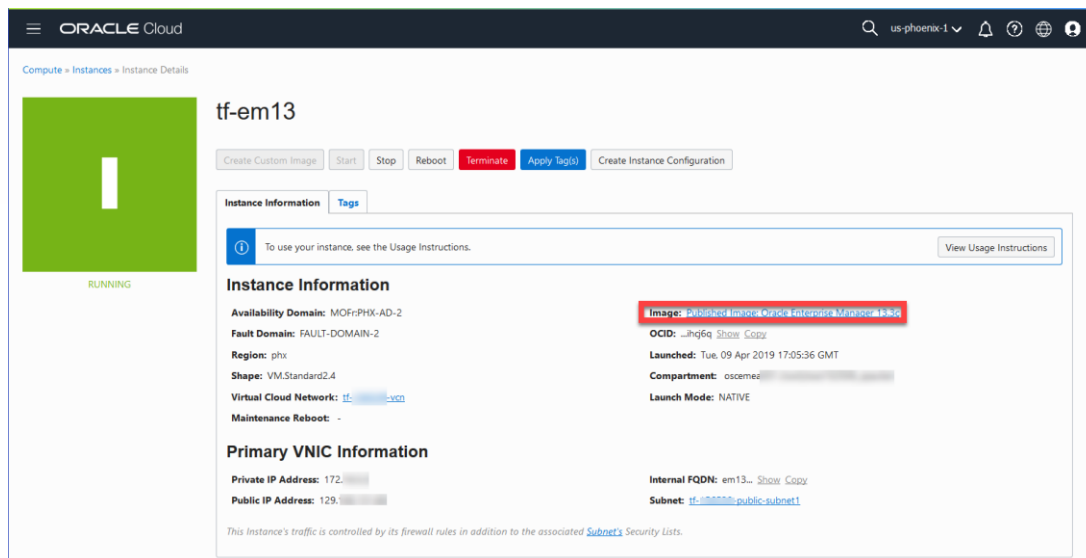


Figure 5. EM13 instance information, note the Image tag

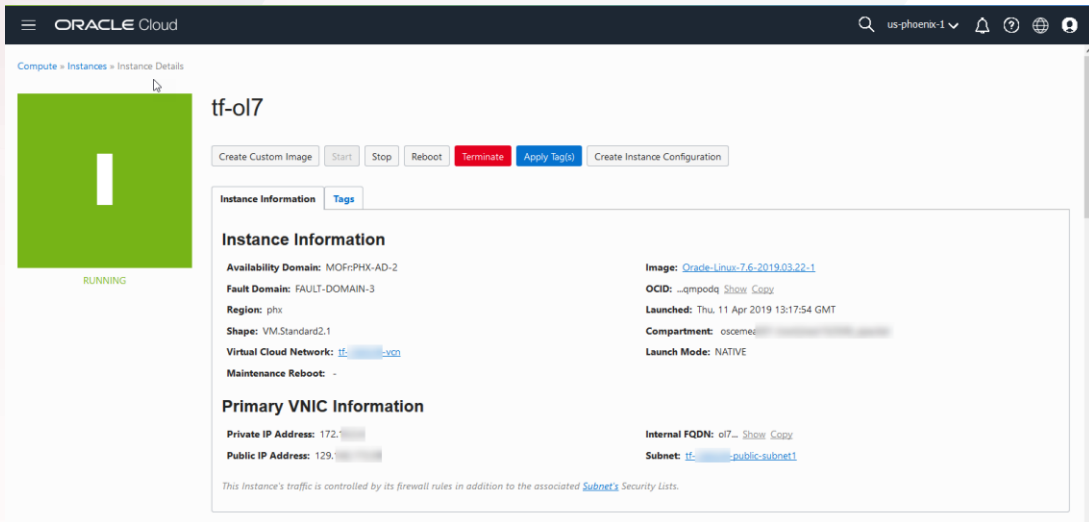


Figure 6. OL7 instance information

Scrolling down this instance page useful performance data is available:

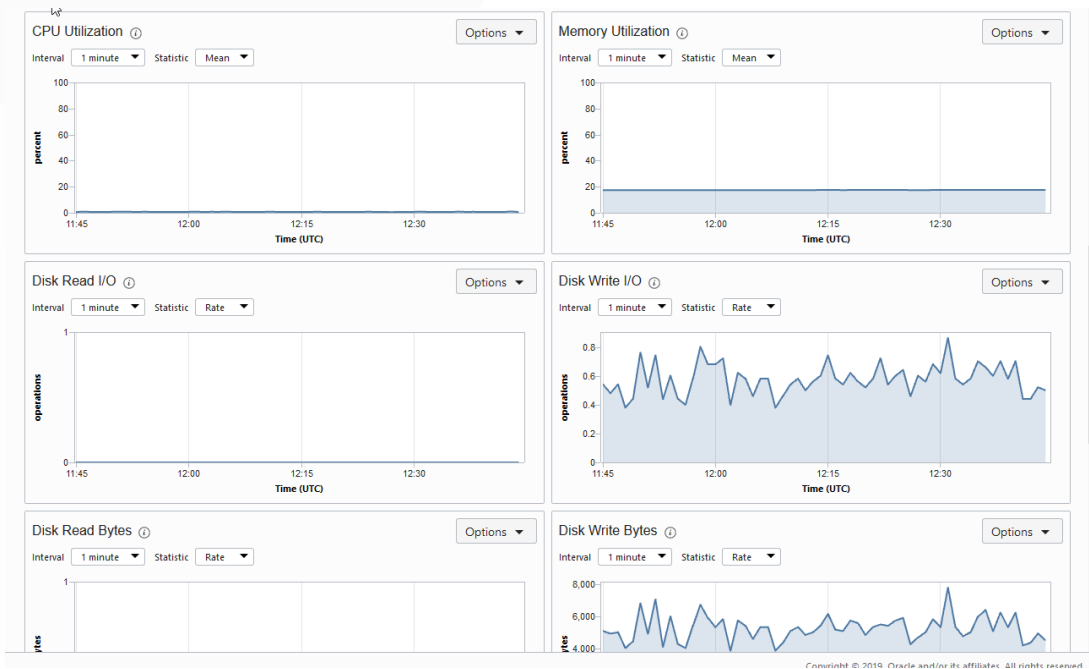


Figure 7. OL7 instance performance information

Similarly, using the Oracle Cloud Infrastructure UI we see information on the Virtual Cloud Network (VCN):

VCN
AVAILABLE

VCN Information | Tags

CIDR Block: 172.16.0.0/16
 Compartment: osci-...
 Created: Tue, Apr 9, 2019, 4:32:35 PM UTC
 OCID: ...ajtura [Show](#) [Copy](#)
 Default Route Table: [Default Route Table for tf-...-vcn](#)
 DNS Domain Name: vcn-...oraclevcn.com

Resources

- Subnets (1)
- Route Tables (2)
- Internet Gateways (1)
- Dynamic Routing Gateways (0)
- Security Lists (2)
- DHCP Options (1)

Subnets in osci-... Compartment

[Create Subnet](#)

| Name | State | CIDR Block | Subnet Access | Created |
|-----------------------|-----------|---------------|-----------------------|----------------------------------|
| tf-...-public-subnet1 | Available | 172.16.0.0/24 | Public (MOF:PHX-AD-2) | Tue, Apr 9, 2019, 4:32:46 PM UTC |

Showing 1 item(s) < Page 1 >

Figure 8. OL7 Virtual Cloud Network (VCN) information

By clicking on the links in the Subnets table and under Resources in the bottom left hand corner we are able to see the Subnet:

S
AVAILABLE

Subnet Information | Tags

OCID: ...u2hfea [Show](#) [Copy](#)
 CIDR Block: 172.16.0.0/24
 Virtual Router Mac Address: 00:00:17:EE:F8:E4
 Subnet Type: Availability Domain-Specific
 Availability Domain: MOF:PHX-AD-2
 DNS Domain Name: subnet1... [Show](#) [Copy](#)
 Subnet Access: Public Subnet
 DHCP Options: [Default DHCP Options for tf-...-vcn](#)
 Route Table: [tf-...-route-table](#)

Resources

- Security Lists (1)

Security Lists

[Add Security List](#)

| Name | State | Compartment | Created |
|-----------------------|-----------|-------------|----------------------------------|
| tf-...-subnet1-sec1st | Available | osci-... | Tue, Apr 9, 2019, 4:32:38 PM UTC |

Showing 1 item(s) < Page 1 >

Figure 9. VCN Subnet information

Also, clicking the Security Lists links:

The screenshot shows the Oracle Cloud console interface. At the top, there's a navigation bar with the Oracle Cloud logo and user information. Below that, a 'Security List Information' section displays the OCID and creation date. The main area is titled 'Ingress Rules' and contains a table with columns for Stateless, Source, IP Protocol, Source Port Range, Destination Port Range, Type and Code, and Allows. The table lists six rules, with the last one specifically for SSH traffic on port 22.

| Stateless | Source | IP Protocol | Source Port Range | Destination Port Range | Type and Code | Allows |
|-----------|---------------|---------------|-------------------|------------------------|---------------|---|
| No | 172.16.0.0/16 | All Protocols | | | | All traffic for all ports |
| No | 10.0.0.0/32 | All Protocols | | | | All traffic for all ports |
| No | 90.0.0.0/32 | All Protocols | | | | All traffic for all ports |
| No | 86.0.0.0/32 | All Protocols | | | | All traffic for all ports |
| No | 10.0.0.0/32 | All Protocols | | | | All traffic for all ports |
| No | 0.0.0.0/0 | TCP | All | 22 | | TCP traffic for ports: 22 SSH Remote Login Protocol |

Figure 10. Security List information

ORACLE ENTERPRISE MANAGER DISCOVERY AND MONITORING OF CLOUD RESOURCES

The Oracle Enterprise Manager instance provides monitoring of Cloud resources such as Oracle Database, Fusion Middleware, hosts and engineered systems. We enable monitoring by deploying an Oracle Enterprise Manager agent to the target cloud resource; all targets must be routable from the Oracle Enterprise Manager instance. As we have our Dynamic Routing Gateway in place and we have in effect extended on-premises subnets, we approach the deployment of Oracle Enterprise Manager agents in exactly the same manner as if the Oracle Enterprise Manager existed within the on-premises datacenter.

Discovering the Oracle Private Cloud Appliance (PCA)

Oracle Enterprise Manager 13c, introduced the Oracle PCA Plug-in which enables users to discover multiple Oracle PCAs and manage them from a single instance of Oracle Enterprise Manager 13c. The Oracle PCA Plug-in also provides photorealistic views of the rack and its components, to facilitate hardware level monitoring. Oracle Enterprise Manager also provides an Oracle Virtualization (VT) Plug-in which enables users to discover and manage multiple Oracle VM Manager instances. The VT Plug-in provides the ability to monitor all Oracle VM components such as Oracle VM guests, Oracle VM Servers (hypervisors), resource pools, storage and networking. The VT Plug-in also provides the foundation for infrastructure cloud services, providing secure multi-tenancy with self-service, elasticity and accountability.

Firstly, we need to create users to perform tasks to discover the Oracle PCA rack and embedded Oracle VM Manager, then configure private cloud. The super user (sysman) is used to create these new users and roles using Oracle Enterprise Manager's sophisticated and powerful Role Based Access Control framework. Oracle Enterprise Manager provides pre-designed roles which contain privileges designed around a series of tasks. An example is the EM_CLOUD_ADMINISTRATOR role whose users assigned to this role are able to discover the Oracle PCA and Oracle VM Manager as well as configure the infrastructure such as networks, storage and compute. The EM_SSA_ADMINISTRATOR role is for users that can view infrastructure but are focused on configuring private clouds for cloud users defining quota and publishing software components for cloud users to consume. Finally, the EM_SSA_USER role is for end users where from their cloud portal they see only their servers they create based upon quota assigned to them by the private cloud administrator (EM_SSA_ADMINISTRATOR role). From the portal they create and lifecycle manage servers created from Oracle Virtual Appliances or Templates. Cloud users (EM_SSA_USER role) are able to add and remove virtual storage as well as upload their own Oracle Virtual Appliances or Templates.

As a user with the EM_CLOUD_ADMINISTRATOR role, follow the procedure documented in the main [documentation](#) or follow the current [whitepaper](#) for Oracle Private Cloud Appliance (PCA) Management. The main steps for Oracle PCA discovery are as follows:

- Deploy the Oracle Enterprise Manager 13c agent on the Oracle PCA active management node
- Deploy the Oracle Enterprise Manager VT Plug-in on the Oracle Enterprise Manager 13c server and Oracle PCA active management node Enterprise Manager 13c agent
- Discover Oracle PCA
- Register Oracle PCA's Oracle VM Manager

Following the successful discovery of the Oracle PCA rack we see the Enterprise Summary page:

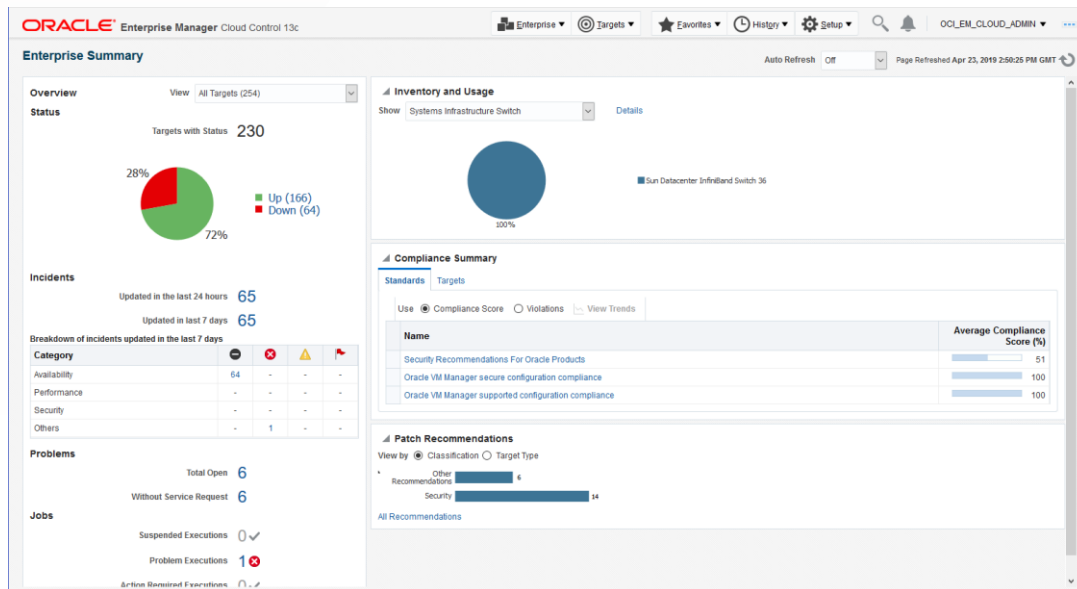


Figure 11. Cloud Administrator Enterprise Summary screen

Oracle Enterprise Manager 13c offers a schematic and photorealistic view of the Oracle PCA rack:

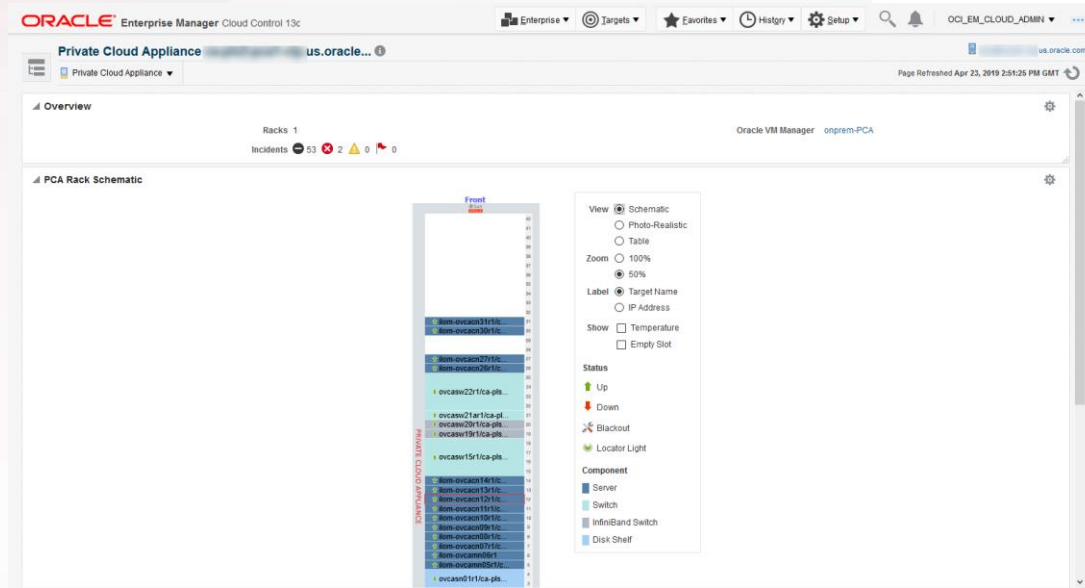


Figure 12. Oracle PCA rack schematic view

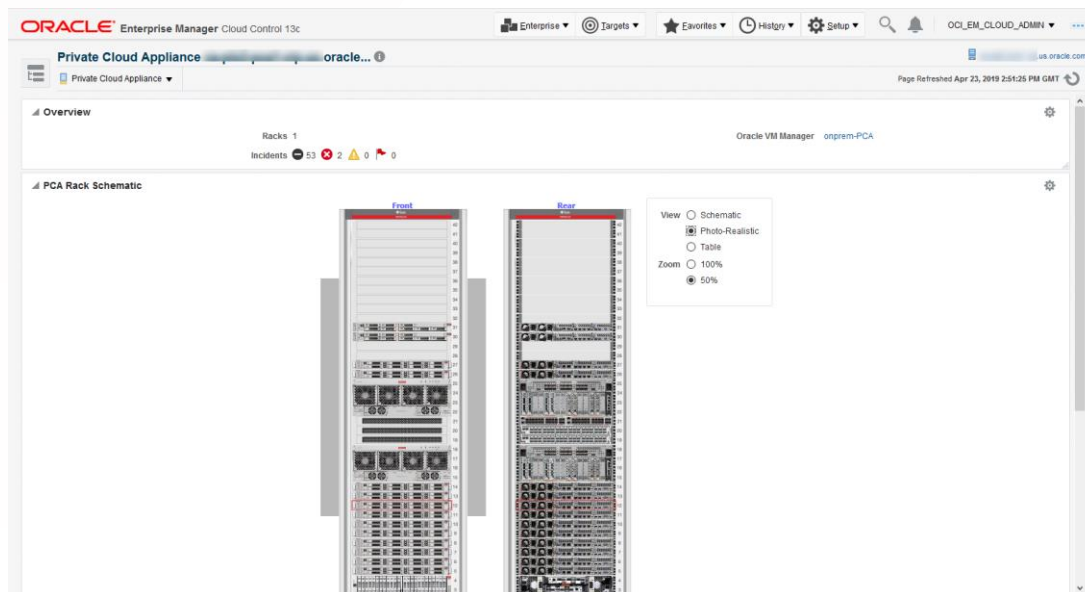


Figure 13. Oracle PCA rack photorealistic view

The association of external Oracle ZFS Storage is possible; this process involves a discovery of the external Oracle ZFS Storage using the Oracle Enterprise Manager Systems Infrastructure (SI) Plug-in and then associating the newly created SI targets within the Oracle PCA rack Target Navigation view:

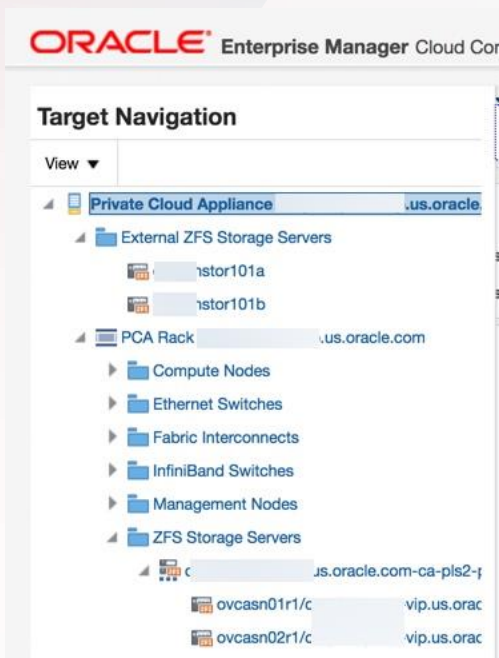


Figure 14. Oracle PCA Target Navigation with External ZFS Storage associated

By installing an Oracle Enterprise Manager agent on a host, we create a host target; this target could be within Oracle Cloud Infrastructure or on-premises.

| Name | Status | Pending Activation | Incidents | | | Compliance Violations | | | Average Compliance Score | CPU Util % | Mem Util % | Total IO/sec |
|----------------------|--------|--------------------|-----------|---------|-------|-----------------------|---------|-------|--------------------------|------------|------------|--------------|
| | | | Critical | Warning | Minor | Critical | Warning | Minor | | | | |
| us.oracle.com | ↑ | - | 0 | 0 | 0 | 0 | 0 | 0 | - | 3.32 | 7.12 | 5.35 |
| vip.us.oracle.com | ↑ | - | 0 | 0 | 0 | 0 | 0 | 0 | - | 19.03 | 9.36 | 79.56 |
| emcc.marketplace.com | ↑ | - | 0 | 1 | 0 | 17 | 0 | 0 | 51 | 4.83 | 15.68 | 19.83 |

CONCLUSION

The placing of the management engine within a cloud provides many benefits such as cost, scalability, resilience and scalability. Using Oracle Cloud Infrastructure and the Dynamic Routing Gateway, we provide extended subnets from cloud to on-premises to create a hybrid network using a single pane of glass for management of cloud services within the cloud and on-premises.

Further Reading / References

The following links are to Documentation Libraries that will provide useful background and technical reading: -

Oracle Cloud Infrastructure

<https://docs.cloud.oracle.com/iaas/Content/home.htm>

Oracle Private Cloud Appliance

<https://www.oracle.com/technetwork/server-storage/private-cloud-appliance/documentation/index.html>

Oracle Enterprise Manager 13c

<https://docs.oracle.com/cd/cloud-control-13.3/index.htm>

Terraform

<https://www.terraform.io/docs/index.html>

Oracle Cloud Marketplace

https://cloudmarketplace.oracle.com/marketplace/en_US/homePage.jsp

ORACLE CORPORATION

Worldwide Headquarters

500 Oracle Parkway, Redwood Shores, CA 94065 USA

Worldwide Inquiries

TELE + 1.650.506.7000 + 1.800.ORACLE1

FAX + 1.650.506.7200

oracle.com

CONNECT WITH US

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

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Integrated Cloud Applications & Platform Services

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White Paper **Hybrid Cloud Management from within the Oracle Cloud**

Oracle Enterprise Manager 13c within Oracle Cloud Infrastructure managing Oracle Private Cloud Appliance
July 2019

Authors: Simon Hayler & Christophe Pauliat (Oracle Solution Center)



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