Technical White Paper: **2021**

Tanzu Standard with VMware Cloud on Dell EMC

Solution Architecture

vmware®

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Executive summary

Tanzu Standard gives enterprises what they need to build a consistent Kubernetes infrastructure across multiple clouds, with governance and efficiency in place. It offers a full Kubernetes runtime distribution which can be deployed across on-premises, on public clouds and at the edge, and at the same time gives platform operators a global control plane, with which they can manage Tanzu clusters, as well as any other conformant Kubernetes clusters, consistently, securely, and efficiently at scale. This solution allows customers to quickly deploy and support modern applications in core data center, edge, and co-location contexts. Tanzu Standard provides the services that a production Kubernetes environment requires, including networking, authentication, ingress control and logging, to alleviate significant infrastructure management burdens. For customers who are already familiar with Kubernetes, or have micro services environments on-premises, deploying Tanzu Standard on VMware Cloud™ on Dell EMC lets you leverage a unified architecture and familiar tools. This means that you can use the same expertise acquired for VMware vSphere® for operational consistency, while also leveraging the same rich feature set and flexibility. By outsourcing the management of the SDDC to VMware you can simplify operation of TKG deployments.

Overview

You can deploy Tanzu Standard on VMware Cloud on Dell EMC to simplify operations of large-scale, multi-cluster Kubernetes environments, and keep your workloads properly isolated. The solution delivers the simplicity and agility of the public cloud and the security and control of on-premises infrastructure delivered as a service to data center and edge locations. It is built upon the latest VMware software-defined data center suite, including industry-leading compute, storage, and network virtualization, and optimized for Dell EMC VxRail hyperconverged infrastructure. It's quick and easy to procure and delivers a cloud-style consumption model for a range of use cases. VMware provides fully automated lifecycle management and monitors the health of the entire SDDC stack around the clock. The combined software, hardware, and services offering enables customers to focus technology resources on initiatives that differentiate the business instead of spending time on infrastructure management.

Document purpose

The purpose of this guide is to provide administrators and architects with a set of steps and best practices for deploying Tanzu Standard on VMware Cloud on Dell EMC. This guide is designed to be used in conjunction with Tanzu Standard documentation and VMware Cloud on Dell EMC documentation.

Audience

This white paper is intended for administrators who want to install Tanzu Kubernetes Grid and use it to create and manage Tanzu Kubernetes clusters and their associated resources. This information is also intended for application administrators and developers who want to use Tanzu Standard to deploy and manage modern applications in a Kubernetes architecture on VMware Cloud on Dell EMC. The information is written for users who have a basic understanding of Kubernetes and are familiar with container deployment concepts. In-depth knowledge of Kubernetes is not required.

Business use case

Evolving architectures require enhanced tooling and infrastructure. Digital transformation drives the need for speed as companies are under increasing pressure to innovate more quickly with much of the transformation being achieved in software. Application developers are evolving to achieve shorter development cycles, faster delivery times and more frequent deployments.

Consequently, application architectures are also evolving from monolithic to microservices, delivering flexible architectural choices, improved scale and availability, faster release cadence, and easier maintenance. Successfully deploying and managing those microservices depends on several fundamental requirements:

- Simplify Kubernetes for developers
- Ease Day 1 and Day 2 operations
- Consistent Kubernetes everywhere
- Automated multi-cluster operations

The Tanzu Standard on VMware Cloud on Dell EMC solution addresses the gap by simplifying the process and providing tooling and infrastructure to quickly deploy rapidly maturing distributed applications.

About VMware Cloud on Dell EMC

VMware Cloud on Dell EMC combines the simplicity and agility of the public cloud with the security and control of on-premises infrastructure delivered as a service to data center and edge locations. It is built upon on the latest VMware software-defined data center suite, including industry-leading compute, storage, and network virtualization that is optimized for Dell EMC VxRail hyperconverged infrastructure. It's quick and easy to procure and delivers a cloud-style consumption model for a range of use cases.

VMware provides fully automated lifecycle management from the cloud and monitors the health of the entire stack around the clock. The combined software, hardware, and services offering enables customers to focus technology resources on initiatives that differentiate the business, instead of spending time on infrastructure management. Many thousands of VMware customers depend on hybrid cloud infrastructure—spanning from private data centers and edge locations to public clouds. Only VMware can offer a consistent operational experience across all of these locations, accommodating the geographical demands driven by business or technical requirements.

In the public cloud, customers have embraced VMware Cloud on AWS—the SDDC-as-a-Service offering that is jointly engineered by VMware and Amazon Web Services (AWS). But many applications cannot be moved to the public cloud due to business policies or technical constraints, such as latency and bandwidth requirements. For customers that are interested in the combined benefits of a fully managed SDDC that still accommodates the demand for on-premises infrastructure, VMware Cloud on Dell EMC is the answer.

VMware Tanzu Standard

VMware Tanzu Standard provides a consistent, upstream-compatible implementation of Kubernetes that is tested, signed, and supported by VMware. Tanzu Standard offerings provision and manage the lifecycle of Tanzu Kubernetes clusters. A Tanzu Kubernetes cluster is an opinionated installation of Kubernetes open-source software that is built and supported by VMware. In this offering, you provision and use Tanzu Kubernetes clusters in a declarative manner that is familiar to Kubernetes operators and developers.

VMware Tanzu Kubernetes Grid

VMware Tanzu Kubernetes Grid, informally known as TKG, is a multi-cloud Kubernetes footprint that you can run both on-premises in vSphere, VMware Cloud on Dell EMC, VMware Cloud on AWS, Microsoft AVS and in the public cloud on Amazon EC2 and Microsoft Azure. In addition to Kubernetes binaries that are tested, signed, and supported by VMware, Tanzu Kubernetes Grid includes signed and supported versions of open-source applications to provide the registry, networking, monitoring, authentication, ingress control, and logging services that a production Kubernetes environment requires. If you are using Tanzu Kubernetes Grid, see the VMware Tanzu Kubernetes Grid Documentation.

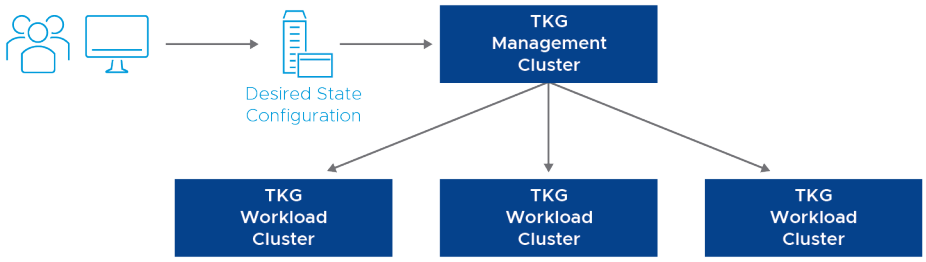

FIGURE 1: Tanzu Basic for VMware Cloud on Dell EMC architecture hosts and components

VMware Tanzu Mission Control

VMware Tanzu Mission Control, informally known as TMC, provides a hosted Tanzu Kubernetes Grid implementation as a managed service for public cloud environments. Tanzu Mission Control is available through VMware Cloud services. Tanzu Mission Control provides a centralized management platform to consistently operate and secure your Kubernetes infrastructure and modern applications across multiple teams and clouds. If you are using the Tanzu Kubernetes Grid service that Tanzu Mission Control provides, see the VMware Tanzu Mission Control Documentation.

Prerequisite

A variety of external services are required for the initial deployment of Tanzu Kubernetes Grid Cluster on VMware Cloud on Dell EMC.

The following table lists the required external services and dependencies for Tanzu Kubernetes Grid Cluster

Service	Purpose
Internet Service	Make sure that the Internet is available to download packages on your bootstrap image.
Domain Name Services (DNS)	Provides name resolution for the various components in the solution.
Dynamic Host Configuration Protocol (DHCP)	Provides automated IP address allocation for Tanzu Kubernetes Grid Cluster.
Network Time Protocol (NTP)	Synchronizes time between the various management components.

In the VMware Cloud on Dell EMC web portal console, please ensure the following:

- Network Uplink connectivity is configured with upstream network router/switch for external data center connectivity or if you want to connect your Tanzu Kubernetes Grid Cluster from outside of your VMware Cloud Dimension environment.
- Appropriate static routes are in place for both VMware Cloud on Dell EMC and Customer Data Center to ensure that you have connectivity to Kubernetes cluster.
- By default, there is no external access to the vCenter® Server system in your SDDC. You can open access to your vCenter Server system by configuring a firewall rule. Set the firewall rule in the compute gateway of VMware Cloud on Dell EMC to enable communication to the vCenter public IP address and TCP port 443 from the desired logical network of your SDDC.
- Configure DNS to allow Kubernetes cluster in your SDDC to resolve fully qualified domain names (FQDNs) to IP addresses belonging to the Internet.

Solution architecture

The following figure shows the deployment architecture options for the Tanzu Kubernetes Grid Basic on VMware Cloud on Dell EMC.

- In this design all the nodes are configured as a single vSphere cluster in the vCenter.
- In this deployment architecture, all SDDC management components, such as VMware vCenter, NSX® Manager and NSX Edge, are placed under Management Resource Pool. This is fully automated as part of VMware Cloud Dell EMC offering.
- All Kubernetes management components, such as API Server, Controller Manager, Schedular and etcd are placed under Compute Resource Pool along with Kubernetes Worker.

Design

A customer can start with a minimum configuration of VMware Cloud on Dell EMC and then scale their Kubernetes environment as needed according to the following architecture and design guidelines. The minimum configuration for Tanzu Kubernetes Grid with VMC on Dell EMC is currently 4 nodes.

Note: Even though you have configured three node cluster, VMC on Dell EMC reserves a 4th node as dark node to supplement if there is any failure in the cluster to provide resiliency and high availability to the cluster.

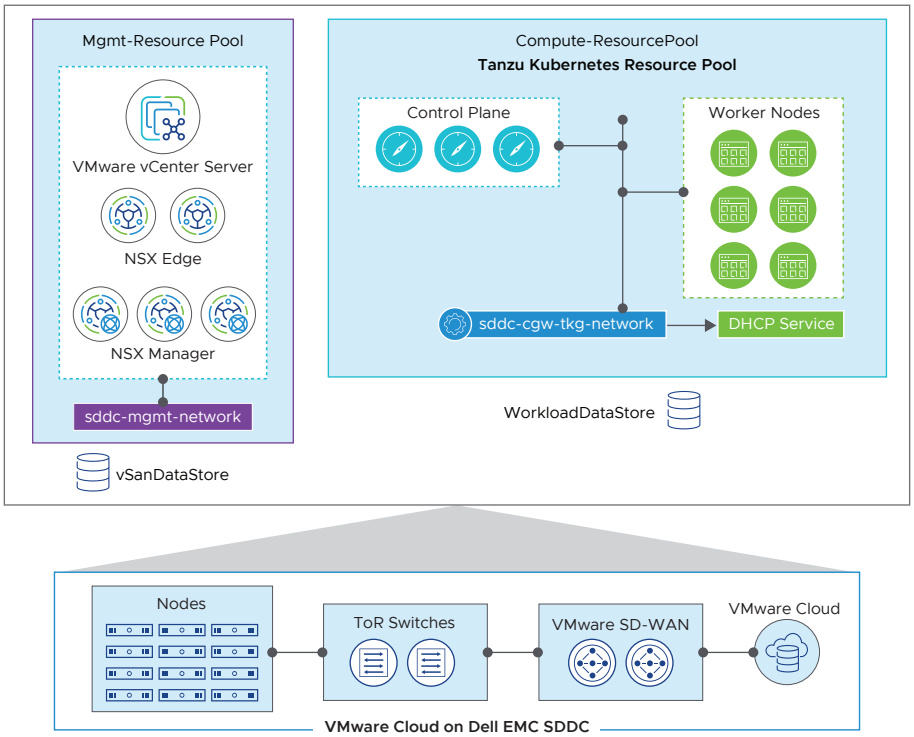

Figure 2: Tanzu Kubernetes with VMware Cloud on Dell EMC

- In this design, we have shown one vSphere Cluster with two Resource Pool (Management and Compute) part of VMware Cloud Dell EMC SDDC deployment.
- Management Resource Pool consists of vCenter Server, NSX-T Manager and NSX Edge, and it is fully managed by VMware. All of the management components are placed on a management vSAN datastore, called vsanDatastore in VMware Cloud on DellEMC.
- Compute Resource Pool is dedicated for Kubernetes Cluster components and cloud native workloads. This is managed by the customer.
- Kubernetes cluster components are connected with a network under Compute Gateway and this network provides DHCP service to the Kubernetes cluster.
- Kubernetes nodes are placed on WorkloadDatastore on VMware Cloud Dell EMC SDDC.

Note: In this design we have used Ubuntu v20.04 Kubernetes v1.20.5 OVA as the base Image template for Kubernetes nodes. Photon base image is not supported on VMware Cloud on Dell EMC in this release.

Solution components

This section describes major components for this solution architecture.

Software-defined data centers-as-a-service

Based on industry-leading virtualization software technology from VMware and proven hyperconverged hardware from Dell EMC, VMware Cloud on Dell EMC is a complete solution for data center infrastructure. The software components include VMware vSphere compute, VMware vSAN™ all-flash storage, and VMware NSX-T networking and security. Dell EMC foundational elements include VxRail hyperconverged infrastructure appliances and high-performance top of rack network switches.

All services delivery hardware is factory integrated inside a standard data center rack enclosure that can be positioned right alongside other racks in your data center, remote office and edge compute locations. Customers are given the choice of using 110 or 220-volt power circuits. See the following table for specific rack details:

Rack Specifications	Rack R2 (42U)
Number of VxRail E560F Nodes	Single-phase power: Min. 3 – Max 12 Three-phase power: Min. 3 – Max. 26
Spare / Standby Hosts per rack	1
Power Requirements	4 x 30 amp single-phase 2 x 60 amp three-phase
Power Source Location	Floor or Ceiling
Top of Rack Switches	2 x 25GbE
Secure Management	

For details on current service infrastructure hardware specifications, see the VMware Cloud on Dell EMC Datasheet.

Management component

The management component for the SDDC and Tanzu Kubernetes Grid includes VMware vCenter® Server.

Note: For common services, such as DNS, customers can bring their own or they can deploy a new set of DNS services in VMware Cloud on Dell EMC SDDC infrastructure under Compute Resource Pool. For the validation of this deployment architecture, we have kept DNS outside of this environment.

Compute components

The compute component includes the Kubernetes Control Plane nodes and Worker nodes.

Please note that, as we are deploying both Kubernetes Control plane nodes and worker nodes on the same vSphere cluster under Compute Resource Pool, we have called out all Kubernetes cluster components as Compute Component on VMware Cloud Dell EMC.

Note: While VMware Cloud on Dell EMC is fully managed by VMware, the Tanzu Kubernetes Grid Cluster infrastructure component are customer managed.

NSX-T components

VMware NSX-T is the network virtualization platform for the VMware Cloud on Dell EMC Software-Defined Data Center, delivering networking and security entirely in software, abstracted from the underlying physical infrastructure.

- Tier-0 router: Handles Internet, route or policy-based IPSEC VPN, and serves as an edge firewall for the Tier-1 Compute Gateway (CGW).
- Tier-1 Compute Gateway (CGW): Serves as a distributed firewall for all customer internal networks.
- The Tier-1 Management Gateway (MGW): Serves as a firewall for the VMware maintained components, including vCenter and NSX.

Resource pool

A resource pool is a logical abstraction for flexible management of resources. Resource pools can be grouped into hierarchies and used to hierarchically partition available CPU and memory resources.

After an SDDC instance on VMware Cloud on Dell EMC is created, two resource pools exist:

- A Management Resource Pool with reservations that contain vCenter Server plus NSX, which is managed by VMware
- A Compute Resource Pool within which everything is managed by the customer

When deploying both management and user resources in the same SDDC, it is recommended that two sub-resource pools are created within the Compute Resource Pool for your Tanzu Kubernetes Grid deployments:

- A Tanzu Kubernetes Grid Resource Pool for your Kubernetes cluster components, such as control plane node and worker nodes.

Note: If you are using NSX advanced load balancer for Kubernetes cluster then you can place It In the same resource pool.

Network configuration

When SDDCs are deployed on VMware Cloud on Dell EMC, NSX-T is used for network configuration. After you deploy an SDDC instance, two isolated networks exist: a management network and a compute network. Each has its own NSX Edge Gateway and NSX Distributed Logical Router for extra networks in the compute section.

Note: Because the Tanzu Kubernetes Grid components must communicate with the vCenter Server, traffic must be allowed on the MGW Edge Firewall. See Appendix section for more detail.

Virtual network segment

The following networks must be configured in VMware Cloud on Dell EMC web portal console in Network Segment section when preparing for Tanzu Kubernetes Grid deployment on VMware Cloud on Dell EMC.

• Tanzu Kubernetes Grid network (sddc-cgw-tkg-network)

VMware Tanzu Standard Edition

VMware Tanzu Standard simplifies operation of Kubernetes for multi-cloud deployment, centralizing management and governance for many clusters and teams across on-premises, public clouds, and edge. It delivers an open source-aligned Kubernetes distribution with consistent operations and management to support your infrastructure and app modernization.

For more details, refer to VMware Tanzu documentation

Technical specification

Hardware

The table below shows the technical specification of this solution validation. However please refer the full list of supported hardware specification at VMware Cloud on Dell EMC Datasheet.

Solution specification	Quantity
VxRail E560N (Node Type M1d .medium) Intel(R) Xeon(R) Platinum 8260 CPU @ 2 .39GHz, 24 Core, 2 Socket per/core 768 GB RAM 3 .49 TB NVMe Flash Disk (Capacity) x 6 1 .46 TB NVMe Flash Disk (Cache) x 2 Disks per vSAN Disk Group – 4 Disk Groups per host – 2	11
Dell EMC Power Switch – s5248	2
VMware SD-WAN 620s	2

Software

The table below shows the software version that was tested.

Components	Version
VMware vSphere	7.0.1
VMware vCenter	7.0.1
VMware NSX	3.0.2
Tanzu Kubernetes Grid	1.3.1

Conclusion

Tanzu Standard with VMware Cloud on Dell EMC eliminates the costly and cumbersome process of refreshing, managing, and maintaining the infrastructure that supports modern application deployments.

When deploying Tanzu Kubernetes Grid on VMware Cloud on Dell EMC you gain the ability to scale microservices and modern applications with the simplicity and agility of the public cloud and the security and control of on-premises infrastructure delivered as a service to data center and edge locations.

Built upon on the latest VMware software-defined data center suite, including industry-leading compute, storage, and network virtualization that is optimized for Dell EMC VxRail hyperconverged infrastructure, VMware TKG on VMware Cloud on Dell EMC is quick and easy to procure and delivers a cloud-style consumption model for a range of use cases.

Because VMware provides fully automated lifecycle management and monitors the health of the SDDC stack around the clock, you can take advantage of a combination of software, hardware, and services to focus technology resources on initiatives that differentiate the business, instead of spending time on infrastructure management.

Additional resources/references

- VMC on Dell EMC: https://www.vmware.com/products/vmc-on-dell-emc.html
- Tanzu: https://tanzu.vmware.com/tanzu

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Acknowledgements

The author would like to thank Neeraj Patalay, Matt Herreras for their input, review and feedback and Shruthin Reddy for the outstanding effort validating this design.

Appendix

This section provides the steps necessary to configure Tanzu Kubernetes Grid on VMware Cloud on Dell EMC. Refer to VMware Tanzu Kubernetes Grid document on how to Deploy Management Cluster to vSphere.

By default, there is no external access to the vCenter Server system in your SDDC (Software Defined Data Center). You can open access to your vCenter Server system by configuring a firewall rule. Set the firewall rule in the compute gateway of VMware Cloud on Dell EMC to enable communication to the vCenter public IP address and tcp port 443 from the desired logical network of your SDDC.

Configure DNS to allow machines in your SDDC to resolve fully-qualified domain names (FQDNs) to IP addresses belonging to the customers.

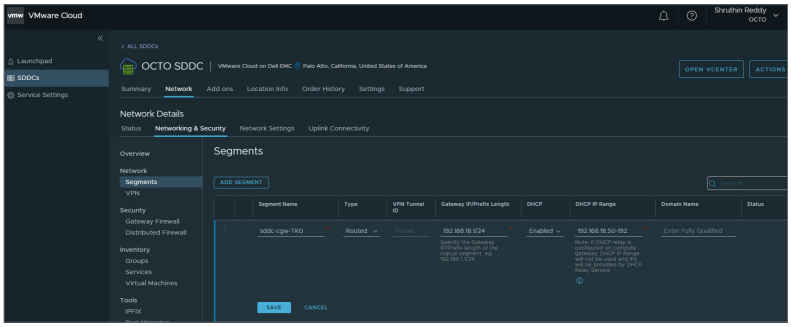
Configure firewall to allow traffic between your local bootstrap machine and port 6443 of all VMs in the clusters you create. Port 6443 is where the Kubernetes API is exposed.

Create a Network Segment for TKG

We must create a Network Segment for TKG if you don't have a segment.

Note: This is an optional step. You can utilize an existing Network Segment or create a new segment for TKG

1. Click on Network
2. Click on Network & Security
3. Click on Segments → ADD SEGMENT
4. Enter Details Segment Name, Type, Gateway IP, DHCP Range and click SAVE

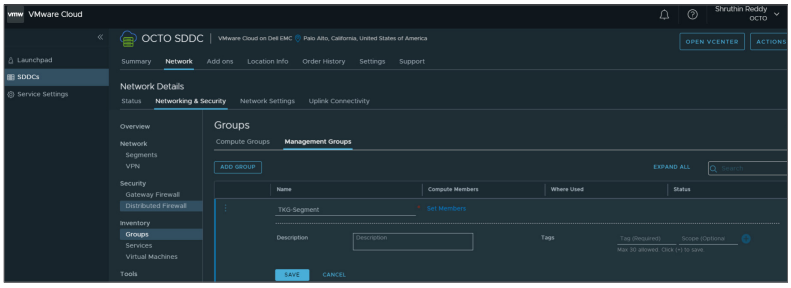


Add Management group

This section talks about adding a new management group. We will add the TKG subnet IP range to the group and create firewall rule for this group to access vCenter, this setting is necessary as it opens the communication for the group members with vCenter.

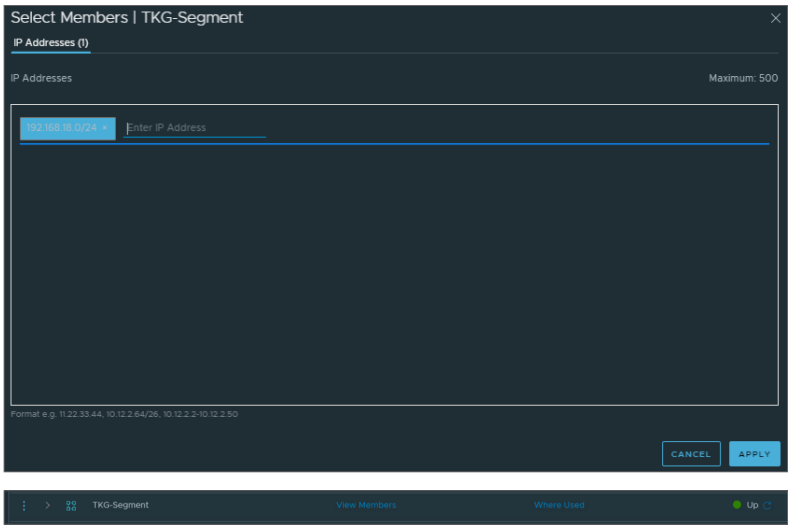
Follow the steps below to create a Security Group

1. Click on Network
2. Click on Network & Security
3. Click on Groups under Inventory Tab
4. Click on Management Groups → ADD GROUP
5. Type Group Name TKG-Segment
6. Click on Set Members



Let's add the IP range of TKG-Segment subnet.

1. Type 192.168.18.0/24 in the IP addresses Tab
2. Click on Apply → Save

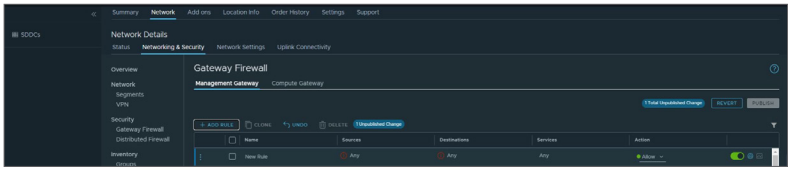


Set Firewall Rules

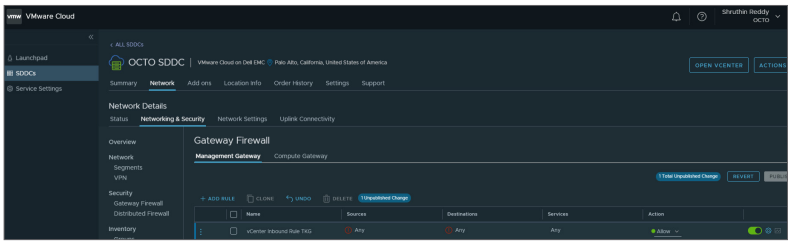
Management Gateway

We must create firewall rules so that we can communicate with management resources, in this case vCenter. This firewall rule will allow inbound traffic to vCenter from the compute resource group. In this case we are enabling this rule so that "sddc-cgw-tkg" segment IP's can send traffic to vCenter. Below are the steps to create the rule.

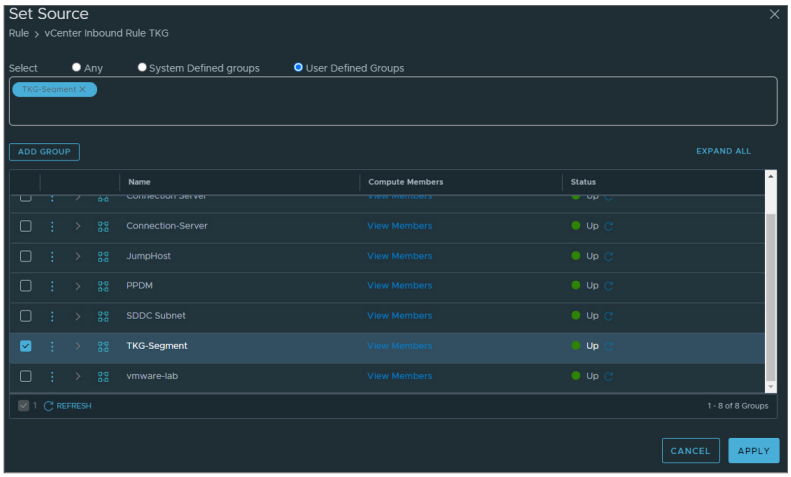
1. Click on Network
2. Click on Network & Security
3. Click on Gateway Firewall
4. Click on Management Gateway
5. Click on ADD NEW RULE



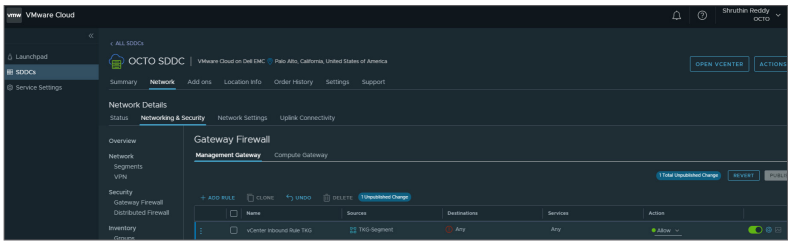
6. Type vCenter Inbound Rule TKG under Name
7. Click on Set Source



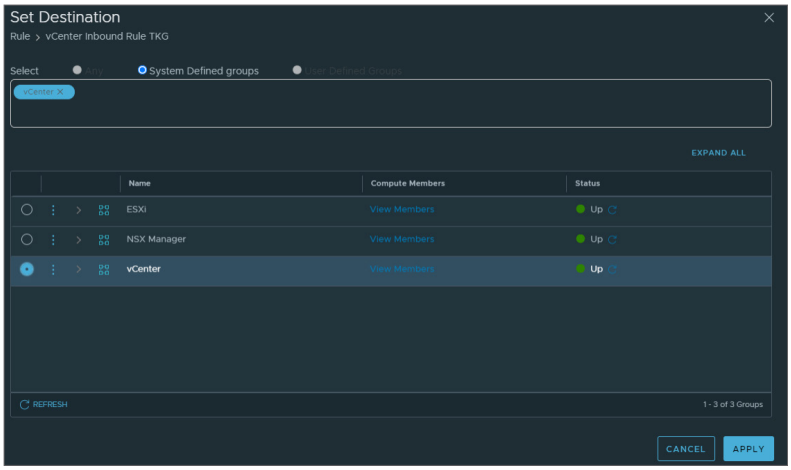
8. Click on user Defined groups and Select TKG-Segment as source (Depending on customer requirement you can choose the specific source IP/ addresses, if any)
9. Click on Apply



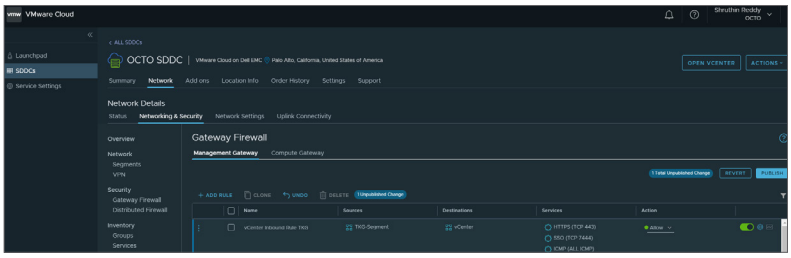
10. Click on Set Destination



11. Select vCenter
12. Click on Apply



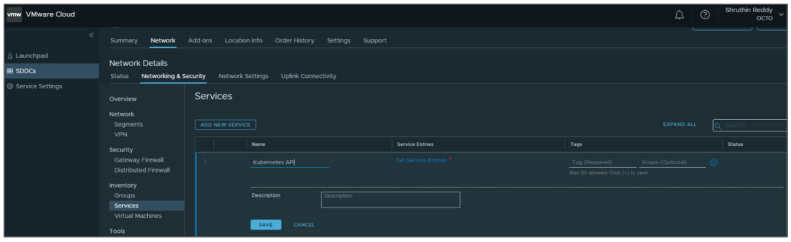
13. Click in Services
    - Click on HTTPS
    - Click on SSO
    - Click on ICMP
14. Click on PUBLISH



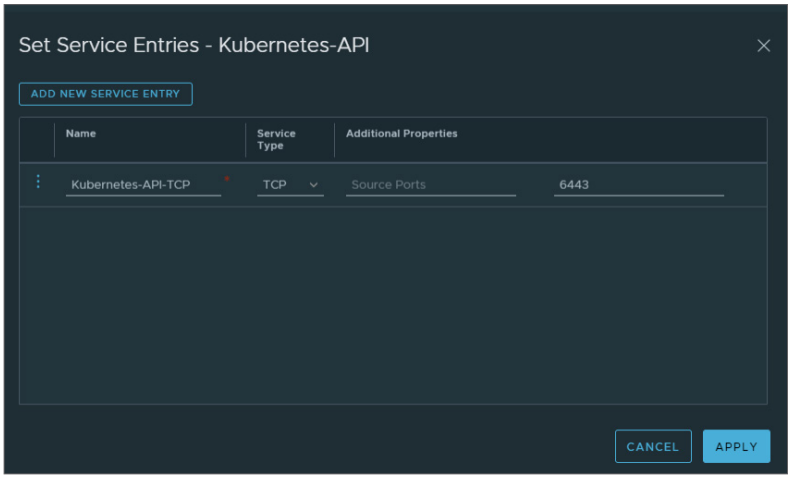
Compute Gateway

Create a Service for Kubernetes API to allow traffic between your local bootstrap machine and port 6443 of all VMs in the clusters you create. Port 6443 is where the Kubernetes API is exposed

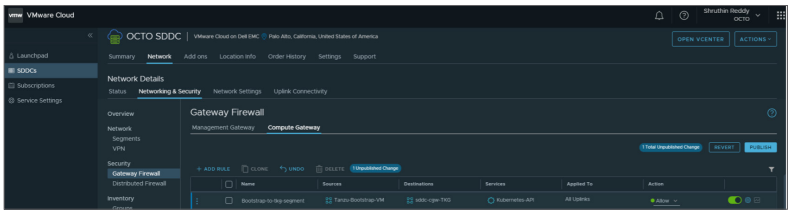
1. Click on Network
2. Click on Network & Security
3. Click On Services → Add New Service



4. Click on Set Service Entries → Add New service Entry
5. Add Name, Service type as TCP and Destination port number- 6443
6. Click Save to create the service



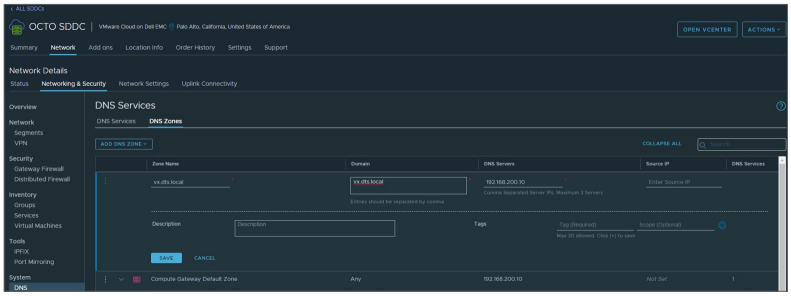
7. Create a Compute Gateway Firewall Rule to allow bootstrap machine to communicate with the service we just created
   - Create a group for Tanzu-Bootstrap machine. This contains the IP address of bootstrap machine (Refer to ADD management group section to create the Tanzu-Bootstrap VM group)
   - Create a sddc-cgw-tkg group and add the segment IP address
   - Now create a Rule to allow traffic between bootstrap VM port 6443 to tkg segment and Publish



Note: Please refer to Tanzu Kubernetes Grid product documentation for more up to date Information

Add FQDN Zone

1. Click on DNS
2. Click on ADD DNS ZONE → Add FQDN Zone
3. Type under Zone Name vx.dts.local
4. Type under Domain vx.dts.local
5. Type under DNS SERVER 192.168.200.10
6. Click on SAVE



Preparing bootstrap VM

To use Tanzu Kubernetes Grid, download and run the Tanzu CLI on a local system, known as the bootstrap environment. The bootstrap environment is the laptop, host, or server on which the initial bootstrapping of a management cluster is performed. Here is where you run Tanzu CLI commands.

Download and install Tanzu CLI

Prerequisites

The bootstrap environment on which you run the Tanzu CLI must meet the following requirements:

- kubectl is installed
- Docker is installed and running, if you are installing Tanzu Kubernetes Grid on Linux
- Download and unpack the Tanzu CLI
- System time is synchronized with a Network Time Protocol (NTP) server
- DNS

Installing kubectl

1. Update the apt package index needed for kubernetes repository

   ```
   sudo apt-get update
   sudo apt-get install -y apt-transport-https ca-certificates curl
   ```

2. Download the google cloud public key

   ```
   sudo curl -fsSLo /usr/share/keyrings/kubernetes-archive-keyring.gpg
   https://packages.cloud.google.com/apt/doc/apt-key.gpg
   ```

3. Add Kubernetes apt repository

   ```
   echo "deb [signed-by=/usr/share/keyrings/kubernetes-archive-keyring.gpg] https://apt.kubernetes.
   io/ kubernetes-xenial main" | sudo tee /etc/apt/sources.list.d/kubernetes.list
   ```

4. Update apt package and install kubectl by running the command below

   ```
   sudo apt-get update
   sudo apt-get install -y kubectl
   ```

5. Verify the installation

   ```
   kubectl version
   ```

```
root@tanzu-131:/home/vmware-user# kubectl version
Client Version: version.Info{Major:"1", Minor:"21", GitVersion:"v1.21.0",
GitCommit:"cb303e613a121a29364f75cc67d3d580833a7479", GitTreeState:"clean"
, BuildDate:"2021-04-08T16:31:21Z", GoVersion:"go1.16.1", Compiler:"gc", P
latform:"linux/amd64"}
```

Download and install Docker

Download Docker

Before you install Docker Engine for the first time on a new host machine, you need to set up the Docker repository. Afterward, you can install and update Docker from the repository.

1. Update the package repository

   ```
   sudo apt-get update
   ```

2. Install Packages to allow apt to use the repository over HTTPS

```
sudo apt-get install \
apt-transport-https \
ca-certificates \
curl \
gnupg-agent \
lsb-release
```

3. Add Docker's official GPG key:

```
curl -fsSL https://download.docker.com/linux/ubuntu/gpg | sudo gpg --dearmor -o /usr/share/keyrings/docker-archive-keyring.gpg
```

4. Use the following command to set up the stable repository

```
echo \
"deb [arch=amd64 signed-by=/usr/share/keyrings/docker-archive-keyring.gpg]
https://download.docker.com/linux/ubuntu \
$(lsb_release -cs) stable" | sudo tee /etc/apt/sources.list.d/docker.list > /dev/null
```

Install Docker Engine

1. Install Docker

```
sudo apt-get update
sudo apt-get install docker-ce docker-ce-cli containerd.io
```

2. Check installed Docker version

```
docker version
```

```
root@tanzu-131:/home/vmware-user# docker version
Client: Docker Engine - Community
 Version:           20.10.6
 API version:       1.41
 Go version:        go1.13.15
 Git commit:        370c289
 Built:             Fri Apr  9 22:47:17 2021
 OS/Arch:           linux/amd64
 Context:           default
 Experimental:      true

Server: Docker Engine - Community
 Engine:
  Version:          20.10.6
  API version:      1.41 (minimum version 1.12)
  Go version:       go1.13.15
  Git commit:       8728dd2
  Built:            Fri Apr  9 22:45:28 2021
  OS/Arch:          linux/amd64
  Experimental:     false
 containerd:
  Version:          1.4.4
  GitCommit:        05f951a3781f4f2c1911b05e61c160e9c30eaa8e
 runc:
  Version:          1.0.0-rc93
  GitCommit:        12644e614e25b05da6fd08a38ffa0cfe1903fdec
 docker-init:
  Version:          0.19.0
  GitCommit:        de40ad0
```

Download and unpack the Tanzu CLI

Go to https://www.vmware.com/go/get-tkg and log in with your My VMware credentials.

1. Under Product Downloads, click Go to Downloads.
2. Scroll to the VMware Tanzu 1.3.1 CLI entries and click the Download Now button for the type of machine that you are using as the bootstrap environment.
   – For Linux, download VMware Tanzu CLI bundle 1.3.1 Linux.

```
root@tanzu-131:/home/vmware-user# ls
Desktop  Documents  Downloads  Music  Pictures  Public  Templates  Videos
root@tanzu-131:/home/vmware-user# cd Downloads/
root@tanzu-131:/home/vmware-user/Downloads# ls
tanzu-cli-bundle-v1.3.1-linux-amd64.tar
```

3. Use the tar command to unpack the binaries.

```
tar -xf tanzu-cli-bundle-v1.3.1-linux-amd64.tar
```

```
root@tanzu-131:/home/vmware-user/Downloads# tar -xf tanzu-cli-bundle-v1.3.1-linux-amd64.tar
root@tanzu-131:/home/vmware-user/Downloads# ls
cli  tanzu-cli-bundle-v1.3.1-linux-amd64.tar
```

Install the Tanzu CLI

1. Navigate to Tanzu/CLI folder that you unpacked in the previous section.
2. Install the CLI binary to /usr/local/bin

```
apt-get update
sudo install core/v1.3.1/tanzu-core-linux_amd64 /usr/local/bin/tanzu3.
```

```
root@tanzu-131:/home/vmware-user/Downloads/cli# sudo install core/v1.3.1/tanzu-core-linux_amd64 /usr/local/bin/tanzu
root@tanzu-131:/home/vmware-user/Downloads/cli# cd /usr/local/bin
root@tanzu-131:/usr/local/bin# ls
tanzu
```

3. At the command line in a new terminal, run tanzu version to check that the correct version of the binary is properly installed
   – You should see information about the installed tanzu version.

```
root@tanzu-131:/usr/local/bin# tanzu version
version: v1.3.1
buildDate: 2021-05-07
sha: e5c37c4
```

Install Tanzu CLI plugins

1. After installing tanzu core executable, you must install the CLI plugins related to Tanzu Kubernetes cluster management and feature operations.
   - Navigate to the tanzu cli folder which we have extracted in the earlier step. In the example below I have it in the Downloads folder, so I will navigate to `/home/user/Downloads` folder
2. Run the command below to install tanzu plugins

   `tanzu plugin install --local cli all`

```
root@tanzu-131:/home/vmware-user/Downloads# tanzu plugin install --local cli all
```

3. Check plugin installation status by running the command

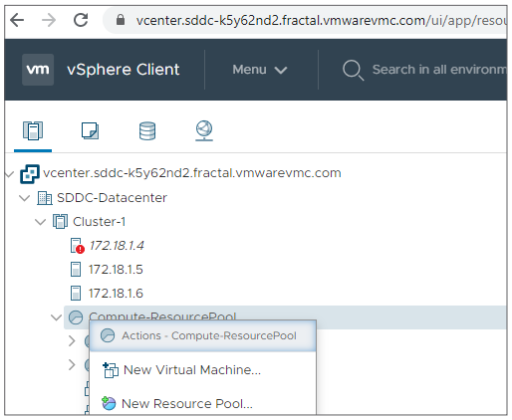
   `tanzu plugin list`

```
root@tanzu-131:/home/vmware-user/Downloads# tanzu plugin list
  NAME                LATEST VERSION  DESCRIPTION                                                REPOSITORY  VERSION  STATUS
  alpha               v1.3.0          Alpha CLI commands                                         core                 not installed
  cluster             v1.3.0          Kubernetes cluster operations                              core        v1.3.1   installed
  kubernetes-release  v1.3.0          Kubernetes release operations                              core        v1.3.1   installed
  login               v1.3.0          Login to the platform                                      core        v1.3.1   installed
  management-cluster  v1.3.0          Kubernetes management cluster operations                   tkg         v1.3.1   installed
  management-cluster                  Kubernetes management cluster operations                   core        v1.3.1   installed
  pinniped-auth       v1.3.0          Pinniped authentication operations (usually not directly invoked)  core        v1.3.1   installed
```

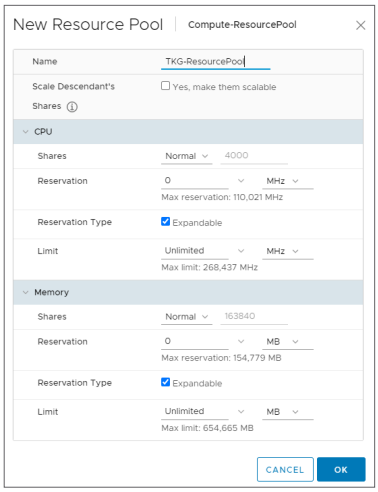
Prepare to deploy management clusters to vSphere

Create a resource pool in which to deploy the Tanzu Kubernetes Grid Instance

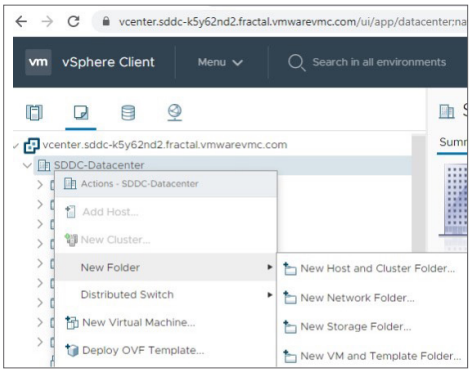
1. Click on Compute resource pool in VMware Cloud on DellEMC vSphere cluster and create a new resource pool for TKG
   (This is an optional step).



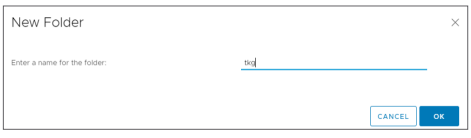
2. Name the resource pool. Choose the CPU and Memory reservations for the pool and click OK to create the resource pool.



3. Create a VM folder in which to collect the Tanzu Kubernetes Grid VMs.
   - Go to your cluster → VMs and Templates → Click on SDDC Datacenter → Right click and select new folder → New VM and Template folder



   - Enter folder name and click ok to create folder



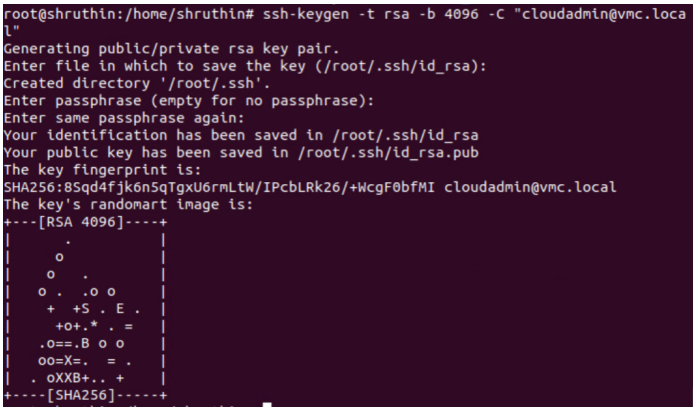
4. A datastore with sufficient capacity for the control plane and worker node VM files.

5. A network with a DHCP server to which to connect the cluster node VMs that Tanzu Kubernetes Grid deploys. The node VMs must be able to connect to vSphere.
   Note: If you intend to deploy multiple Tanzu Kubernetes Grid instances to this vSphere instance, create a dedicated resource pool, VM folder, and network for each instance that you deploy.
6. Traffic to vCenter Server is allowed from the network on which clusters will run.
7. The Network Time Protocol (NTP) service is running on all hosts, and the hosts are running on UTC. To check the time settings on hosts, perform the following steps:
   - Use SSH to log in to the ESXi host
   - Run the date command to see the timezone settings
   - If the timezone is incorrect, run esxcli system time set
8. We will be using the cloudadmin@VMC.local account for the deployment, which will have all the necessary permissions to deploy TKG.

Create SSH key pair

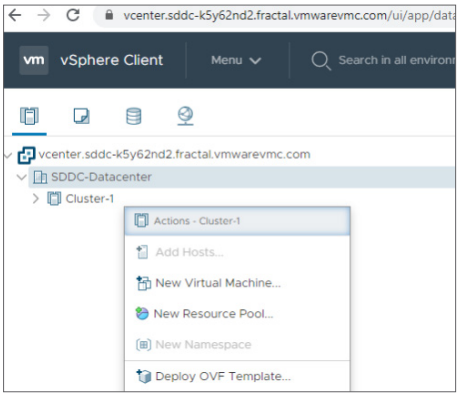
SSH key pair is needed for the Tanzu Kubernetes Grid CLI to connect to vSphere from the machine on which it is running, and you must provide the public key part of an SSH key pair to Tanzu Kubernetes Grid when you deploy the management cluster. If you do not already have one on the machine on which you run the CLI, you can use a tool such as **ssh-keygen** to generate a key pair.

```
ssh-keygen -t rsa -b 4096 -C cloudadmin@vmc.local
```

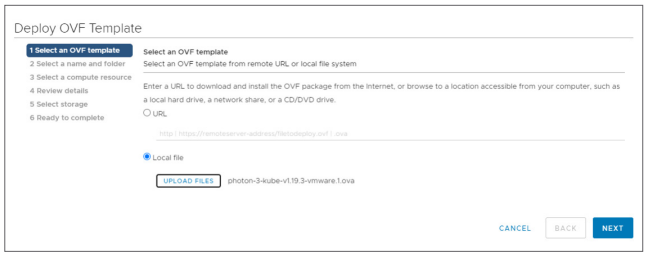


Import the base OS image template into vSphere

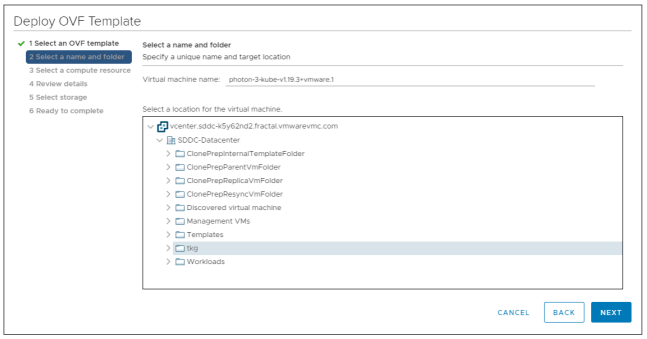
1. Go to https://www.vmware.com/go/get-tkg and log in with your My VMware credentials.
2. Download the Tanzu Kubernetes Grid OVAs for node VMs.
   - Kubernetes v1.19.3: Photon v3 Kubernetes v1.19.3 OVA
3. In the vSphere Client, right-click an object in the vCenter Server inventory, select Deploy OVF template.



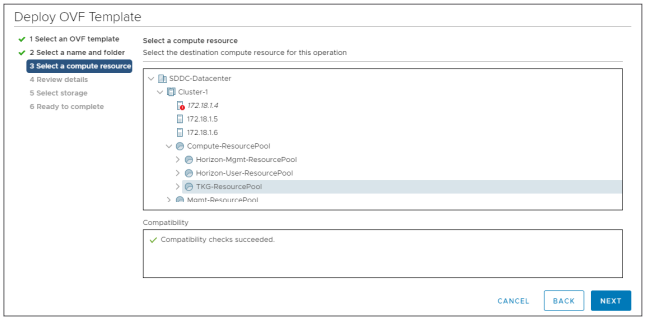
4. Select Local file, click the button to upload files, and navigate to the downloaded OVA file on your local machine.



5. Accept or modify the appliance name and select the destination datacenter or folder.

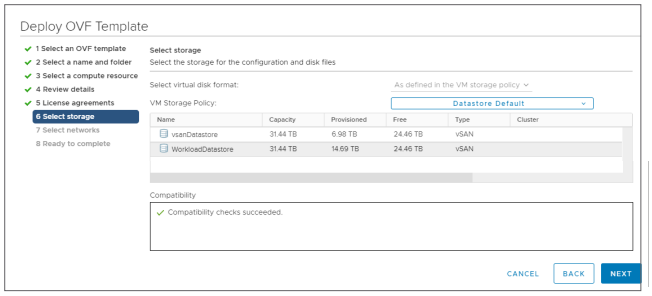


6. Select the destination host, cluster, or resource pool.

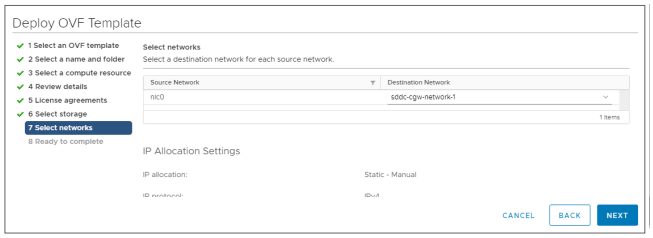


7. Review Details and Accept the end user license agreements (EULA).

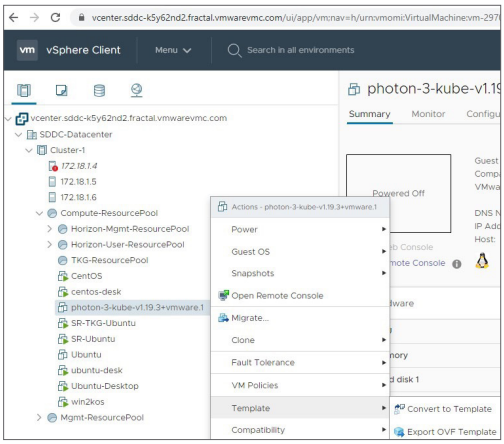
8. Select the disk format and **WorkloadDatastore** and click Next.



9. Select the network to which the VM will connect.
10. Click Finish to deploy the VM.



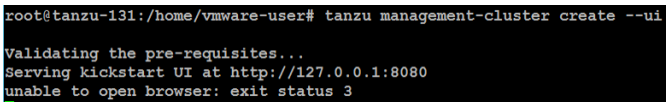
11. When the OVA deployment finishes, right-click the VM and select Template > Convert to Template.
    Note: Do not power on the VM before you convert it to a template.
12. In the VMs and Templates view, right-click the new template, select Add Permission, and assign the tkg-user to the template with the TKG role.



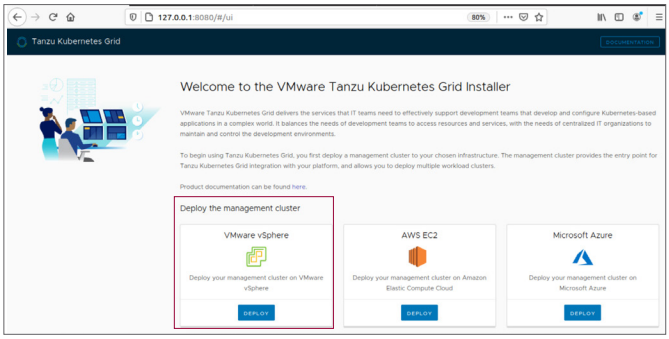
Deploy management clusters to vSphere with the Installer interface

This topic describes how to use the Tanzu Kubernetes Grid installer interface to deploy a management cluster to a vSphere instance. The Tanzu Kubernetes Grid installer interface guides you through the deployment of the management cluster and provides different configurations for you to select or reconfigure.

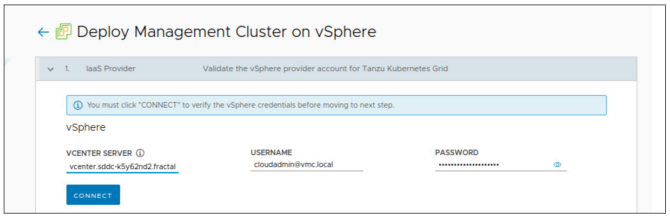
1. Run `tkg init -ui` command to start the Kickstart UI on localhost:8080.



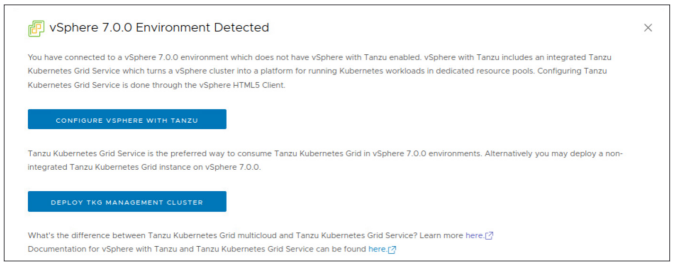
2. Open a browser and enter the IP http://127.0.0.1:8080 to access the installer page. Choose the option "Deploy your management cluster on VMware vSphere."



3. Enter the public facing FQDN of the vCenter, user name and password and click Connect.

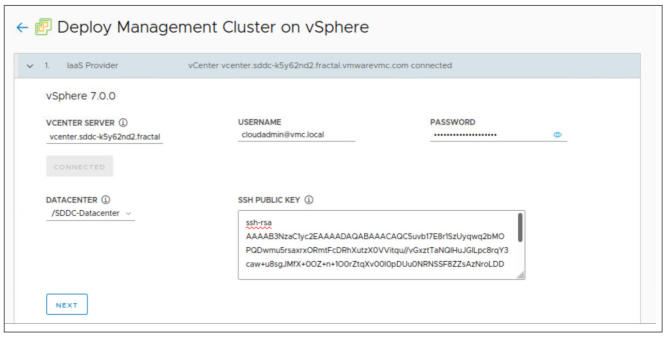


4. Select "Deploy TKG management Cluster" option.

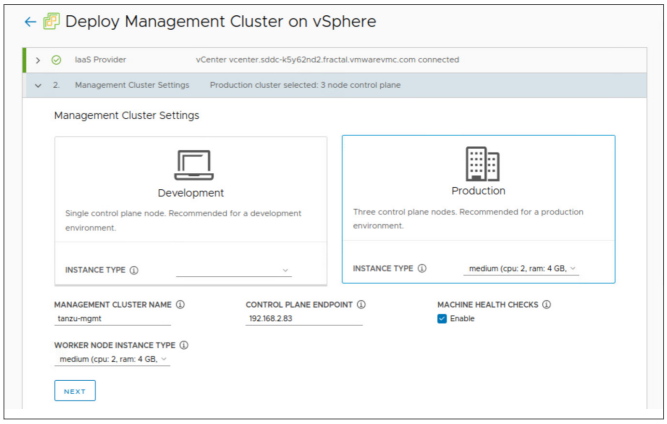


5. Select the SDDC datacenter, enter the SSH public key. Run **cat ~/.ssh/id_rsa.pub** command to get the public key that was created earlier. Copy the public key to TKG deployment screen and click Next.

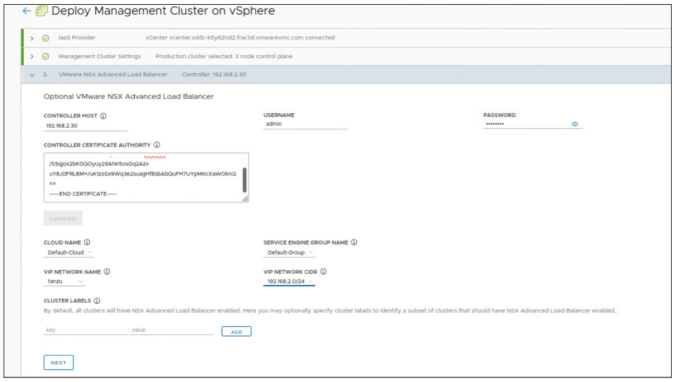
```
root@tanzu-131:/home/vmware-user# cat ~/.ssh/id_rsa.pub
ssh-rsa AAAAB3NzaC1yc2EAAAADAQABAAACAQC1TLGw0RTj7bVLyGZfI30QAQTCxSJiHxFQsEllL
kAegq9QCF+JOl4lmTSj5YwUThtUpu4CYcMjRGlADklP5dhiYnMfV279YYMSZeFrxSQkn0oIdN6EBF
tolApI+CmW54Zl1giZkWLD/3r2zrz3mclVeVCxZ96cCWPyIxl4R1kJF+XZsT0PTdb+cwYrMfi8bKH
RAZ0xqAOyl3dbI/dblE0FGuoVw0sAydCntbxk8Z0GWow+AGVtMfcEOcSKgI2iBiqdJPZa2WhvfkgB
OrquZZXuqWpeQVTldB5tbl5PgRDzAhx30OekhW3z2lwuppK8kmL1VUQmLCK1TiK+MdHo/rqXN172j
oUEySkiYmWO8s0pbn3OrYGMGcKFAKo3q1geU4KwZ6qpF82YQGqR6DZT0TqR4UE0AQ0sLf3JSquoms
NzU38/OUcWJMA/0/2sbi2s8rHSWe/+lOVT3V+2ggQkRCKGwNW11wi0DSip6HMBlsBl+h8S14ZXvFI
GJIoVOjU3M7yC7vczk7TX/uZEkU6bqrSZ2RtLQ4l4dBWa5Y605SJZ0/k6CJg7ISbT3XI3YhgEilXV
xot0uAz9juTputzplzC4SCLGS/H5PoKGIrUm6q11QHz+CjtADtt4eRxVnNL6QcJsEKDd2hU1BbUky
nNshqNrYyJ1NMlNMjG5dZNJXvM1fQ== cloudadmin@vmc.local
```



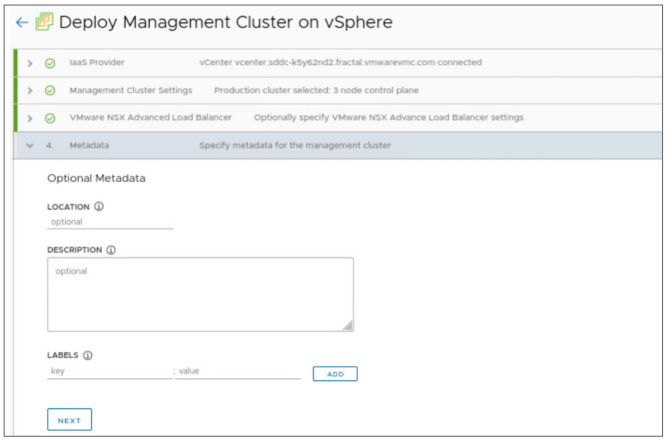
6. Choose the Production instance type. Give a name for management cluster, Worker Node Instance Type and a Control Plane Endpoint IP address.



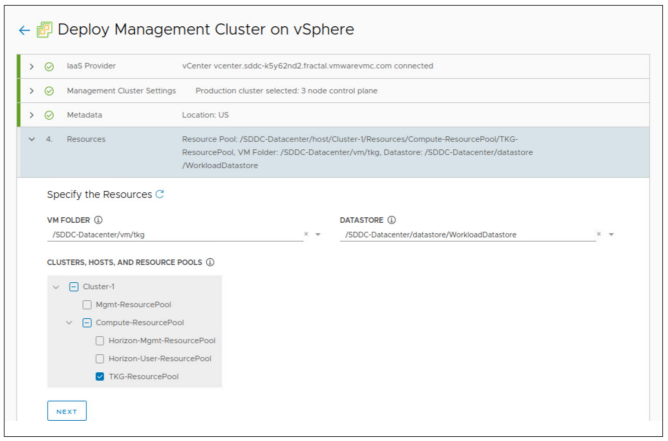
7. Fill in the NSX load balancer details and click Next. Note: This is optional



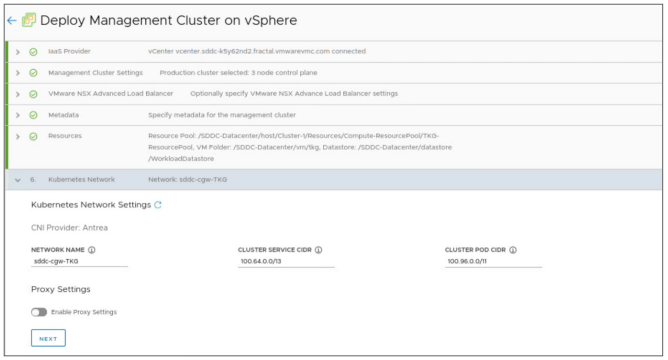
8. Fill in the optional data and click next.



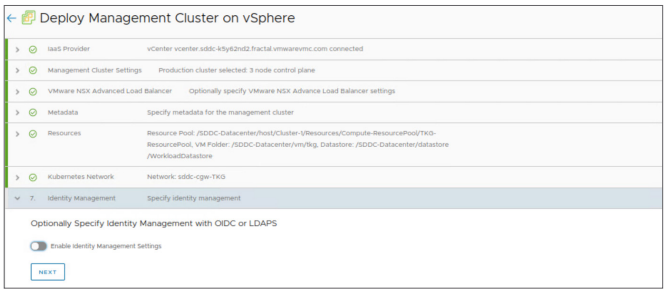
9. Choose the VM Folder, Datastore and resource pool and click Next.



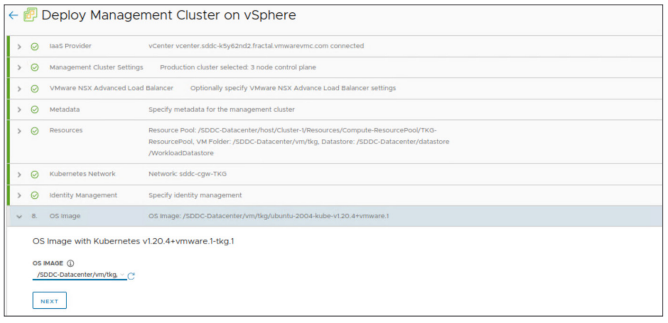
10. Choose a network name and leave the Cluster Service CIDR and Cluster POD CIDR default.



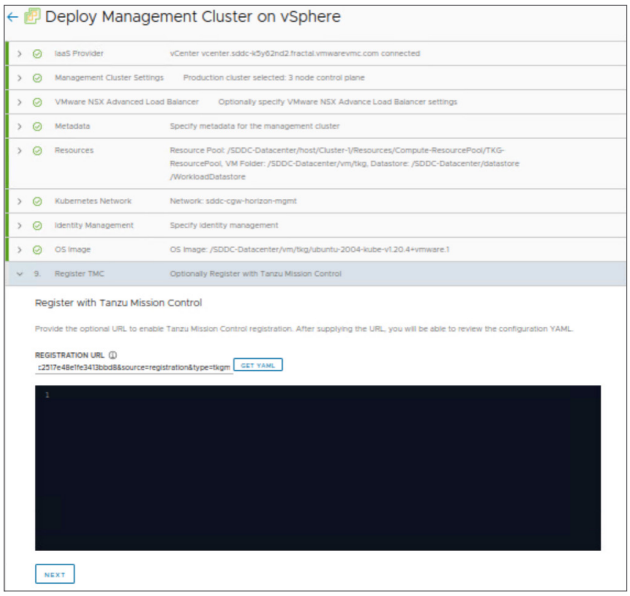
11. Disable Optional identity management setting and click next.



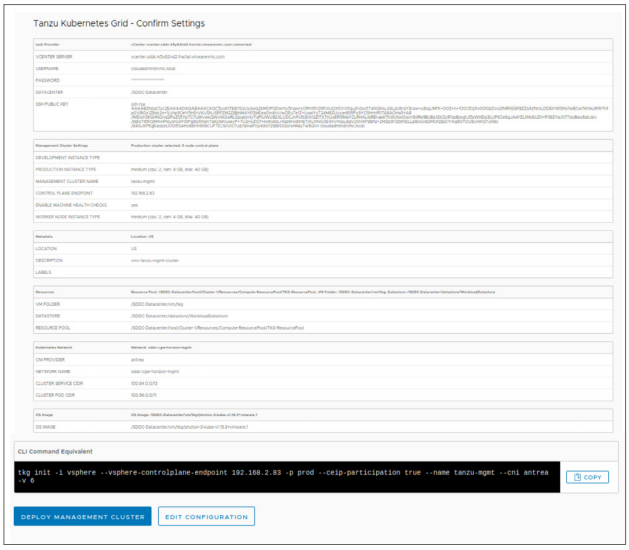
12. Select the OS image (Ubuntu) and click Next.



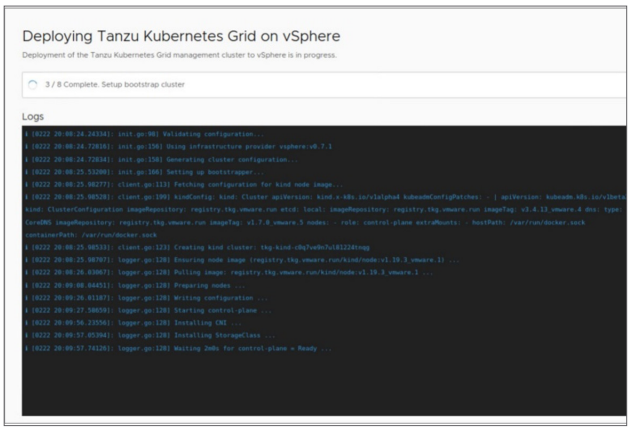
13. Register the cluster with Tanzu Management Control (TMC) and click next, this is an optional step. Login to your TMC account to get the URL and register the tanzu cluster.



14. Review the information and click Deploy Management Cluster to start the deployment.



15. You should see a similar screen displaying the progress of the deployment. The deployment will take about 15 minutes. You should have the supervisor cluster ready once it is finished.



Tanzu Mission Control (TMC)

VMware Tanzu Mission Control is a centralized management platform for consistently operating and securing your Kubernetes infrastructure and modern applications across teams and clouds. For more details refer to VMware Tanzu Mission Control Documentation.

Register Tanzu Kubernetes Grid with Tanzu Mission Control (TMC)

Prerequisites

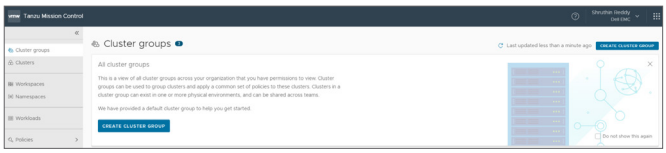
• Create a Cluster Group

Create a Cluster Group

A cluster group is an organizational grouping in the VMware Tanzu Mission Control object hierarchy that provides for better management of your Kubernetes clusters

1. Sign in to TMC portal.

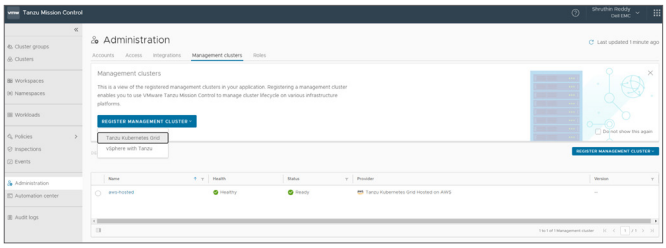
2. Click on Cluster Groups



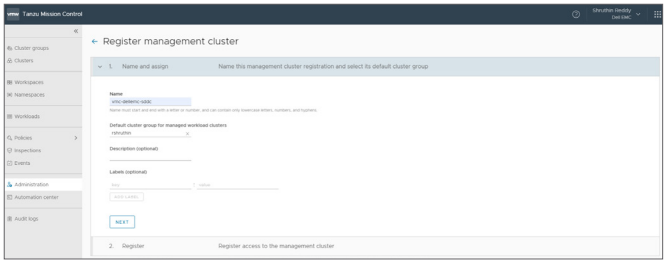
3. Enter a Name and click on Create

Register Management Cluster

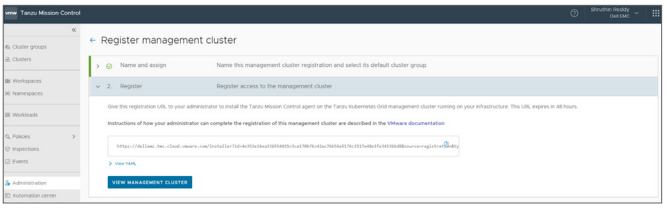
1. Click on Administration → Management Cluster, Click on Register Management Cluster and choose the Deployment type as Tanzu Kubernetes Grid



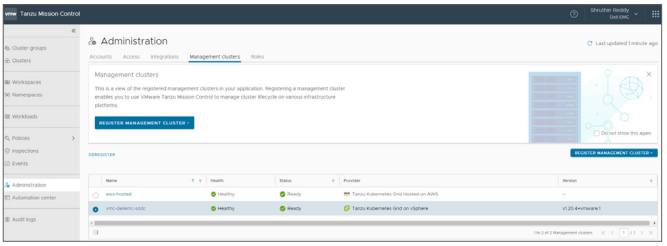
2. Enter a name for management cluster, Description and click Next



3. Copy the URL and save it. We will use the URL while deploying the Tanzu Kubernetes Grid cluster and register it with TMC

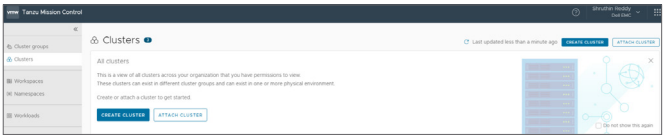


4. Go to administration → Management Clusters to check the status and health of the cluster
   Note: The cluster status is updated after we register the Tanzu Kubernetes Cluster with TMC during the deployment process

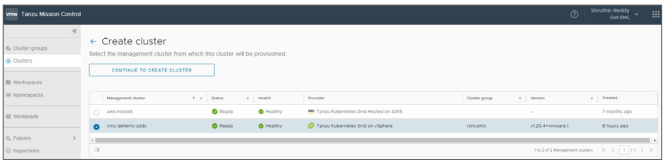


Create a Cluster from TMC Console

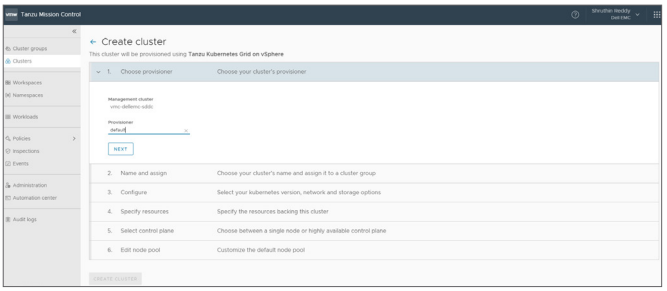
Now that we have registered the VMC vCenter, we can either attach an existing cluster or create a new cluster



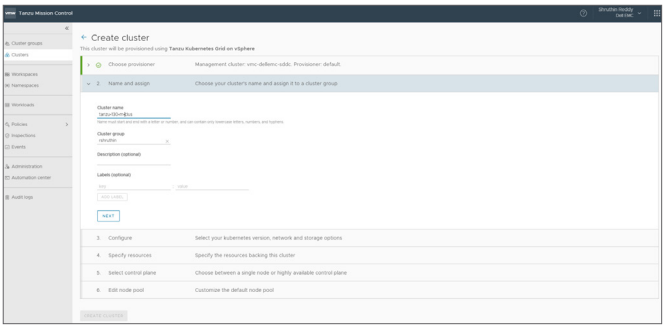
1. Click on cluster → Create Cluster
2. Select the management cluster and click on Continue to Create Cluster



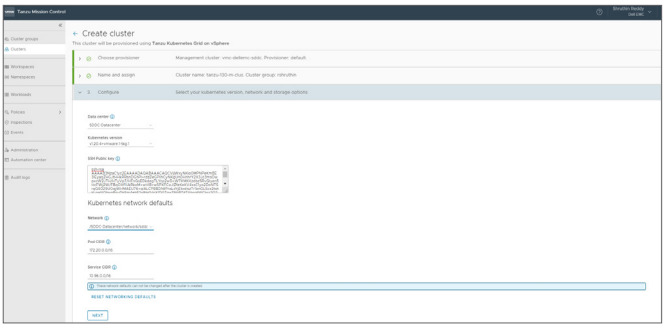
3. Choose the default cluster provisioner and click Next



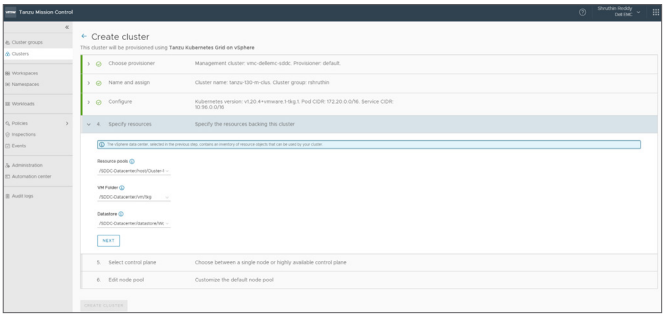
4. Give a name for the cluster and click Next



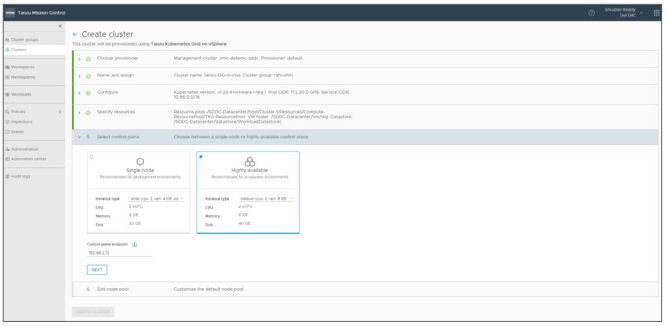
5. Enter the configuration details and click on Next



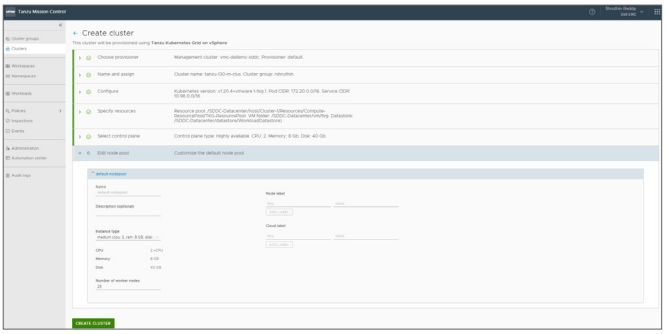
6. Specify the resources and click Next



7. Choose the Control plane type you want to deploy, I have chosen the HA configuration below



8. Select the worker node instance type and the number of worker nodes required and click on Create Cluster to start the deployment



Item No: Tanzu Kubernetes Grid with VMware Cloud on Dell EMC 11/21