Auto Scale Solution for Threat Defense Virtual on GCP

The following sections describe how the components of the Auto Scale solution work for the threat defense virtual on GCP.

About the Auto Scale Solution

Threat Defense Virtual Auto Scale for GCP is a complete serverless implementation that makes use of serverless infrastructure provided by GCP (Cloud Functions, Load Balancers, Pub/Sub, Instance Groups, etc.).

Some of the key features of the Threat Defense Virtual Auto Scale for GCP implementation include:

- GCP Deployment Manager template-based deployment.
- Support for scaling metrics based on CPU utilization..
- Support for threat defense virtual deployment and multi-availability zones.
- Support for automatic registration and de-registration of threat defense virtual.
- Completely automated configuration automatically applied to scaled-out threat defense virtual instances.

- Support for automatic application of NAT policy, access policy, and routes, to threat defense virtual.
- Support for Load Balancers and multi-availability zones.
- Support for management center virtual on other platforms.
- Cisco provides an Auto Scale for GCP deployment package to facilitate the deployment.

Auto Scale Guidelines and Limitations

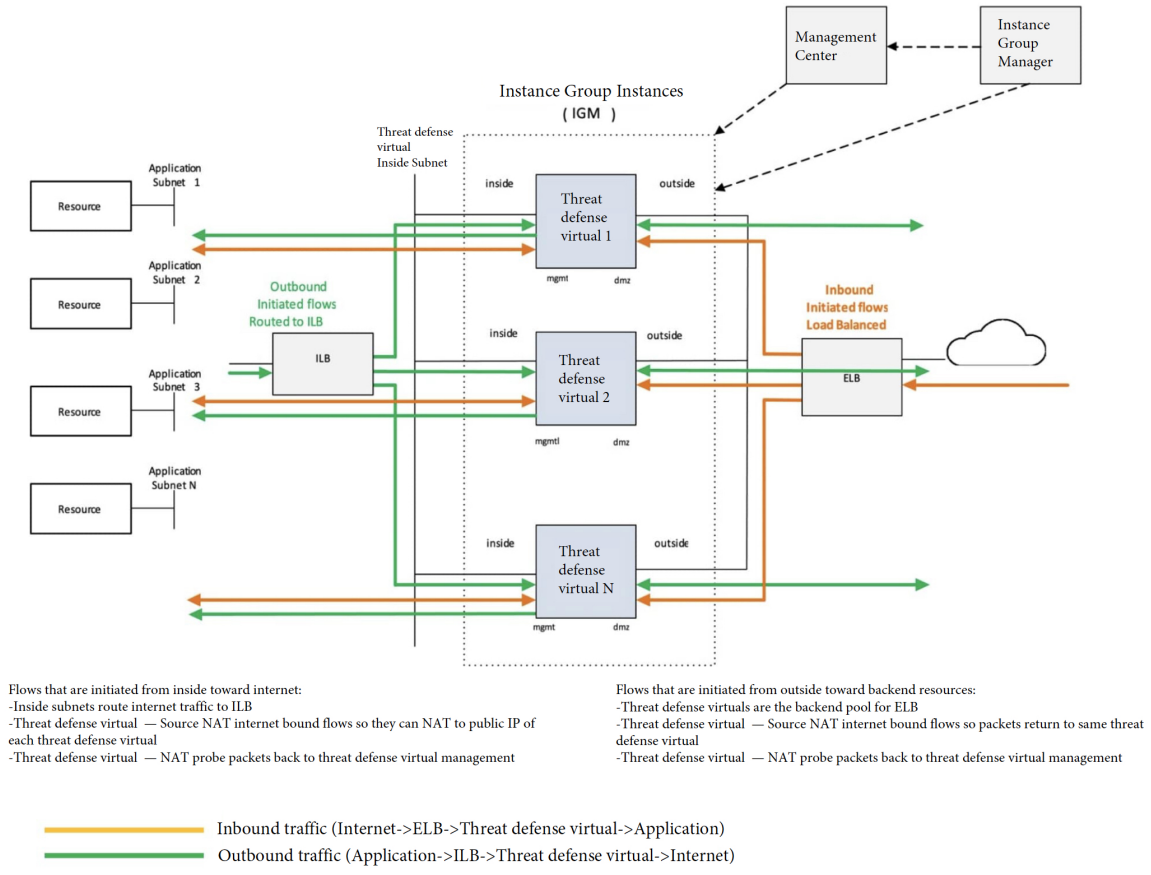
- Only IPv4 is supported.
- Licensing - Only BYOL is supported. PAYG licensing is not supported.
- Device functionality errors are not displayed in the logs.
- The maximum number of devices supported is 25. This is the maximum limit in a management center virtual instance.
- Templates are provided for 4 interfaces only. For any variations, you have to modify these templates.
- Cold standby or Snapshot methods to reduce scale-out time are not supported.
- Schedule based scaling is not supported.
- Auto Scaling based on Average Memory Utilization is not supported.
- Scale-In/Scale-Out may decrease/increase the number of instances by more than 1. However, the threat defense virtual instances will only deregister/register on the management center virtual sequentially, that is, one by one.
- During scale-in, there is a connection draining time of 300s. You can also manually configure the draining time to a required period.
- The external Load Balancer is created by the template that is provided. Customizing DNS requirements of the Load Balancer's public IP is not supported.
- Users have to fit their existing infrastructure into the sandwich model of implementation.
- For details on errors faced during the scale-out and scale-in process, analyze the logs of the Cloud Functions.
- NAT, security policies attached to device group, and static routes, are applied to the newly created threat defense.
- If you are deploying the solution for more than 1 threat defense virtual, then the deployment time will increase as the management center virtual can handle only one registration request at a time. Deployment time also increases when scaling out adds more than one threat defense virtual instance. Currently, all registrations and de-registrations are sequential.
- Device Group, NAT rules, and network objects, have to be created in management center virtual before Auto Scaling is initiated. Note that the ILB and ELB IPs are only available after deploying the solution. So, you can create dummy objects and update the objects after the actual IPs are obtained.

Auto Scale Use Case

The threat defense virtual Auto Scale for GCP is an automated horizontal scaling solution that positions a threat defense virtual instance group sandwiched between a GCP Internal load balancer (ILB) and a GCP External load balancer (ELB).

- The ELB distributes traffic from the Internet to threat defense virtual instances in the instance group; the threat defense virtual then forwards traffic to the application.
- The ILB distributes outbound Internet traffic from an application to threat defense virtual instances in the instance group; the threat defense virtual then forwards traffic to the Internet.
- A network packet will never pass through both (internal & external) load balancers in a single connection.
- The number of threat defense virtual instances in the scale set will be scaled and configured automatically based on load conditions.

Figure 2: Threat Defense Virtual Auto Scale Use Case



Scope

This document covers the detailed procedures to deploy the serverless components for the Threat Defense Virtual Auto Scale for GCP solution.

Important

- Read the entire document before you begin your deployment.
- Make sure the prerequisites are met before you start deployment.
- Make sure you follow the steps and order of execution as described herein.

Download the Deployment Package

The Threat Defense Virtual Auto Scale for GCP solution is a GCP Deployment Manager template-based deployment that makes use of the serverless infrastructure provided by GCP (Cloud Functions, Load Balancers, Pub/Sub, Instance Groups, etc.).

From the download location specified by your beta manager, download the files required to launch the Threat Defense Virtual Auto Scale for GCP solution. Deployment scripts and templates for your threat defense virtual version are available at the specified download location.

Attention Note that Cisco-provided deployment scripts and templates for auto scale are provided as open source examples, and are not covered within the regular Cisco TAC support scope.

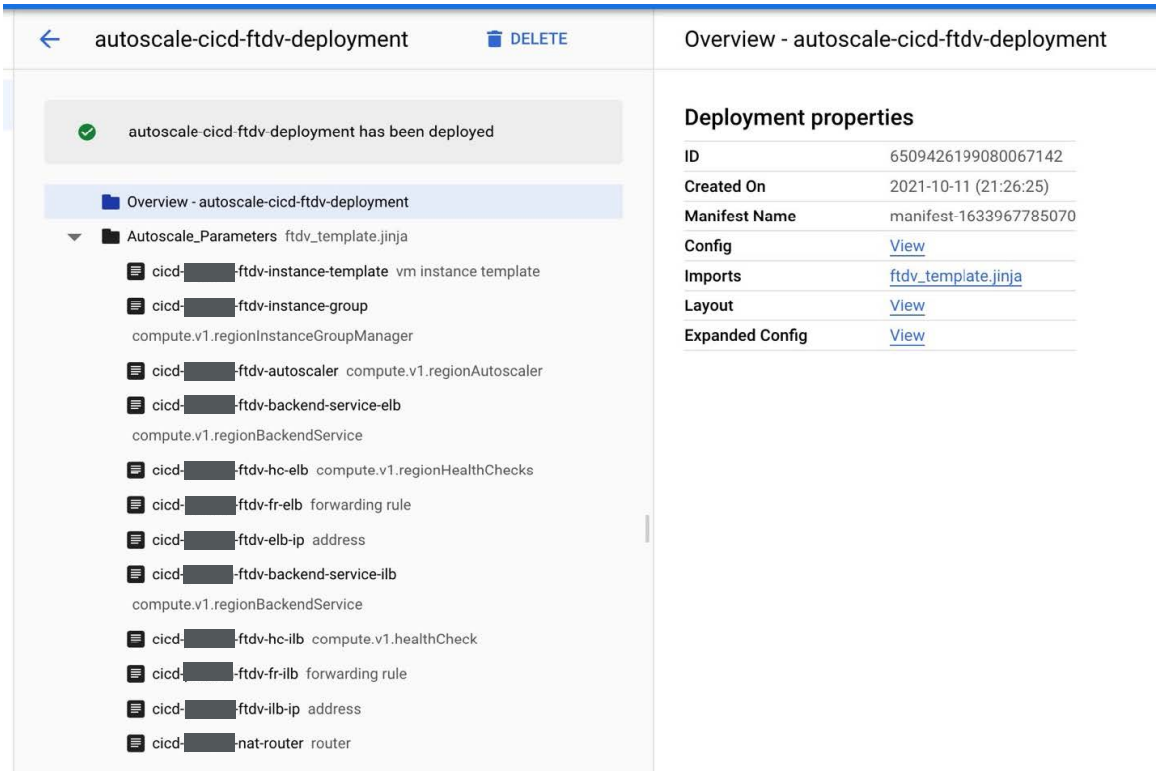
Auto Scale Solution Components

The following components make up the Threat Defense Virtual Auto Scale for GCP solution.

Deployment Manager

- Treat your configuration as code and perform repeatable deployments. Google Cloud Deployment Manager allows you to specify all the resources needed for your application in a declarative format using YAML. You can also use Jinja2 templates to parameterize the configuration and allow the reuse of common deployment paradigms.
- Create configuration files that define the resources. The process of creating those resources can be repeated over and over with consistent results. See https://cloud.google.com/deployment-manager/docs for more information.

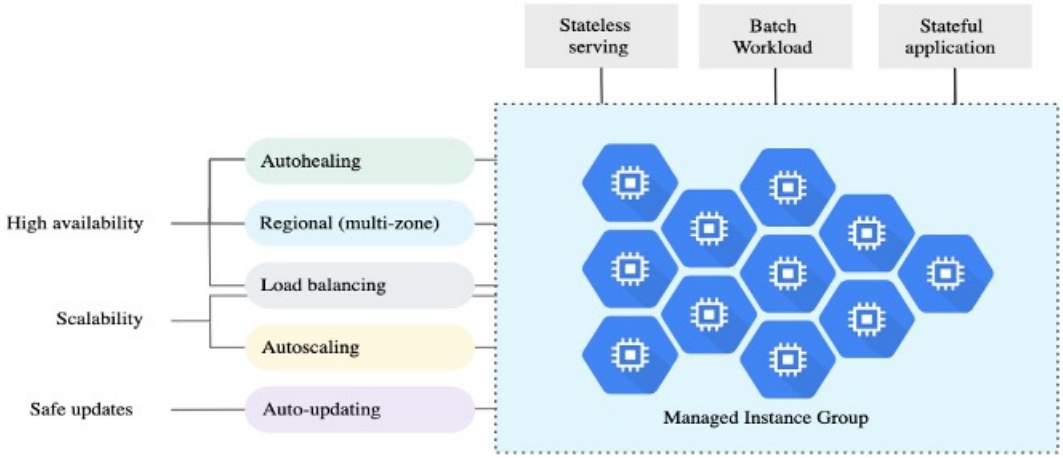
Figure 3: Deployment Manager View



Managed Instance Group in GCP

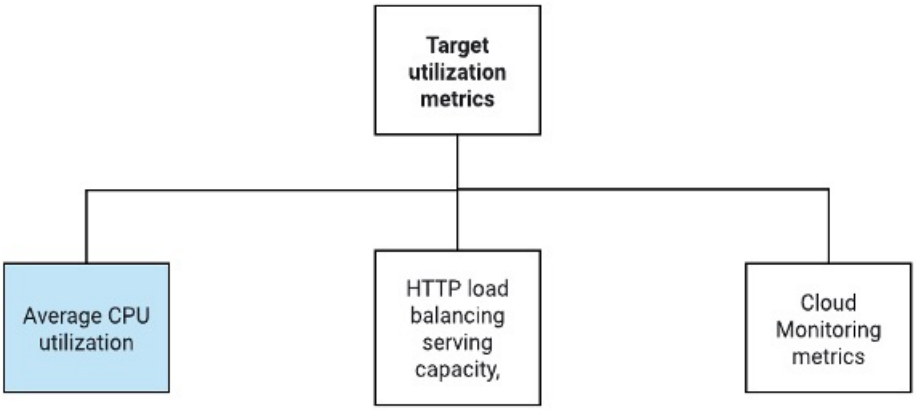
A Managed Instance Group (MIG) creates each of its managed instances based on the instance template and optional stateful configuration that you specify. See https://cloud.google.com/compute/docs/instance-groups for more information.

Figure 4: Instance Group Features



Target Utilization Metrics

- The following diagram alongside shows the target utilization metrics. Only average CPU utilization metrics are used in making autoscaling decisions.
- The autoscaler continuously collects usage information based on the selected utilization metric, compares actual utilization to your desired target utilization, and uses this information to determine whether the group needs to remove instances (Scale In) or add instances (Scale Out).
- The target utilization level is the level at which you want to maintain your virtual machine (VM) instances. For example, if you scale based on CPU utilization, you can set your target utilization level at 75% and the autoscaler will maintain the CPU utilization of the specified group of instances at or close to 75%. The utilization level for each metric is interpreted differently based on the autoscaling policy. See https://cloud.google.com/compute/docs/autoscaler for more information.



Serverless Cloud Functions

You use serverless Google Cloud functions for tasks such as changing the SSH Password, configure manager, registering threat defense virtual on management center virtual, deregistering threat defense virtual from management center virtual, and so on.

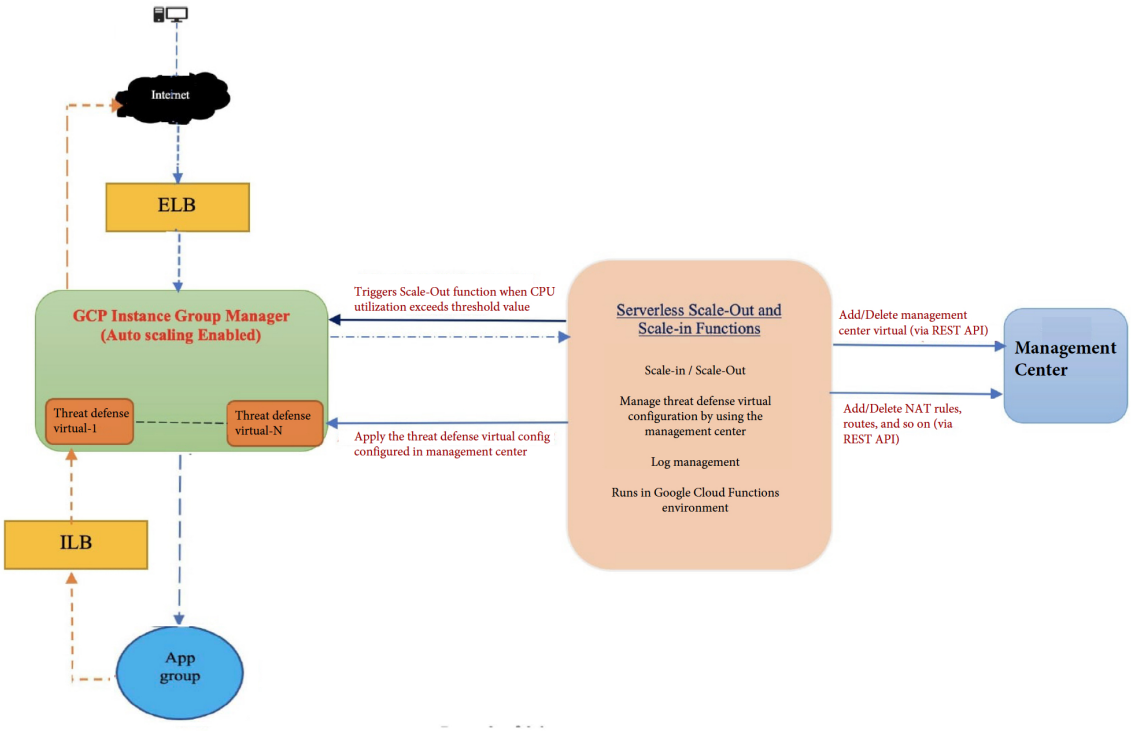
- When a new threat defense virtual instance comes up in the instance group during Scale Out, you need to performs tasks such as changing the SSH Password, configure manager, registering threat defense virtual on management center virtual, deregistering threat defense virtual from management center virtual, and so on.
- Cloud functions are triggered through a Cloud Pub/Sub Topic during the Scale Out process. You also have a Log Sink with a filter that is exclusive to the addition of instances during Scale Out.

Serverless License Deregistering using Cloud Functions

- While the instances are getting deleted during Scale In, you need to deregister the license from the threat defense virtual instance and deregsister threat defense virtual from management center virtual.
- Cloud functions are triggered through a Cloud Pub/Sub Topic. Particularly for the deletion process, you have a Log Sink with a filter that is exclusive to the deletion of instances during Scale In.
- Cloud Function, when triggered, will SSH into the deleting threat defense virtual instance and run the command for license deregistration.

High-Level Overview of Auto Scale Solution

Figure 5: Auto Scale Solution Overview



Auto Scale Solution Prerequisites

GCP Resources

GCP Project

An existing or newly created project is required to deploy all the components of this solution.

VPC Networks

Make sure four VPCs are available/created. An Auto Scale deployment will not create, alter, or manage any networking resources.

In addition to the existing subnetworks, create a new VPC connector in the management VPC network with a /28 subnetwork. The Cloud Function uses the VPC connector to access the threat defense virtual with private IP addresses.

The threat defense virtual requires 4 network interfaces, thus your virtual network requires 4 subnets for:

- Outside traffic
- Inside traffic
- Management traffic

- Diagnostic traffic

Firewall

Firewall rules that allow inter VPC communication and also allow health probes are required to be created.

Create 4 firewall rules for the Inside, Outside, Management, and Diagnostic interfaces. Also, create a Firewall rule to allow the health check probes.

The IP addresses for the health check probes are given below:

- 35.191.0.0/16
- 130.211.0.0/22
- 209.85.152.0/22
- 209.85.204.0/22

You must note the firewall tags which are used later in the deployment manager template.

The following ports should be open in the Network Security Group to which the subnets are connected:

- SSH(TCP/22) — Required for the health probe between the Load Balancer and threat defense virtual. Required for communication between the serverless functions and threat defense virtual.
- Application-specific protocol/ports — Required for any user applications (for example, TCP/80, etc.).

Build the GCP Cloud Function Package

The Threat Defense Virtual GCP Auto Scale solution requires that you build two archive files that deliver the cloud functions in the form of a compressed ZIP package.

- `ftdv_scalein.zip`
- `ftdv_scaleout.zip`

See the Auto Scale deployment instructions for information on how to build the `ftdv_scalein.zip` and `ftdv_scaleout.zip` packages.

These functions are as discrete as possible to carry out specific tasks and can be upgraded as needed for enhancements and new release support.

Input Parameters

The following table defines the template parameters and provides an example. Once you decide on these values, you can use these parameters to create the threat defense virtual device when you deploy the GCP Deployment Manager template into your GCP project.

Table 4: Template Parameters

Parameter Name	Allowed Values/Type	Description	Resource Creation Type
resourceNamePrefix	String	All the resources are created with name containing this prefix. Example: demo-test	New
region	Valid regions supported by GCP [String]	Name of the region where project will be deployed. Example: us-central1	
serviceAccountMailId	String [Email Id]	Email address that identifies the service account.	
vpcConnectorName	String	Name of the connector that handles the traffic between your serverless environment and your VPC network. Example: demo-test-vpc-connector	
bucketName	String	Name of the GCP storage bucket where the cloud function ZIP package will be uploaded. Example: demo-test-bkt	
coolDownPeriodSec	Integer	Number of seconds that the autoscaler should wait before it starts collecting information from a new instance. Example: 30	
cpuUtilizationTarget	Decimal (0,1]	The average CPU utilization of the VMs in the instance group the autoscaler should maintain. Example: 0.5	
diagFirewallRule	String	Name of the diagnostic firewall rule. Example: cisco-ftdv-diag-firewall-rule	

Parameter Name	Allowed Values/Type	Description	Resource Creation Type
diagSubnetworkName	String	Name of the diagnostic subnet. Example: cisco-ftdv-diag-subnet	
diagVpcName	String	Name of the diagnostic VPC. Example: custom-ftdv-diag-vpc	
elbFePorts	Integer	ELB Fast ethernet ports. Example: 80,22	
elbIpProtocol	String	ELB IP protocol used. Example: TCP	
elbPort	Integer	ELB port number. Example: 80	
elbPortName	String	Name of the ELB port. Example: tcp	
elbPortRange	Integer	Range of ELB ports. Example: 80-80	
elbProtocol	String	ELB protocol used. Example: TCP	
elbProtocolName	String	Name of the ELB protocol. Example: TCP	
elbTimeoutSec	Integer	ELB timeout period in seconds. Example: 5	
elbUnhealthyThreshold	Integer	Threshold number for failed health checks. Example: 2	
fmcIP	String	IP address of the management center Example: 10.61.1.2	
fmcPasswordSecret and new FtdPasswordSecret	String	Names of the secrets created.	

Parameter Name	Allowed Values/Type	Description	Resource Creation Type
fmcUsername	String	Management Center Virtual username.	
ftdvCheckIntervalSec	Integer	Interval between health checks. Example: 300	
ftdvHealthCheckPort	Integer	Port number for the threat defense virtual health check. Example: 22	
ftdvHealthCheckProtocolName	String	Protocol used for the health check. Example: TCP	
ftdvPassword	String	Threat Defense Virtual password.	
ftdvTimeoutSec	Integer	Timeout for threat defense virtual connection. Example: 300	
ftdvUnhealthyThreshold	Integer	Threshold number for failed health checks. Example: 3	
grpID	String	Name of the device group created in management center. Example: auto-group	
healthCheckFirewallRule	String	Name of the firewall rule that allows packets from health check probe IP ranges. Example: custom-ftdv-hc-firewall-rule	
healthCheckFirewallRuleName	String	Tag of the firewall rule that allows packets from health check probe IP ranges. Example: demo-test-health-allow-all	Existing

Parameter Name	Allowed Values/Type	Description	Resource Creation Type
ilbCheckIntervalSec	Integer	Interval period for checking the ILB connection. Example: 10	
ilbDrainingTimeoutSec	Integer	Connection draining timeout period. Example: 60	
ilbPort	Integer	ILB port number. Example: 80	
ilbProtocol	String	ILB protocol used. Example: TCP	
ilbProtocolName	String	ILB protocol name. Example: TCP	
ilbTimeoutSec	Integer	ILB timeout period. Example: 5	
ilbUnhealthyThreshold	Integer	Threshold number for failed health checks. Example: 3	
insideFirewallRule	String	Name of the inside firewall rule. Example: custom-ftdv-in-firewall-rule	
insideFirewallRuleName	String	Tag of the firewall rules that allows communication in Inside VPC. Example: demo-test-inside-allowall	Existing
insideGwName	String	Name of the inside gateway. Example: inside-gateway	
insideSecZone	String	Name of the inside security zone. Example: inside-zone	

Parameter Name	Allowed Values/Type	Description	Resource Creation Type
insideSubnetworkName	String	Name of the inside subnet. Example: custom-ftdv-inside-subnet	
insideVPCName	String	Name of Inside VPC. Example: demo-test-inside	Existing
insideVPCSubnet	String	Name of Inside subnet. Example: demo-test-inside-subnet	Existing
licenseCAPS	String	Names of the licenses used. Example: BASE,MALWARE,URL Filter,THREAT	
machineType	String	Machine type for the threat defense virtual VM. Example: n1-standard-4	
maxFTDCount	Integer	The maximum number of threat defense virtual instances allowed in the instance group. Example: 3	
maxFTDReplicas	Integer	Maximum number of threat defense virtual instances in the auto scaling group. Example: 2	
mgmtFirewallRule	String	Name of the management firewall rule. Example: cisco-ftdv-mgmt-firewall-rule	
mgmtFirewallRuleName	String	Tag of the firewall rules which allows communication in Management VPC. Example: demo-test-mgmt-allowall	

Parameter Name	Allowed Values/Type	Description	Resource Creation Type
mgmtSubnetworkName	String	Name of the management subnet. Example: custom-ftdv-mgmt-subnet	
mgmtVPCName	String	Name of Management VPC. Example: demo-test-mgmt	
mgmtVPCSubnet	String	Name of Management Subnet. Example: demo-test-mgmt-subnt	
minFTDCount	Integer	The minimum number of threat defense virtual instances available in the Instance Group at any given time. Example: 1	
minFTDReplicas	Integer	The minimum number of threat defense virtual instances in the auto scaling group. Example: 2	
natID	String	Unique NAT ID required while registering management center on threat defense.	
outsideFirewallRule	String	Name of the outside firewall rule. Example: cisco-ftdv-out-firewall-rule	
outsideFirewallRuleName	String	Tag of the firewall rules which allows communication in outside VPC. Example: demo-test-outside-allowall	
outsideGwName	String	Name of the outside gateway. Example: outside-gateway	

Parameter Name	Allowed Values/Type	Description	Resource Creation Type
outsideSecZone	String	Name of the outside security zone. Example: outside-zone	
outsideSubnetworkName	String	Name of the outside subnet. Example: custom-ftdv-outside-subnet	
outsideVPCName	String	Name of Outside VPC. Example: demo-test-outside	
outsideVPCSubnet	String	Name of Outside Subnet. Example: demo-test-outside-subnt	
policyID	String	Name of the ACL policy.	
publicKey	String	SSH key of the threat defense virtual VM.	
sourceImageURL	String	URL of the threat defense virtual image which is to be used in the project.	

Deploy the Auto Scale Solution

Step 1 Clone the Git repository to a local folder.

```
git clone git_url -b branch_name
```

Step 2 Create the bucket in gcloud CLI.

```
gsutil mb -c nearline gs://bucket_name
```

Note Run any **gsutil** or **gcloud** commands in this procedure in the Google cloud shell or the Google cloud SDK installed on your system.

Step 3 Build compressed Zip packages:

a) Create compressed Zip packages consisting of the following files from the folders `ftdv_scaleout` and `ftdv_scalein`.

- main.py
- basic_functions.py
- fmc_functions.py

- requirements.txt

Note In the main.py file, use the **ssh_ip = response['networkInterfaces'] [2] ['networkIP']** command if an internal IP address is used. If an external IP address is used, enter the **ssh_ip = response['networkInterfaces'] [2] ['accessConfigs'] [0] ['natIP']** command. Also, two static routes are added in this function. You can modify the static routes using the **fmc.create_static_network_route (vm_name, 'outside', 'any_ipv4', os.getenv("OUTSIDE_GW_NAME"), metric=1)** and **fmc.create_static_network_route (vm_name, 'inside', 'any_ipv4', os.getenv("INSIDE_GW_NAME"), metric=2)** commands.

b) Rename the compressed Zip packages to `ftdv_scaleout.zip` and `ftdv_scalein.zip`.

Note Navigate inside the folder, select the files, right-click, and select 'compress | archive' to make a .zip that GCP can read.

Step 4 Upload the compressed Zip packages (`ftdv_scaleout.zip` and `ftdv_scalein.zip`) to the Cloud Editor workspace.

Step 5 Upload the following files from the deployment manager template to the Cloud Editor workspace.

- ftdv_predeployment.yaml
- ftdv_predeployment.jinja
- ftdv_parameters.yaml
- ftdv_template.jinja

Step 6 Copy the compressed Zip packages to the Bucket Storage.

- `gsutil cp ftdv_scaleout.zip gs://bucket_name`
- `gsutil cp ftdv_scalein.zip gs://bucket_name`

Step 7 Create VPC and Subnet for inside, outside, management, and diagnostic interfaces.

In the management VPC, you need to have /28 subnet, for example, 10.8.2.0/28.

Step 8 You need four firewall rules for the inside, outside, management, and diagnostic interfaces. Also, you should have a firewall rule to allow the health check probes.

Step 9 Create two secrets for the following using the Secret Manager GUI. See https://console.cloud.google.com/security/secret-manager.

- fmc-password
- ftdv-new-password

Step 10 Create the VPC connector.

```
gcloud beta compute networks vpc-access connectors create <vpc-connector-name>
--region <region> --subnet=</28 subnet name>
```

Example:

```
gcloud beta compute networks vpc-access connectors create demo-vpc-connector
--region us-central1 --subnet=outside-connect-28
Create request issued for: [demo-vpc-connector]
Waiting for operation [projects/asavgcp-poc-4krn/locations/us-central1/operations/
```

```
10595de7-837f-4c19-9396-0c22943ecf15] to complete...done.
Created connector [demo-vpc-connector].
```

Step 11 Deploy the management center virtual on any public cloud platform with a public IP. See Cisco Firepower Management Center Virtual Getting Started Guide for more information on how to deploy management center virtual on various public cloud platforms.

Note Perform Steps 12 to 16 on the deployed management center virtual instance.

Step 12 On the management center virtual instance - Create a user restapi for management center virtual and use the same password that is saved in the fmcpassword secret. See Users for more information.

Step 13 On the management center virtual instance - Create a Device Group, Access Control Policy, and an Access Control Rule. See Add a Device Group, Creating a Basic Access Control Policy, and Create and Edit Access Control Rules for more information.

Step 14 On the management center virtual instance - Create the objects given below. See Object Management for more information on how to create objects on management center virtual.

- ELB-IP
- ILB-IP
- Application-IP
- Health Check IP ranges (4)
- Metadata

```
object network hc1
  subnet 35.191.0.0 255.255.0.0
object network metadata
  host 169.254.169.254
object network ilb-ip
  host 10.52.1.218
object network hc2
  subnet 130.211.0.0 255.255.252.0
object network elb-ip
  host 34.85.214.40
object network hc3
  subnet 209.85.152.0 255.255.252.0
object network hc4
  subnet 209.85.204.0 255.255.252.0
object network inside-linux
  host 10.52.1.217
object network outside-gateway
  host <>
object network inside-gateway
  host <>
```

Step 15 On the management center virtual instance - Create Security Zones (Interface Objects). See Creating Security Zone and Interface Group Objects for more information.

- inside-security-zone
- outside-security-zone

Step 16 On the management center virtual instance - Create NAT Policy and NAT Rules. See Network Address Translation for more information.

```
nat (inside,outside) source dynamic hc1 interface destination static ilb-ip metadata service
SVC_4294968559 SVC_4294968559
nat (inside,outside) source dynamic hc2 interface destination static ilb-ip metadata service
SVC_4294968559 SVC_4294968559
nat (inside,outside) source dynamic any interface
nat (outside,inside) source dynamic hc1 interface destination static elb-ip metadata service
SVC_4294968559 SVC_4294968559
nat (outside,inside) source dynamic hc2 interface destination static elb-ip metadata service
SVC_4294968559 SVC_4294968559
nat (outside,inside) source dynamic hc3 interface destination static elb-ip metadata service
SVC_4294968559 SVC_4294968559
nat (outside,inside) source dynamic hc4 interface destination static elb-ip metadata service
SVC_4294968559 SVC_4294968559
nat (outside,inside) source dynamic any interface destination static elb-ip inside-linux
```

#	Direction	Type	Source Interface Objects	Destination Interface Objects	Original Sources	Original Destinations	Original Services	Translated Sources	Translated Destinations	Translated Services	Options
1	↗	D...	inside-zone	outside-zone	hc1	ilb-ip	Original HTTP	Interface	metadata	Original HTTP	Dns:false
2	↗	D...	inside-zone	outside-zone	hc2	ilb-ip	Original HTTP	Interface	metadata	Original HTTP	Dns:false
3	↗	D...	inside-zone	outside-zone	any-ipv4			Interface			Dns:false
4	↗	D...	outside-zone	inside-zone	hc1	elb-ip	Original HTTP	Interface	metadata	Original HTTP	Dns:false
5	↗	D...	outside-zone	inside-zone	hc2	elb-ip	Original HTTP	Interface	metadata	Original HTTP	Dns:false
6	↗	D...	outside-zone	inside-zone	hc3	elb-ip	Original HTTP	Interface	metadata	Original HTTP	Dns:false
7	↗	D...	outside-zone	inside-zone	hc4	elb-ip	Original HTTP	Interface	metadata	Original HTTP	Dns:false
8	↗	D...	outside-zone	inside-zone	any-ipv4	elb-ip		Interface	inside-linux		Dns:false

Step 17 Update the parameters in the Jinja and YAML files for the Pre-Deployment and Threat Defense Virtual Autoscale deployment.

a) Open the `ftdv_predeployment.yaml` file and update the following parameters:

- **resourceNamePrefix**: <resourceNamePrefix>
- **region**: <region>
- **serviceAccountMailId**: <serviceAccountMailId>
- **vpcConnectorName**: <VPC-Connector-Name>
- **bucketName**: <bucketName>
- **fmcIP**: <management center-IP-address>
- **regID**: <registration-ID>
- **natID**: <unique-NAT-ID>
- **grpID**: <device-group-name>
- **policyID**: <acl-policy-name>
- **licenseCAPS**: <licenses>
- **fmcPasswordSecret**: <management center-password>
- **newFtdPasswordSecret**: <new-threat defense virtual-password>
- **fmcUsername**: <username>

- **ftdvPassword**: <password>
- **outsideGwName**: <outside-gateway-name>
- **insideGwName**: <inside-gateway-name>
- **outsideSecZone**: <outside-security-zone>
- **insideSecZone**: <inside-security-zone>

b) The `ftdv_predeployment.jinja` file takes parameters from the `ftdv_predeployment.yaml` file.
c) Open the `ftdv_parameters.yaml` file and update the following parameters.

VPC and Firewall Parameters

- **mgmtVpcName**: <mgmt-vpc-name>
- **diagVpcName**: <diagnostic-vpc-name>
- **outsideVpcName**: <outside-vpc-name>
- **insideVpcName**: <inside-vpc-name>
- **mgmtSubnetworkName**: <mgmt-subnet-name>
- **diagSubnetworkName**: <diagnostic-subnet-name>
- **outsideSubnetworkName**: <outside-subnet-name>
- **insideSubnetworkName**: <inside-subnet-name>
- **mgmtFirewallRule**: <mgmt-firewall-rule>
- **diagFirewallRule**: <diagnostic-firewall-rule>
- **outsideFirewallRule**: <outside-firewall-rule>
- **insideFirewallRule**: <inside-firewall-rule>
- **healthCheckFirewallRule**: <healthcheck-firewall-rule>

Instance Template parameters

- **machineType**: <machine-type>
- **sourceImageURL**: <source-image-URL>

FTDv Health Check

- **ftdvHealthCheckPort**: <port-number>
- **ftdvCheckIntervalSec**: <interval-in-seconds>
- **ftdvTimeoutSec**: <timeout-in-seconds>
- **ftdvHealthCheckProtocolName**: <protocol-name>
- **ftdvUnhealthyThreshold**: <threshold-count>

FTDv Autoscaler

- **cpuUtilizationTarget**: <percentage-in-decimals (for example, 0.7)>

- **coolDownPeriodSec**: <cooldown-period-in-seconds>
- **minFTDReplicas**: <min-number-of-FTDv-instances>
- **maxFTDReplicas**: <max-number-of-FTDv-instances>

ELB Services

- **elbPort**: <port-number>
- **elbPortName**: <port-name>
- **elbProtocol**: <protocol-name>
- **elbTimeoutSec**: <timeout-in-seconds>
- **elbProtocolName**: <protocol-name>
- **elbUnhealthyThreshold**: <threshold-number-for-failed-health-checks>
- **elbIpProtocol**: <IP-Protocol>
- **elbPortRange**: <port-range>
- **elbFePorts**: <fast-ethernet-ports>

ILB Services

- **ilbProtocol**: <protocol-name>
- **ilbDrainingTimeoutSec**: <timeout-in-seconds>
- **ilbPort**: <port-number>
- **ilbCheckIntervalSec**: <interval-in seconds>
- **ilbTimeoutSec**: <timeout-in-seconds>
- **ilbProtocolName**: <protocol-name>
- **ilbUnhealthyThreshold**: <threshold-number-for-failed-health-checks>

Note For the threat defense virtual Auto Scale, the **cpuUtilizationTarget: 0.5** parameter is set and you can edit it according to your requirements. This value signifies 50% CPU usage of all the threat defense virtual Instance Groups.

d) The `ftdv_template.jinja` file takes parameters from the `ftdv_parameters.yaml` file.

Step 18 Deploy the pre-deployment YAML configuration.

```
gcloud deployment-manager deployments create <pre-deployment-name>
--config ftdv_predeployment.yaml
```

Example:

```
gcloud deployment-manager deployments create demo-predeployment
--config ftdv_predeployment.yaml

The fingerprint of the deployment is b'9NOy0gsTPgg16SqUEVsBjA=='
Waiting for create [operation-1624383045917-5c55e266e596d-4979c5b6-66d1025c]...done.
Create operation operation-1624383045917-5c55e266e596d-4979c5b6-66d1025c
completed successfully
```

Step 19 Create the threat defense virtual Auto Scale deployment.

```
gcloud deployment-manager deployments create <deployment-name>
--config ftdv_parameters.yaml
```

Example:

```
gcloud deployment-manager deployments create demo-asav-autoscale
--config ftdv_parameters.yaml
The fingerprint of the deployment is b'1JCQi7Il-laWOY7vOLza0g=='
Waiting for create [operation-1624383774235-5c55e51d79d01-1a3acf92-4f3daf16]...done.
Create operation operation-1624383774235-5c55e51d79d01-1a3acf92-4f3daf16
completed successfully.
```

Step 20 Create a route for ILB to forward the packets from the inside application to the Internet.

```
gcloud beta compute routes create <ilb-route-name>
--network=<inside-vpc-name> --priority=1000 --destination-range=0.0.0.0/0
--next-hop-ilb=<ilb-forwarding-rule-name> --next-hop-ilb-region=<region>
```

Example:

```
gcloud beta compute routes create demo-ilb --network=sdt-test-asav-inside
--priority=1000 --destination-range=0.0.0.0/0 --next-hop-ilb=demo-asav-fr-ilb
--next-hop-ilb-region=us-central1
Created [https://www.googleapis.com/compute/beta/projects/asavgcp-poc-4krn/global
/routes/demo-ilb].
```

Auto Scale Logic

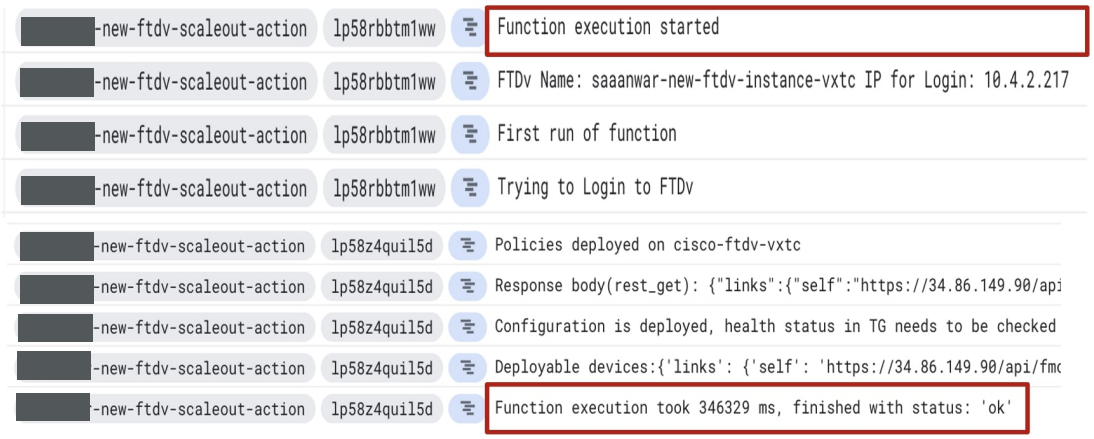
- The autoscaler treats the target CPU utilization level as a fraction of the average use of all vCPUs over time in the instance group.
- If the average utilization of your total vCPUs exceeds the target utilization, the autoscaler adds more VM instances. If the average utilization of your total vCPUs is less than the target utilization, the autoscaler removes instances.
- For example, setting a 0.75 target utilization tells the autoscaler to maintain an average utilization of 75% among all vCPUs in the instance group.
- Only CPU utilization metrics are used in scaling decisions.
- This logic is based on the assumption that load balancer will try to equally distribute connections across all threat defense virtuals, and on average, all threat defense virtuals should be loaded equally.

Auto Scale Logging and Debugging

Logs of cloud functions can be viewed as follows.

- Scale Out function logs

Figure 6: Scale Out Function Logs



In the scale out function logs given above, the **Function execution started** and the **Function execution took 346329 ms, finish with status: 'ok'** entries indicate the start and the end of the function logs respectively. You can also track other operations such as the first function run, threat defense virtual login, policy deployment, and so on.

- Scale In function logs

In the scale out function logs given above, the **Function execution started** and the **Function execution took 50852 ms, finish with status: 'ok'** entries indicate the start and the end of the function logs respectively. You can also track other operations such as initiation of the deregistration process, status of deregistration, obtaining a new authToken, and so on.

Auto Scale Troubleshooting

The following are common error scenarios and debugging tips for Threat Defense Virtual Auto Scale for GCP:

- `main.py` not found—Ensure that the Zip package is made only from the files. You can go to cloud functions and check the file tree. There should not be any folder.

- Error while deploying the template—Ensure that all the parameter values within "<>" are filled in jinja and yaml, or check if a deployment by the same name already exists.
- Google Function cannot reach threat defense virtual—Ensure that the VPC connector is created and the same name is mentioned in the YAML parameter file.
- Authentication Failed while SSH-ing threat defense virtual—Ensure that the Public and Private key pair is correct.
- Auth-token not found—Ensure that the management center virtual password in Secret is correct.
- Unhealthy threat defense virtual and traffic issues—Ensure that there are no issues in the firewall rules and routes.
- Unable to manually log in to threat defense virtual—Ensure that you are using the new password. The old password is changed by the scale-out function.
- Unable to register device on management center virtual—Ensure that threat defense virtual is reachable from management center virtual. The management interface of threat defense virtual and management center virtual should be in the same subnet.
- Preserved connections forming a loop between ILB and threat defense virtual cause high CPU usage due to the initiation of health probe requests. To reduce high CPU usage, you can use one of the following options:

  Option 1 - On the management center virtual, disable data interface, configure health probe NAT rules, and enable data interface. For more information on data interfaces and NAT, refer Interface Overview and Network Address Translation.

  Option 2 - After applying health probe NAT rules from management center virtual, log in to the threat defense virtual console, and use the **clear conn** command. If you have set up clustering, use the **cluster exec clear conn** command.

  Verify CPU usage using the **show cpu** command on the threat defense virtual console.