



# **Turbonomic 7.21.3 Target Configuration Guide**

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## Target Configuration

A target is a service that performs management in your virtual environment. Turbonomic uses targets to monitor workload and to execute actions in your environment. Target Configuration specifies the ports Turbonomic uses to connect with these services. You must install Turbonomic on a network that has access to the specific services you want to set up as targets.

For each target, Turbonomic communicates with the service via the management protocol that it exposes — The REST API, SMI-S, XML, or some other management transport. Turbonomic uses this communication to discover the managed entities, monitor resource utilization, and execute actions.

You can assign instances of the following technologies as Turbonomic targets:

- Cloud Managers
  - Microsoft System Center 2012 Virtual Machine Manager and System Center 2012 R2 Virtual Machine Manager
  - Amazon AWS
  - Microsoft Azure
  - Microsoft Enterprise Agreement
- Fabric Managers
  - Cisco UCS 3.1+
  - HPE OneView 3.00.04+
- Guest OS Processes
  - AppDynamics 4.1+
  - AppInsights 4.1+
  - DynaTrace 1.1+
  - NewRelic 4.1+
  - SNMP
  - WMI Probe Supported Systems
    - Windows 2019
    - Windows 2016
    - Windows 2012 / 2012 R2
    - Windows 2008 R2
    - Windows 10

- Windows 8 / 8.1
- Windows 7
- Hypervisors
  - Microsoft Hyper-V 2008 R2, Hyper-V 2012, and Hyper-V 2012 R2
  - VMware vCenter 5.1, 5.5, 6.0, 6.5, and 6.7
- Storage Managers
  - NetApp Cmode/7mode using ONTAP 8.0+ (excluding AFF and SolidFire)
  - EMC ScaleIO 2.x and 3.x
  - EMC VMAX using SMI-S 8.1+
  - Pure Storage F-series and M-series arrays
  - HPE 3PAR InForm OS 3.2.2+, 3PAR SMI-S, 3PAR WSAPI

## Transport Layer Security Requirements

Turbonomic requires Transport Layer Security (TLS) version 1.2 to establish secure communications with targets. Most targets should have TLSv1.2 enabled. However, some targets might not have TLS enabled, or they might have enabled an earlier version. In that case, you will see handshake errors when Turbonomic tries to connect with the target service. When you go to the Target Configuration view, you will see a Validation Failed status for such targets.

If target validation fails because of TLS support, you might see validation errors with the following strings:

- `No appropriate protocol`

To correct this error, ensure that you have enabled the latest version of TLS that your target technology supports. If this does not resolve the issue, please contact Turbonomic Technical Support.
- `Certificates do not conform to algorithm constraints`

To correct this error, refer to the documentation for your target technology for instructions to generate a certification key with a length of 1024 or greater on your target server. If this does not resolve the issue, please contact Turbonomic Technical Support.

# Adding and Removing Target Virtual Management Servers

The target services your Turbonomic installation will manage appear in the Target Configuration list. You can add, remove, and edit entries in this list. Note that the target service's account must be configured with privileges that support the Turbonomic activities you want to perform. For example, the following list shows how vCenter privileges correspond to activities Turbonomic can perform:

- **Read Only** — Enables Turbonomic monitoring and simulation (what-if scenarios) only
- **vCenter Administrator** — Enables Turbonomic monitoring, simulation (what-if scenarios), and automation functions
- **Enable Datastore Browse** — Enabling this property for the account gives Turbonomic the privileges it needs to enable its storage management functionality

## Adding Targets

To add a target service, click the **Target Configuration** button, provide the requested information, and click **Apply** to validate those targets and start a new discovery.

Typical information you provide includes:

- **Target Type** — Choose among the supported VM Management technologies (Hypervisor, Cloud Management, Load Balancer, etc.)

After you choose the technology, then choose the specific target type for that technology. For example, for Hypervisor technology, the types you can choose include vCenter, RHEV, Hyper-V, and XenServer.

- **Hostname or IP address** — The address of the target service you want to add
- **User Name** — A valid account username for the target service
- **Password** — A password for the target service account

## Editing and Removing Targets

To edit a target entry, select it in the list and then click **Edit**. The **Target Configuration Form** opens, where you can make your settings.

To remove a target, select the entry in the list and then click **Delete**.



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# Hypervisor Targets

A hypervisor is a service that creates and runs virtual machines (VMs), providing the VMs compute and storage resources. When you connect Turbonomic to hypervisor targets in your environment, Turbonomic controls your environment, assuring application performance while also utilizing resources as efficiently as possible.

One of the first steps in any Turbonomic deployment is to connect to the hypervisors within your environment. Once connected, Turbonomic discovers the VMs, the physical machines that host the VMs, the datastores that provide storage resources to the physical machines, and the virtual datastores that provide storage resources to the VMs.

## Supply Chain

Each hypervisor requires a physical machine (host) and one or more datastores to provide compute and storage resources. Virtual machines (VMs) run on those physical resources, and the VMs in turn provide resources to applications.

At the bottom of the supply chain, physical machines consume resources from data centers.

If your environment includes SAN technologies such as disk arrays, then the storage consumes resources from that underlying technology. If you add these storage targets, then Turbonomic extends the supply chain analysis into the components that make up the disk array. For more information, see [Storage Manager Targets \(on page 43\)](#).

## Actions

Turbonomic recommends actions for the hypervisor supply chain as follows.

**NOTE:**

This is a general list of actions for entities discovered for hypervisors. Detailed actions per target are described in each target section.

Entity Type	Action
Virtual Machines	<ul style="list-style-type: none"><li>• Provision additional resources (VMem, VCPU)</li><li>• Move Virtual Machine</li><li>• Move Virtual Machine Storage</li><li>• Reconfigure Storage</li></ul>



Entity Type	Action
	<ul style="list-style-type: none"> <li>Reconfigure Virtual Machine</li> </ul>
Physical Machines	<ul style="list-style-type: none"> <li>Start Physical Machine</li> <li>Provision Physical Machine</li> <li>Suspend Physical Machine</li> </ul>
Storage	<ul style="list-style-type: none"> <li>Start Storage</li> <li>Provision Storage</li> <li>Suspend Storage</li> <li>Move (only with Storage Targets configured)</li> <li>Resize (only with Storage Targets configured)</li> </ul>
Consumer Virtual Datacenters	<ul style="list-style-type: none"> <li>Resize Consumer vDC</li> <li>Provision Consumer vDC</li> </ul>

## Monitored Resources

Turbonomic monitors the following resources for the hypervisor supply chain:

Entity Type	Commodity
Virtual Machine	<ul style="list-style-type: none"> <li>Virtual Memory (VMem) The utilization of the VMem allocated to the hosting VM Measured in Kilobytes (KB)</li> <li>Virtual CPU (VCPU) The utilization of the VCPU allocated to the hosting VM Measured in Megahertz (MHz)</li> <li>Virtual Storage (VStorage) The utilization of the virtual storage capacity allocated for the VM Measured in Kilobytes (KB)</li> <li>Storage Access Operations Per Second (IOPS) The utilization of IOPS allocated for the VStorage on the VM Measured in IOPS</li> <li>Latency The utilization of latency allocated for the VStorage on the VM Measured in milliseconds (ms)</li> </ul>
Physical Machine	<ul style="list-style-type: none"> <li>Memory (Mem) The utilization of the PM's memory reserved or in use Measured in Kilobytes (KB)</li> <li>CPU The utilization of the PM's CPU reserved or in use Measured in Megahertz (MHz)</li> </ul>

Entity Type	Commodity
	<ul style="list-style-type: none"> <li>• IO The utilization of the PM's IO adapters Measured in Kilobytes per second (KB/s)</li> <li>• Net The utilization of data through the PM's network adapters Measured in Kilobytes per second (KB/s)</li> <li>• Swap The utilization of the PM's swap space Measured in Kilobytes (KB)</li> <li>• Balloon The utilization of shared memory among VMs running on the host. ESX-only Measured in Kilobytes (KB)</li> <li>• CPU Ready The utilization of the PM's allocated ready queue capacity (measured in Kbytes) that is in use, for 1, 2, and 4 CPU ready queues. ESX-only Measured in Megahertz (MHz)</li> </ul>
Storage	<ul style="list-style-type: none"> <li>• Storage Amount The utilization of the datastore's capacity Measured in Megabytes (MB)</li> <li>• Storage Provisioned The utilization of the datastore's capacity, including overprovisioning. Measured in Megabytes (MB)</li> <li>• Storage Access Operations Per Second (IOPS) The summation of the read and write access operations per second on the datastore Measured in Operations per second</li> <li>• Latency The utilization of latency on the datastore Measured in Milliseconds (ms)</li> </ul>
Datacenter	<p><b>NOTE:</b> For datacenter entities, Turbonomic does not monitor resources directly from the datacenter, but from the physical machines in the datacenter.</p> <ul style="list-style-type: none"> <li>• Memory (Mem) The utilization of the PM's memory reserved or in use Measured in Kilobytes (KB)</li> <li>• CPU The utilization of the PM's CPU reserved or in use Measured in Megahertz (MHz)</li> </ul>

Entity Type	Commodity
	<ul style="list-style-type: none"> <li data-bbox="362 233 1523 359"> <p>• IO The utilization of the PM's IO adapters Measured in Kilobytes per second (KB/s)</p> </li> <li data-bbox="362 369 1523 495"> <p>• Net The utilization of data through the PM's network adapters Measured in Kilobytes per second (KB/s)</p> </li> <li data-bbox="362 506 1523 632"> <p>• Swap The utilization of the PM's swap space Measured in Kilobytes (KB)</p> </li> <li data-bbox="362 642 1523 768"> <p>• Balloon The utilization of shared of memory among VMs running on the host. ESX-only Measured in Kilobytes (KB)</p> </li> <li data-bbox="362 779 1523 947"> <p>• CPU Ready The utilization of the PM's allocated ready queue capacity (measured in Kbytes) that is in use, for 1, 2, and 4 CPU ready queues. ESX-only Measured in Kilobytes (KB)</p> </li> </ul>
Provider Virtual Datacenter	<ul style="list-style-type: none"> <li data-bbox="362 974 1523 1100"> <p>• Memory (Mem) The utilization of the Datacenter's memory reserved or in use Measured in Kilobytes (KB)</p> </li> <li data-bbox="362 1110 1523 1236"> <p>• CPU The utilization of the Datacenter's CPU reserved or in use Measured in Megahertz (MHz)</p> </li> <li data-bbox="362 1247 1523 1373"> <p>• Storage The utilization of the storage attached to the Provider vDC. Measured in Kilobytes (KB)</p> </li> </ul>
Consumer Virtual Datacenter	<ul style="list-style-type: none"> <li data-bbox="362 1404 1523 1530"> <p>• Memory (Mem) The utilization of the Datacenter's memory reserved or in use Measured in Kilobytes (KB)</p> </li> <li data-bbox="362 1541 1523 1667"> <p>• CPU The utilization of the Datacenter's CPU reserved or in use Measured in Megahertz (MHz)</p> </li> <li data-bbox="362 1677 1523 1803"> <p>• Storage The utilization of the storage attached to the Consumer vDC. Measured in Kilobytes (KB)</p> </li> </ul>

# Hyper-V

If you have a small number of Hyper-V hosts in your environment, you can add them individually as Turbonomic targets. Also, if you have deployed the Hyper-V hosts in a clustered domain (for example as a failover cluster), you can specify one Hyper-V host as a target and Turbonomic automatically add the other members of that cluster.

Note that for large Hyper-V environments, it's typical to manage the hosts via System Center Virtual Machine Manager (VMM). You can specify the VMM server as a target and Turbonomic will use it to discover and manage its child Hyper-V hosts. If you use VMM, you should not add individual Hyper-V hosts as targets. For information about adding VMM targets, see [Adding Virtual Machine Manager Targets \(on page 25\)](#).

**NOTE:**

Even if you manage Hyper-V using a VMM target, you must still configure remote management on each Hyper-V server. This Hyper-V topic includes instructions to configure remote management — see [Enabling Windows Remote Management \(on page 101\)](#).

For accurate SMB storage calculations, Turbonomic requires a VMM target.

## Prerequisites

- Create a user account that Turbonomic can use to connect to your Hyper-V servers. See [Creating a Service User Account in Hyper-V \(on page 15\)](#)
- Configure remote management on each Hyper-V server. Refer to [Enabling Windows Remote Management \(on page 101\)](#)
- Your Hyper-V environment must not use Server Message Block (SMB) storage.  
To manage SMB storage, Turbonomic requires a VMM target, and that VMM instance must manage the Hyper-V hypervisors and the SMB storage that they use.  
Managing a Hyper-V plus SMB environment via Hyper-V targets will result in incorrect data collection for SMB storage.

## Adding Hyper-V Targets

Once you've enabled remote management, you can add your Hyper-V hosts as targets. To add Hyper-V targets, select the **Hypervisors > Hyper-V** option on the Target Configuration page and provide the following information:

- Address  
The FQDN of the Hyper-V host. If you're using the "Discover Host Cluster" below to add an entire cluster, enter the name of any one of the Hyper-V hosts in the cluster.  
Note that you can enter an IP address for the host, but you must first configure an SPN on the host. Turbonomic recommends that you use the FQDN in this field.
- Port number  
The port number for the remote management connection. The default HTTP port is 5985; the default HTTPS port is 5986.
- Secure connection  
Select this option to use a secure connection (HTTPS). Make sure the required certificate is configured for use on the host.
- Full domain name

The full domain name of the cluster to which the host belongs.

- Discover Host Cluster

Turbonomic discovers and adds all Hyper-V hosts in the named cluster if this option is checked. Note that each server must be configured to allow remote management. You may find it helpful to configure WinRM using a GPO so new servers are configured automatically (see [Enabling WinRM Via a GPO \(on page 102\)](#)).

- Username

The username of a user account Turbonomic can use to connect to the Hyper-V host. If you checked "Discover Host Cluster" in the field above, use an account that is valid for all Hyper-V hosts in that cluster.

- Password

Password for account used.

## Exporting Hyper-V Virtual Machines

In Hyper-V environments, you must be sure that all VMs have unique IDs.

Hyper-V supports the export of a VM, so that you can create exact copies of it by importing those exported files. The `Copy` import type creates a new unique ID for the imported VM. When importing VMs in your environment, you should always use the `Copy` import type.

Turbonomic uses the unique ID to discover and track a VM. If your environment includes multiple VMs with the same ID, then discovery will assume they are the same VM. As a result, the counts for VMs will be incorrect.

## Supported Actions

For each discovered entity within the hypervisor supply chain, Turbonomic can execute or recommend certain actions, as outlined below.

Entity Type	Can Be Automated	Recommendations Only
Virtual Machine	Start, Move, Suspend, Resize Down, Resize Up	Terminate, Provision, Reconfigure
Physical Machine	Start, Suspend	Terminate, Provision
Storage		Provision

## Monitored Resources

Turbonomic monitors the following resources for the hypervisor supply chain:

Entity Type	Commodity
Virtual Machine	<ul style="list-style-type: none"> <li>Virtual Memory (VMem) The utilization of the VMem allocated to the hosting VM Measured in Kilobytes (KB)</li> <li>Virtual CPU (VCPU) The utilization of the VCPU allocated to the hosting VM Measured in Megahertz (MHz)</li> <li>Virtual Storage (VStorage)</li> </ul>

Entity Type	Commodity
	<p>The utilization of the virtual storage capacity allocated for the VM Measured in Kilobytes (KB)</p> <ul style="list-style-type: none"> <li>Storage Access Operations Per Second (IOPS)</li> </ul> <p>The utilization of IOPS allocated for the VStorage on the VM Measured in IOPS</p> <ul style="list-style-type: none"> <li>Latency</li> </ul> <p>The utilization of latency allocated for the VStorage on the VM Measured in milliseconds (ms)</p>
Physical Machine	<ul style="list-style-type: none"> <li>Memory (Mem) The utilization of the PM's memory reserved or in use Measured in Kilobytes (KB)</li> <li>CPU The utilization of the PM's CPU reserved or in use Measured in Megahertz (MHz)</li> <li>IO The utilization of the PM's IO adapters Measured in Kilobytes per second (KB/s)</li> <li>Net The utilization of data through the PM's network adapters Measured in Kilobytes per second (KB/s)</li> <li>Swap The utilization of the PM's swap space Measured in Kilobytes (KB)</li> </ul>
Storage	<ul style="list-style-type: none"> <li>Storage Amount The utilization of the datastore's capacity Measured in Megabytes (MB)</li> <li>Storage Provisioned The utilization of the datastore's capacity, including overprovisioning. Measured in Megabytes (MB)</li> <li>Storage Access Operations Per Second (IOPS) The summation of the read and write access operations per second on the datastore Measured in Operations per second</li> <li>Latency The utilization of latency on the datastore</li> </ul>

Entity Type	Commodity
	Measured in Milliseconds (ms)
Datacenter	<p><b>NOTE:</b> For datacenter entities, Turbonomic does not monitor resources directly from the datacenter, but from the physical machines in the datacenter.</p> <ul style="list-style-type: none"> <li>• Memory (Mem) The utilization of the PM's memory reserved or in use Measured in Kilobytes (KB)</li> <li>• CPU The utilization of the PM's CPU reserved or in use Measured in Megahertz (MHz)</li> <li>• IO The utilization of the PM's IO adapters Measured in Kilobytes per second (KB/s)</li> <li>• Net The utilization of data through the PM's network adapters Measured in Kilobytes per second (KB/s)</li> <li>• Swap The utilization of the PM's swap space Measured in Kilobytes (KB)</li> <li>• Balloon The utilization of shared of memory among VMs running on the host. ESX-only Measured in Kilobytes (KB)</li> <li>• CPU Ready The utilization of the PM's allocated ready queue capacity (measured in Kbytes) that is in use, for 1, 2, and 4 CPU ready queues. ESX-only Measured in Kilobytes (KB)</li> </ul>

## Creating A Service User Account

The service account Turbonomic uses to connect to a Hyper-V host must be an Active Directory domain account. The account must have full access to the cluster. To create such an account, execute the following command at a PowerShell prompt:

```
Grant-ClusterAccess <domain>\<service_account> -Full
```

Additionally, the service account must have specific local access rights on each host. The easiest way to grant Operations Manager the access it requires is to add the domain account to the `Local Administrators` group on each Hyper-V server.

Some enterprises require that the service account does not grant full administrator rights. In that case, you can create a restricted service account on every Hyper-V host:

**NOTE:**

Turbonomic does not support Restricted User Accounts on Windows 2012 Hyper-V nodes.

1. Add the service account to each of the following local groups:
  - WinRMRemoteWMIUsers\_\_ (Or Remote Management Users)
  - Hyper-V Administrators
  - Performance Monitor Users

**NOTE:**

These groups are standard Windows Server 2012 security groups. If you are using an earlier version of Windows Server and do not see these groups, contact Turbonomic Support for assistance.

2. Grant permissions to the service account.

In the WMI Management console, grant the `Enable Account`, `Act as Operating System`, and `Remote Enable` permissions to the service account.

3. Configure the WinRM security descriptor to allow access by the service account:

- At a PowerShell prompt, execute `winrm configSDDL default`.
- In the "Permissions for Default" dialog box, grant the service account Read and Execute access.

## vCenter Server

VMware vCenter Server provides a centralized management platform for VMware hypervisors. To manage your VMware environment with Turbonomic, you specify a vCenter Server instance as a target. Turbonomic discovers the associated infrastructure and performs intelligent workload management.

### Prerequisites

- A user account Turbonomic can use to connect to your vCenter and execute actions (see [Creating a User Account In vCenter \(on page 20\)](#)).

### General Considerations Before Target Addition

- **Linked vCenters:**

For linked vCenters, you must add each vCenter separately. Turbonomic communicates with each vCenter through a separate API endpoint, but aggregates the data from those vCenters and makes cross-vCenter actions possible.

- **Restricting Turbonomic Access to Specific Clusters:**

When you add a vCenter target, Turbonomic discovers all of the connected entities that are visible based on the account used to connect to the vCenter target. If there are clusters or other entities you want to exclude, you can do this by setting the role for the Turbonomic account to `No access` in the vSphere management client.

- **Shared Datastores:**

If you add more than one vCenter target that manages the same datastore, you may see conflicts in the metadata Turbonomic maintains for each vCenter. For example, datastore browsing may display a conflict between active and



wasted files, or each vCenter may define the same datastore as a member of a different storage cluster. Turbonomic recommends that you do not add multiple vCenter targets that manage the same datastore.

- **VSAN Permissions:**

In order to enable VSAN support and discover groups based on storage profiles, you must ensure that the user role Turbonomic is assigned has the `Profile-driven storage view` permission enabled. This permission is *disabled* in the built-in `readonly` role.

## Adding vCenter Targets

To add vCenter targets, select the **Hypervisors > vCenter** option on the Target Configuration page and provide the following information:

- **Address**

The name or IP address of the vCenter server.

- **Username/Password**

Credentials for the user account Turbonomic can use to connect to the vCenter Server. Include the domain if required (`<domain>\<username>`).

## vCenter Post-Addition Imports

In addition to discovering entities managed by the hypervisor, Turbonomic also imports a wide range of vSphere settings, such as Host and Storage DRS rules, annotations, Resource Pools, and DRS HA settings (See [Other Information Imported From vCenter \(on page 21\)](#)).

VMware vSphere 6.0 introduced the ability to move VMs between vCenters. If you enabled this feature in your VMware environment, you can configure Turbonomic to include cross vCenter vMotions in its recommendations.

To configure Turbonomic to support cross vCenter vMotion recommendations, you must create a Workload Placement Policy that merges the datacenters on the different vCenters, and then another policy to merge the given clusters. Also note that the merged clusters must use the same network names in the different datacenters. To create a Merge Policy:

1. In the Policy Management Tab, select **Placement Policy**.
2. For `policy type`, select **Merge**.
3. For `MERGE`, choose the merge type, and click **Select**.

To merge datacenters choose `Datacenter`, to merge Host clusters choose `Cluster`, and for storage choose `StorageCluster`.

4. Choose the specific datacenters or clusters to merge in this policy, then click **Select**.
5. Click **Save Policy**.

**NOTE:**

Since Turbonomic can only execute vMotions between clusters that use the same switch type (VSS or VDS), make sure any clusters you merge use the same switch type. Although Turbonomic will not initiate VSS → VDS vMotions, vSphere may do so. If this happens, Turbonomic displays a compliance violation notification.

## Supported Actions

For each discovered entity within the hypervisor supply chain, Operations Manager can execute or recommend certain actions, as outlined below.

Entity Type	Can Be Automated	Recommendations Only
Virtual Machine	Start, Move, Suspend, Storage Move, Resize Down, Resize Up	Terminate, Provision, Reconfigure
Physical Machine	Start, Suspend	Terminate, Provision
Storage		Provision

## Monitored Resources

Turbonomic monitors the following resources for the hypervisor supply chain:

Entity Type	Commodity
Virtual Machine	<ul style="list-style-type: none"> <li>Virtual Memory (VMem) The utilization of the VMem allocated to the hosting VM Measured in Kilobytes (KB)</li> <li>Virtual CPU (VCPU) The utilization of the VCPU allocated to the hosting VM Measured in Megahertz (MHz)</li> <li>Virtual Storage (VStorage) The utilization of the virtual storage capacity allocated for the VM Measured in Kilobytes (KB)</li> <li>Storage Access Operations Per Second (IOPS) The utilization of IOPS allocated for the VStorage on the VM Measured in IOPS</li> <li>Latency The utilization of latency allocated for the VStorage on the VM Measured in milliseconds (ms)</li> </ul>
Physical Machine	<ul style="list-style-type: none"> <li>Memory (Mem) The utilization of the PM's memory reserved or in use Measured in Kilobytes (KB)</li> <li>CPU The utilization of the PM's CPU reserved or in use Measured in Megahertz (MHz)</li> <li>IO The utilization of the PM's IO adapters Measured in Kilobytes per second (KB/s)</li> <li>Net The utilization of data through the PM's network adapters Measured in Kilobytes per second (KB/s)</li> </ul>

Entity Type	Commodity
	<ul style="list-style-type: none"> <li data-bbox="362 233 1521 359">                     • Swap                      The utilization of the PM's swap space                      Measured in Kilobytes (KB)                 </li> <li data-bbox="362 365 1521 491">                     • Balloon                      The utilization of shared memory among VMs running on the host. ESX-only                      Measured in Kilobytes (KB)                 </li> <li data-bbox="362 497 1521 688">                     • CPU Ready                      The utilization of the PM's allocated ready queue capacity (measured in Kbytes) that is in use, for 1, 2, and 4 CPU ready queues. ESX-only                      Measured in Megahertz (MHz)                 </li> </ul>
Storage	<ul style="list-style-type: none"> <li data-bbox="362 695 1521 821">                     • Storage Amount                      The utilization of the datastore's capacity                      Measured in Megabytes (MB)                 </li> <li data-bbox="362 827 1521 953">                     • Storage Provisioned                      The utilization of the datastore's capacity, including overprovisioning.                      Measured in Megabytes (MB)                 </li> <li data-bbox="362 959 1521 1085">                     • Storage Access Operations Per Second (IOPS)                      The summation of the read and write access operations per second on the datastore                      Measured in Operations per second                 </li> <li data-bbox="362 1092 1521 1218">                     • Latency                      The utilization of latency on the datastore                      Measured in Milliseconds (ms)                 </li> </ul>
Datacenter	<p data-bbox="383 1268 1521 1339"><b>NOTE:</b> For datacenter entities, Turbonomic does not monitor resources directly from the datacenter, but from the physical machines in the datacenter.</p> <ul style="list-style-type: none"> <li data-bbox="362 1367 1521 1493">                     • Memory (Mem)                      The utilization of the PM's memory reserved or in use                      Measured in Kilobytes (KB)                 </li> <li data-bbox="362 1499 1521 1625">                     • CPU                      The utilization of the PM's CPU reserved or in use                      Measured in Megahertz (MHz)                 </li> <li data-bbox="362 1631 1521 1757">                     • IO                      The utilization of the PM's IO adapters                      Measured in Kilobytes per second (KB/s)                 </li> <li data-bbox="362 1764 1521 1921">                     • Net                      The utilization of data through the PM's network adapters                      Measured in Kilobytes per second (KB/s)                 </li> </ul>

Entity Type	Commodity
	<ul style="list-style-type: none"> <li data-bbox="362 233 1518 359">• Swap The utilization of the PM's swap space Measured in Kilobytes (KB)</li> <li data-bbox="362 369 1518 495">• Balloon The utilization of shared of memory among VMs running on the host. ESX-only Measured in Kilobytes (KB)</li> <li data-bbox="362 506 1518 680">• CPU Ready The utilization of the PM's allocated ready queue capacity (measured in Kbytes) that is in use, for 1, 2, and 4 CPU ready queues. ESX-only Measured in Kilobytes (KB)</li> </ul>
Provider Virtual Datacenter	<ul style="list-style-type: none"> <li data-bbox="362 695 1518 821">• Memory (Mem) The utilization of the Datacenter's memory reserved or in use Measured in Kilobytes (KB)</li> <li data-bbox="362 831 1518 957">• CPU The utilization of the Datacenter's CPU reserved or in use Measured in Megahertz (MHz)</li> <li data-bbox="362 968 1518 1094">• Storage The utilization of the storage attached to the Provider vDC. Measured in Kilobytes (KB)</li> </ul>
Consumer Virtual Datacenter	<ul style="list-style-type: none"> <li data-bbox="362 1127 1518 1253">• Memory (Mem) The utilization of the Datacenter's memory reserved or in use Measured in Kilobytes (KB)</li> <li data-bbox="362 1264 1518 1390">• CPU The utilization of the Datacenter's CPU reserved or in use Measured in Megahertz (MHz)</li> <li data-bbox="362 1400 1518 1526">• Storage The utilization of the storage attached to the Consumer vDC. Measured in Kilobytes (KB)</li> </ul>

## Creating A Service User Account In vCenter

The service account you use must have specific permissions on the vCenter. The easiest way to grant Turbonomic the access it requires is to grant full administrator rights.

Some enterprises require that the service account does not grant full administrator rights. In that case, you can create a restricted service account that grants the following permissions to enable the required Turbonomic activities:

Turbonomic Activity	Required Privileges
Monitoring	Read-only for all entity types
Recommend Actions	Read-only for all entity types
Wasted Storage Reporting	Datastore > Browse Datastore
Execute VM Move (vMotion)	Resource > Migrate Resource > Query Vmotion Resource > Modify Resource Pool Resource > Assign VM to Resource Pool
Execute VM Storage Move (svMotion)	Datastore > Allocate Space Datastore > Browse Datastore Resource > Assign VM to Resource Pool Resource > Migrate Resource > Modify Resource Pool Resource > Move Resource Pool Resource > Query VMotion Virtual Machine > Configuration > Change Resource Virtual Machine > Configuration > Swap File Placement
Execute VM Resize	Virtual Machine > Configuration > Change CPU Count Virtual Machine > Configuration > Change Resources Virtual Machine > Configuration > Memory Virtual Machine > Interaction > Reset Virtual Machine > Interaction > Power Off Virtual Machine > Interaction > Power On
Discover tags	Global > Global tags In addition, you must open ports 10443 and 7443 on the target server

## Other Information Imported from vCenter

In addition to discovering entities managed by the vSphere hypervisors and their resources, Turbonomic:

- Imports any vSphere Host DRS rules when DRS is enabled, and displays them on the **Policy > Workload Placement** view under **Imported Placement Policies**. Imported rules are enabled by default, but you can disable specific rules if you want.

### NOTE:

In vCenter environments, Turbonomic does not import DRS rules if DRS is disabled on the hypervisor. Further, if Turbonomic did import an enabled DRS rule, that somebody subsequently disables that DRS rule, then Turbonomic will discover that the rule was disabled and will remove the imported placement policy.

- Imports any custom annotations and displays related groupings in the **Inventory > Groups** tree view, under **VC Annotations**. The service account must enable the **Global > Global tag** privilege, and the target server must open ports 10443 and 7443.
- For vCenter Server versions 5.5 and later, discovers Virtual Machine Storage Profiles and displays them as groups anywhere that you can set scope. The groups appear under **VC Storage Profiles**. You can use these discovered storage profiles the same as any other groups — For example, to scope dashboards, or to set the scope for specific action policies.
- Discovers resource pools and displays them as folders in the Inventory tree and as components in the Supply Chain Navigator. If you have the Cloud Control Module license, Turbonomic manages resource pools as Virtual Datacenters (VDCs) and can recommend resize actions. Root resource pools appear as Provider VDCs in the supply chain, whereas child resource pools appear as Consumer VDCs.
- Imports vSphere HA cluster settings and translates them into CPU and memory utilization constraints. These are displayed as cluster-level overrides under **Folders** on the **Policy > Analysis > Host** view.



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## Cloud Management Targets

Cloud-based datacenters support scalability, resource pooling, multi-tenancy, and self-service management of virtual resources. Turbonomic supports the following cloud technologies:

- Microsoft Virtual Machine Manager (VMM)

Cloud infrastructures declare resource pools to serve business needs for multi-tenancy, authorized visibility into the infrastructure, and regional distribution of resources. These pools manage resources such as compute, storage, memory, and network bandwidth in ways that support the cloud's business requirements. Turbonomic discovers and manages these resource pools in relation to the whole datacenter. This enables Turbonomic to:

- Display cloud resources within each pool
- Analyze workload distribution across the entire datacenter
- Control the distribution of workload at each level of the cloud infrastructure

## Private Cloud

A private cloud manages resources in pools to support multi-tenancy and self-service provisioning of virtual workloads. Turbonomic manages these resource pools in real time as demand fluctuates. This includes demand across resource pools, virtual datacenters (VDCs), and tenants.

On the private cloud, you can use Turbonomic to:

- Set up charge-back and show-back for private cloud or service-provider scenarios
- For service-providers, set up scoped views to limit exposure to the customer base
- Plan hardware requirements — the planning scenarios takes cloud architectures into account

### Supply Chain

For private clouds, Turbonomic discovers resource partitions that are managed by the cloud manager, as well as the workload running on these partitions (the VMs and applications) and, where applicable, the supply that hosts

workload (the physical machines and storage). Turbonomic represents these partitions as the following types of Virtual Datacenters (VDCs):

- **Provider VDC**  
 A collection of physical resources (PMs and datastores) within a private cloud. The cloud administrator has access to these resources, and defines the datacenter members. Administrators allocate Provider VDCs to manage resources that will be allocated to external customers through one or more Consumer VDCs.
- **Consumer VDC**  
 A collection of resources that are available for customers to perform self-service management of workload through the cloud. It is an environment customers can use to store, deploy, and operate virtual systems. Consumer VDCs use the resources supplied by a Provider VDC.

## Actions

Turbonomic recommends actions for private cloud infrastructures as follows:

Entity Type	Action
Provider Virtual Datacenters	Turbonomic does not recommend actions to perform on a Provider VDC. Instead, it recommends actions to perform on the devices running in the datacenter.
Consumer Virtual Datacenters	<ul style="list-style-type: none"> <li>• Resize Consumer vDC</li> <li>• Provision Consumer vDC</li> </ul>

## Monitored Resources

Turbonomic monitors the following private cloud infrastructure resources:

Entity Type	Commodity
Provider Virtual Datacenter	<ul style="list-style-type: none"> <li>• <b>Memory (Mem)</b>                      The utilization of the Datacenter's memory reserved or in use                      Measured in Kilobytes (KB)</li> <li>• <b>CPU</b>                      The utilization of the Datacenter's CPU reserved or in use                      Measured in Megahertz (MHz)</li> <li>• <b>Storage</b>                      The utilization of the storage attached to the Provider vDC.                      Measured in Kilobytes (KB)</li> </ul>
Consumer Virtual Datacenter	<ul style="list-style-type: none"> <li>• <b>Memory (Mem)</b>                      The utilization of the Datacenter's memory reserved or in use                      Measured in Kilobytes (KB)</li> <li>• <b>CPU</b>                      The utilization of the Datacenter's CPU reserved or in use                      Measured in Megahertz (MHz)</li> <li>• <b>Storage</b></li> </ul>



Entity Type	Commodity
	The utilization of the storage attached to the Consumer vDC. Measured in Kilobytes (KB)

## Virtual Machine Manager

In a VMM environment, the VMM management server processes commands and controls communications with the Hyper-V hosts. To manage VMM, you set the management server as a target. Turbonomic communicates with that target, and also with the Hyper-V hosts that the VMM server manages. For this reason, if you add a VMM target, you should not also add individual Hyper-V hosts as targets. You must grant Turbonomic access to the VMM management server, and also to all the associated Hyper-V machines.

### Prerequisites

- VMM Dynamic Optimization disabled (recommended) or set to Low aggressiveness, with a frequency of at least 60 minutes.
- Configure remote management on the VMM management Hyper-V server. Refer to [Enabling Windows Remote Management \(on page 101\)](#)
- Apply necessary hot fixes on the VMM host

For example, if you are running VMM Server on a Windows Server version earlier than Windows Server 2012 R2, you must apply the hotfix referenced in the Microsoft Knowledge Base article #2842230 (<http://support.microsoft.com/kb/2842230>).

- Apply time synchronization

The VM that hosts Turbonomic must be synchronized with each target VMM management server. The Turbonomic Installation Guide includes instructions for synchronizing the clock on the Turbonomic server.

- PowerShell execution must be enabled on the VMM management server.
- Configure port access

WinRM uses ports 5985 and 5986 for standard and secure communications, respectively. The firewall on your VMM server must open these ports.

- Preexisting Hyper-V Targets

If any of the hosts that make up the VMM target were added separately as Hyper-V targets (and you do not plan to exclude these hosts), these targets must be deleted. Failure to do so will create duplicate entities in the market, which will negatively impact Turbonomic performance.

### Adding VMM Targets

Turbonomic uses the address and credentials you provide to discover the VMM target. From the VMM target, Turbonomic gets the list of managed Hyper-V instances. It then uses that list to discover each Hyper-V instance. The Hyper-V credentials you provide must be valid for all of these machines.

Turbonomic will also import your Availability Sets, representing them as placement policies for the affected infrastructure.

To add VMM targets, select the **Cloud Management > VMM** option on the Target Configuration page, and provide the following information:

- The IP address or host name of the VMM management server

- Which port to use for the WSMAN connection

For a standard connection (HTTP) use 5985. For a secure connection (HTTPS) use 5986.

- Enable or disable a secure connection

If you enable a secure connection, then you must configure a certificate, and you must configure Turbonomic to communicate over HTTPS. For more information, see [Secure Setup for WSMAN \(on page 104\)](#).

Note that setting a secure connection for VMM does not also set secure connections for the underlying Hyper-V hosts. Any communications between Turbonomic and VMM will be secure. To configure secure connections to the underlying Hyper-V hosts, you must specify secure connections on each one.

- Full domain name for the user account

This domain name identifies the user account for Active Directory authentication.

- Login credentials for the Hyper-V servers that are managed by the VMM target (Optional)

Turbonomic must log into the Hyper-V servers that the VMM server manages. If you leave the Hyper-V credentials blank, then it will use the same credentials that VMM uses. If you provide Hyper-V credentials, then it will use that service account to log into every Hyper-V managed by the VMM.

Note that the service account Turbonomic uses to log into a Hyper-V host must satisfy certain requirements. For more information, see [Creating a Service User Account in Hyper-V \(on page 15\)](#).

- Hosts in the VMM target that you would like to exclude from Turbonomic.

Turbonomic will not discover or manage any hosts you enter in this field. These hosts do not participate in the market, and Turbonomic does not generate actions that involve these hosts. Enter multiple hosts in a comma-separated list. This field accepts both host names, and FQDNs (Fully Qualified Domain Names), and allows the use of the wildcard characters \* and ?.

## Microsoft VMM and Hyper-V VLANs

Windows Server Hyper-V provides support for VLANs on host and VM partitions. If your Hyper-V environment makes use of this VLAN support, then your VM moves must be sensitive to which hosts provide networking access to your defined VM networks. If a VM is a member of a given VM network, then any move of that VM must be to a host that has access to the same network.

For Hyper-V targets in a VMM environment, the Cloud Control Module is aware of the VM networks, and ensures that a move is to a host that provides connectivity over the given VM network. For example, if Host 1 and 2 provides connectivity to VM Network A, and Host 3 and 4 provide connectivity to VM Network B, Turbonomic will never recommend a VM with access to Network A, residing on Host 1, to move to Host 3. That would render the VM unable to communicate on Network A.

## Configuring SMB 3.0 File Shares Discovery

With VMM, Turbonomic can discover SMB 3.0 shares as datastores, assuming these shares have been properly added to your VMM service center. When you add shares to your VMM environment, be sure to:

- Use the Fully Qualified Domain Name of the file server

As you add the associated file server to your VMM environment (via the Add Storage Devices Wizard), be sure to specify the FQDN of the file server on the Specify Discovery Scope page of the wizard. Do not use the file server's IP address.

- Ensure that file server names are unique

Do not specify file servers with the same name, even if they belong to different domains. Turbonomic requires the file server names to be unique.

For information about setting up SMB 3.0 shares, please refer to your Microsoft documentation. For example, see [“How to Assign SMB 3.0 File Shares to Hyper-V Hosts and Clusters in VMM”](#).

## Actions

Turbonomic recommends actions for the cloud target supply chain as follows.

Entity Type	Action
Virtual Machines	<ul style="list-style-type: none"> <li>Provision additional resources (VMem, VCPU)</li> <li>Move Virtual Machine</li> <li>Move Virtual Machine Storage</li> <li>Reconfigure Storage</li> <li>Reconfigure Virtual Machine</li> </ul>
Physical Machines	<ul style="list-style-type: none"> <li>Start Physical Machine</li> <li>Provision Physical Machine</li> <li>Suspend Physical Machine</li> </ul>
Consumer Virtual Datacenters	<ul style="list-style-type: none"> <li>Resize Consumer vDC</li> <li>Provision Consumer vDC</li> </ul>

## Monitored Resources

Turbonomic monitors the following resources for the cloud target supply chain:

Entity Type	Commodity
Virtual Machine	<ul style="list-style-type: none"> <li>Virtual Memory (VMem) The utilization of the VMem allocated to the hosting VM Measured in Kilobytes (KB)</li> <li>Virtual CPU (VCPU) The utilization of the VCPU allocated to the hosting VM Measured in Megahertz (MHz)</li> <li>Virtual Storage (VStorage) The utilization of the virtual storage capacity allocated for the VM Measured in Kilobytes (KB)</li> <li>Storage Access Operations Per Second (IOPS) The utilization of IOPS allocated for the VStorage on the VM Measured in IOPS</li> <li>Latency The utilization of latency allocated for the VStorage on the VM Measured in milliseconds (ms)</li> </ul>
Physical Machine	<ul style="list-style-type: none"> <li>Memory (Mem) The utilization of the PM's memory reserved or in use</li> </ul>

Entity Type	Commodity
	<p>Measured in Kilobytes (KB)</p> <ul style="list-style-type: none"> <li>• CPU The utilization of the PM's CPU reserved or in use</li> </ul> <p>Measured in Megahertz (MHz)</p> <ul style="list-style-type: none"> <li>• IO The utilization of the PM's IO adapters</li> </ul> <p>Measured in Kilobytes per second (KB/s)</p> <ul style="list-style-type: none"> <li>• Net The utilization of data through the PM's network adapters</li> </ul> <p>Measured in Kilobytes per second (KB/s)</p> <ul style="list-style-type: none"> <li>• Swap The utilization of the PM's swap space</li> </ul> <p>Measured in Kilobytes (KB)</p> <ul style="list-style-type: none"> <li>• Balloon The utilization of shared memory among VMs running on the host. ESX-only</li> </ul> <p>Measured in Kilobytes (KB)</p> <ul style="list-style-type: none"> <li>• CPU Ready The utilization of the PM's allocated ready queue capacity (measured in Kbytes) that is in use, for 1, 2, and 4 CPU ready queues. ESX-only</li> </ul> <p>Measured in Megahertz (MHz)</p>
Datacenter	<p><b>NOTE:</b> For datacenter entities, Turbonomic does not monitor resources directly from the datacenter, but from the physical machines in the datacenter.</p> <ul style="list-style-type: none"> <li>• Memory (Mem) The utilization of the PM's memory reserved or in use Measured in Kilobytes (KB)</li> <li>• CPU The utilization of the PM's CPU reserved or in use Measured in Megahertz (MHz)</li> <li>• IO The utilization of the PM's IO adapters Measured in Kilobytes per second (KB/s)</li> <li>• Net The utilization of data through the PM's network adapters Measured in Kilobytes per second (KB/s)</li> <li>• Swap The utilization of the PM's swap space</li> </ul>

Entity Type	Commodity
	<p>Measured in Kilobytes (KB)</p> <ul style="list-style-type: none"> <li>Balloon</li> </ul> <p>The utilization of shared of memory among VMs running on the host. ESX-only</p> <p>Measured in Kilobytes (KB)</p> <ul style="list-style-type: none"> <li>CPU Ready</li> </ul> <p>The utilization of the PM's allocated ready queue capacity (measured in Kbytes) that is in use, for 1, 2, and 4 CPU ready queues. ESX-only</p> <p>Measured in Kilobytes (KB)</p>
Provider Virtual Datacenter	<ul style="list-style-type: none"> <li>Memory (Mem)</li> </ul> <p>The utilization of the Datacenter's memory reserved or in use</p> <p>Measured in Kilobytes (KB)</p> <ul style="list-style-type: none"> <li>CPU</li> </ul> <p>The utilization of the Datacenter's CPU reserved or in use</p> <p>Measured in Megahertz (MHz)</p> <ul style="list-style-type: none"> <li>Storage</li> </ul> <p>The utilization of the storage attached to the Provider vDC.</p> <p>Measured in Kilobytes (KB)</p>
Consumer Virtual Datacenter	<ul style="list-style-type: none"> <li>Memory (Mem)</li> </ul> <p>The utilization of the Datacenter's memory reserved or in use</p> <p>Measured in Kilobytes (KB)</p> <ul style="list-style-type: none"> <li>CPU</li> </ul> <p>The utilization of the Datacenter's CPU reserved or in use</p> <p>Measured in Megahertz (MHz)</p> <ul style="list-style-type: none"> <li>Storage</li> </ul> <p>The utilization of the storage attached to the Consumer vDC.</p> <p>Measured in Kilobytes (KB)</p>

## Public Cloud

The public cloud provides compute, storage, and other resources on demand. You can run all of your infrastructure on a public cloud, or you can set up a hybrid environment where you burst workload to the public cloud as needed. Turbonomic can analyze the performance of applications running on the public cloud, and provision more instances as demand requires. For a hybrid environment, Turbonomic can provision copies of your application VMs on the public cloud to satisfy spikes in demand, and as demand falls off it can suspend those VMs if they're no longer needed.

With public cloud targets, you can use Turbonomic to:

- Scale VMs and Databases
- Change storage tiers
- Purchase VM Reservations
- Locate the most efficient workload placement within the hybrid environment, while assuring performance
- Detect unused storage volumes

Cloud-based datacenters support scalability, resource pooling, multi-tenancy, and self-service management of virtual resources. Turbonomic supports the following cloud technologies:

## Supply Chain

For public clouds, Turbonomic discovers Regions and Zones, and adds them as Datacenter Entities. Regions and zones divide the public cloud into managed subsets. A region is typically associated with the geographic location of the cloud resources, and a zone is some division within the region. One region contains multiple zones.

## Amazon Web Services

Amazon Web Services (AWS) provides a reliable and scalable infrastructure platform in the cloud. You gain access to this infrastructure through a subscription account with the appropriate organization API permissions. To specify an AWS target, you provide the credentials for that account and Turbonomic discovers the resources available to you through that account.

In order to discover RI utilization, you must provide Turbonomic with access to the S3 bucket that contains the AWS Cost and Usage report. Without this access, Turbonomic's purchase and scale decisions will be made without consideration of this data.

### Adding AWS Targets

For Turbonomic to manage an AWS account, you provide the Access Key credentials that you use to access that account. For information about getting an Access Key for an AWS account, see the Amazon Web Services documentation.

To add AWS targets, select **Cloud Management > AWS** on the Target Configuration page, and provide the following information:

- Address  
The display name that will be used to identify the target in the Target List. This is for display in the UI only; it does not need to match any internal name.
- Access Key  
Provide the **Access Key** for the account you want to manage.
- Secret Access Key  
Provide the **Access Key Secret** for the account you want to manage.
- Proxy Host  
The IP of your Proxy Host
- Proxy Port  
The port required for the proxy above
- Cost and Usage Report Bucket

Name of the S3 bucket that contains the AWS Cost and Usage report.

- Cost and Usage Report Region

Region of the S3 bucket that contains the AWS Cost and Usage report.

- Cost and Usage Report Path

Path in the S3 bucket to the AWS Cost and Usage report.

- ARN Account ID

Shows the ARN that Turbonomic discovers for this target. You should never provide a value for this field.

**NOTE:**

Turbonomic supports logging in to AWS targets via AWS Identity and Access Management (IAM) with IAM Users or IAM Roles. To enable using IAM Roles, you must run the Turbonomic software on an EC2 instance in the AWS cloud, and you must have the Turbonomic instance run as the IAM Role, and connect to the AWS target accounts with the appropriate IAM Role. To perform these actions, please contact Technical Support.

## Firewall and Proxy Access

To use AWS with a proxy or firewall, it must be configured to allow unrestricted access to the following URLs:

Functionality	AWS Endpoint
Price List	api.pricing.us-east-1.amazonaws.com
AWS Bill	{bucket-name}.s3.{region-containing-report}.amazonaws.com
CloudWatch	monitoring.{region-id}.amazonaws.com
CloudWatch Events	events.{region-id}.amazonaws.com
CloudWatch Logs	logs.{region-id}.amazonaws.com
EC2	ec2.{region-id}.amazonaws.com
Elastic Load Balancing	elasticloadbalancing.{region-id}.amazonaws.com
IAM	iam.amazonaws.com
Organizations	organizations.{region-id}.amazonaws.com
Relational Database Service (RDS)	rds.{region-id}.amazonaws.com
Resource Groups	resource-groups.{region-id}.amazonaws.com
Service Catalog	servicecatalog.{region-id}.amazonaws.com
S3	s3.{region-id}.amazonaws.com
Storage Gateway	storagegateway.{region-id}.amazonaws.com

## Whitelisting AWS Regions

While Turbonomic is discovering your AWS environment, if it fails to reach one or more AWS regions, then AWS discovery will fail for that target.

There may be policy decisions that prevent Turbonomic from reaching all AWS regions. For example, if you operate Turbonomic behind a firewall, you might not be able to reach all the regions that are available to your AWS account. In that case, you need to specify which regions you want Turbonomic to discover.

For information about how to specify the regions that you want Turbonomic to discover, contact your support representative.

## Cost and Usage Report

In order for Turbonomic to display month-to-day spend, you must create a cost and usage report in AWS and store it in an S3 bucket.

For more information, see [Displaying AWS Spend In Turbonomic](#).

## Enabling Collection of Memory Statistics

For Turbonomic to collect memory statistics in AWS, you must set up CloudWatch to enable the collection of these statistics on the VMs in your environment. For more information, see [Enabling Collection of Memory Statistics: AWS \(on page 98\)](#).

## IAM Authentication

To connect to an AWS target via IAM, Turbonomic requires an IAM User for authentication. This user must have the following permissions:

**NOTE:**

Turbonomic recommends that you set up IAM access via an IAM group that has the necessary permissions. After you create this group, create a user that is a member of it and specify that user for Turbonomic to access your AWS environment. For more information on IAM Groups, see <http://docs.aws.amazon.com/IAM/latest/UserGuide/best-practices.html>.

The Turbonomic user account must have the following permissions.

For read access:

Use these permissions to gain insight into your environment, including utilization statistics and costs for workloads and services. Turbonomic can recommend actions, but this account cannot execute them.

- AmazonRDSReadOnlyAccess
- AmazonEC2ReadOnlyAccess
- AmazonS3ReadOnlyAccess
- organizations:List\*
- organizations:Read\*

For write access (Action Execution):

Use these permissions to automate actions based on Turbonomic analysis.

- AmazonRDSFullAccess
- AmazonEC2FullAccess
- AmazonS3ReadOnlyAccess
- kms:CreateGrant\*
- organizations:List\*
- organizations:Read\*



Turbonomic also supports logging in to AWS targets via IAM Roles. To enable using Roles, you must run the Turbonomic software on an EC2 instance in the AWS cloud, and you must have the Turbonomic instance run as the IAM Role, and connect to the AWS target accounts with the appropriate IAM Role. To perform these actions, see <https://greencircle.vmturbo.com/docs/DOC-5593-role-based-target-access>. For troubleshooting, contact Turbonomic Technical Support.

## Actions

Turbonomic recommends actions for the cloud target supply chain as follows.

Entity Type	Action
Virtual Machines (Cloud)	<ul style="list-style-type: none"> <li>Scale up to template (based on VMem / VCPU)</li> <li>Scale down to template (based on VMem / VCPU)</li> <li>Move Virtual Machine (intra-cloud)</li> </ul> <p><b>NOTE:</b> This is a destructive move- data / applications are not preserved. This action also requires both a Turbonomic merge policy and the moved VM to be a Linux VM with template configuration.</p>
Zone	<ul style="list-style-type: none"> <li>Start VM on the Zone</li> <li>Suspend VM on the Zone</li> </ul>

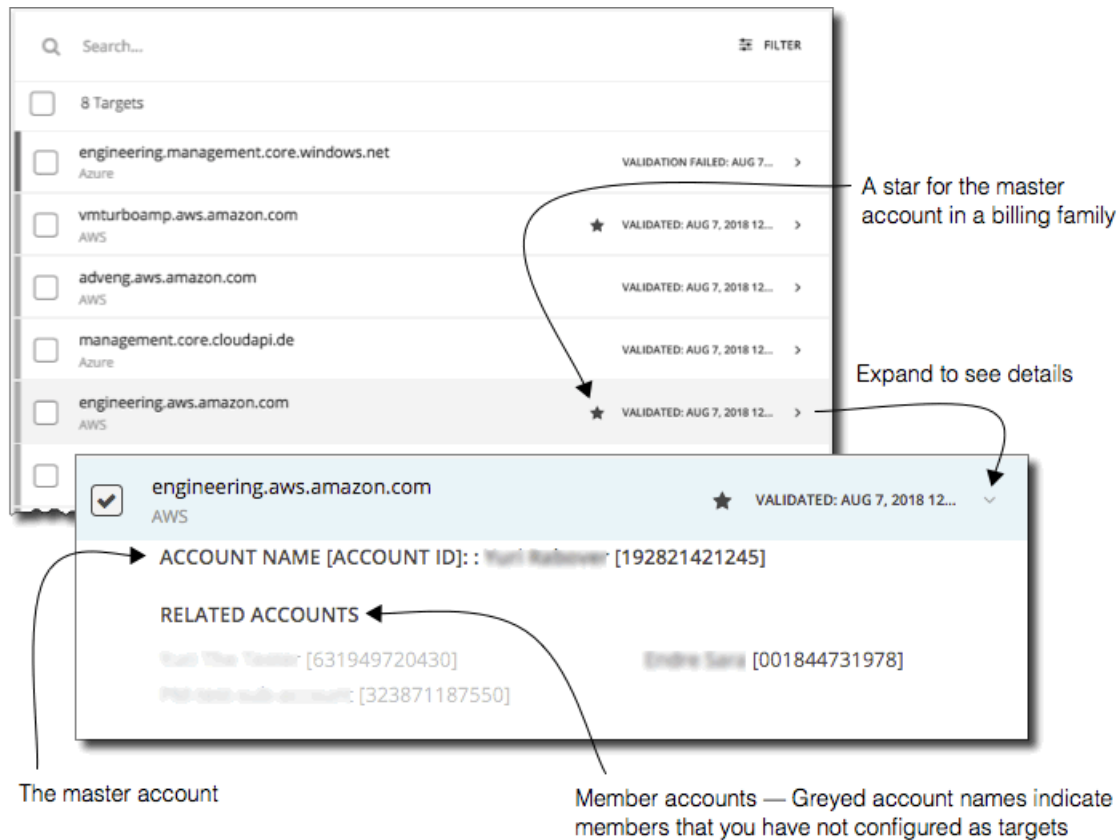
## Monitored Resources

Turbonomic monitors the following resources for the cloud target supply chain:

Entity Type	Commodity
Virtual Machine (Cloud)	<ul style="list-style-type: none"> <li>Virtual Memory (VMem) The utilization of the VMem allocated to the hosting VM Measured in Kilobytes (KB)</li> <li>Virtual CPU (VCPU) The utilization of the VCPU allocated to the hosting VM Measured in Megahertz (MHz)</li> <li>Storage Amount The utilization of the datastore's capacity Measured in Megabytes (MB)</li> <li>Storage Access Operations Per Second (IOPS) The utilization of IOPS allocated for the VStorage on the VM Measured in IOPS</li> <li>Net Throughput Rate of message delivery over a port Measured in KB/s</li> <li>I/O Throughput The throughput to the underlying storage for the entity</li> </ul>

Entity Type	Commodity
	<p>Measured in KB/s</p> <ul style="list-style-type: none"> <li>Latency</li> </ul> <p>The utilization of latency allocated for the VStorage on the VM</p> <p>Measured in milliseconds (ms)</p>
Database Server	<ul style="list-style-type: none"> <li>Virtual Memory (VMem)                     <p>The utilization of the VMem allocated to the hosting VM</p> <p>Measured in Kilobytes (KB)</p> </li> <li>Virtual CPU (VCPU)                     <p>The utilization of the VCPU allocated to the hosting VM</p> <p>Measured in Megahertz (MHz)</p> </li> <li>Storage Amount                     <p>The utilization of the datastore's capacity</p> <p>Measured in Megabytes (MB)</p> </li> <li>I/O Throughput                     <p>The throughput to the underlying storage for the entity</p> <p>Measured in KB/s</p> </li> <li>Latency                     <p>The utilization of latency allocated for the VStorage on the VM</p> <p>Measured in milliseconds (ms)</p> </li> </ul>

# AWS Billing Families



As you configure AWS targets, Turbonomic discovers AWS accounts that are consolidated into *billing families*. A billing family has one *master* account, and zero or more *member* accounts. By recognizing billing families, Turbonomic more accurately calculates cloud investments and savings, and makes more accurate recommendations for RI coverage.

In the Targets user interface, master accounts appear in bold, with a star next to them. You can expand the account entry to see the related member accounts. If you expand the entry for a member account, then the related accounts includes the family master, indicated by a star.

For RI purchases, different accounts in a billing family can share the same RI resources. At the same time, accounts in other billing families cannot use those RIs. This adds flexibility to your RI coverage, while maintaining order over the billing.

In Turbonomic, if you enable Billing Family Recognition, then you can see the billing family master and member accounts in the Targets user interface, and Turbonomic can recommend proper RI purchases within the correct billing families.

To enable Billing Family Recognition, ensure the following as you configure your AWS targets:

- Use the proper role for each AWS target

To properly discover billing family information for a target, you must give Turbonomic credentials for an AWS role that includes the permission, `organizations:DescribeOrganization`. With that permission, Turbonomic can:

- Discover master accounts and member accounts in different billing families
- Display the account names in the user interface
- Discover billing information for each family and account
- Recommend RI actions that respect billing family boundaries

- Configure targets for the complete billing family

One billing family can consolidate a number of AWS accounts. For Turbonomic to include these accounts in its analysis, you must configure each one as a separate target. If you do not configure all the accounts in a billing family, then Turbonomic cannot discover complete billing information for that family, and its analysis will be based on incomplete information.

Turbonomic displays member accounts that have been configured as targets in regular text. For members that Turbonomic discovers but have not been configured as targets, Turbonomic displays their names in grayed text.

If you have enabled Billing Family Recognition, you should keep the following points in mind:

- Billing families can grow

Turbonomic regularly checks the membership of your billing families. If it discovers a new member account, it adds that account to the list of members. If you have already configured the account as a target, then Turbonomic includes the new member in its analysis of billing families. If the new member is not already a target, then Turbonomic lists the new member in grayed text.

- You can configure discounts per billing family

Turbonomic includes a feature to set a discount for a billing group, and to override that discount for specific template families within that scope. For more information, see "Cloud Discounts" in the *User Guide* and "Discount Override: AWS" in the *User Guide*.

- You might see master accounts that have no member accounts

AWS treats every account you create as a part of a billing family. Assume you created an account, but you had no reason to consolidate its billing with any other accounts. In that case, the account appears in the Turbonomic user interface as a master account, but it has no member accounts.

## Microsoft Azure

Microsoft Azure is Microsoft's infrastructure platform for the public cloud. You gain access to this infrastructure through a service principal target. To specify an Azure target, you provide the credentials for that account and Turbonomic discovers the resources available to you through that account.

Azure service principal targets will automatically discover the subscriptions to which the service principal has been granted access in the Azure portal. This in turn will create a derived target for each subscription that inherits the authorization provided by the service principal (e.g. contributor). Derived subscription targets are not directly modifiable but otherwise behave like any other target that may be validated and the inventory discovered.

### Prerequisites

- External access via Client/App ID
- Azure Resource Manager

**NOTE:**

Turbonomic will not discover Azure Classic virtual machines, as they do not utilize the Azure Resource Manager.

You must allow at least 30 minutes of discovery time for Turbonomic to allow full discovery of the Resource Group information.

**NOTE:**

In Azure environments, when you first configure an Azure target, under some circumstances the target has `No Quotas Available`, and so Turbonomic cannot discover the available templates. This can happen when you initially set up the Azure account and you have not enabled any providers. If this occurs, you can install a single VM in your cloud subscription to make quotas available. Or you can navigate to the Azure Subscriptions Blade and select the subscription you want. Then for the resource providers, register the `Microsoft.Compute` option. For more information, see the following Microsoft article: [Resolve errors for resource provider registration](#).

## External Access via Client/App ID

The administrator of an Azure account can register a Web App with the account — This gives an external application access to the account's resources. Turbonomic connects to an Azure target via a Web App registered for that Azure account.

To register a Web App with your account:

- Log into the Azure Management Portal
- Add a Web App to an available Active Directory — The Active Directory will correspond with the Tenant ID that you set for the target.
- From the Application's page in the Management Portal, go to the Configure page  
This page displays the generated Client App ID and Client Secret Key for this app.

**NOTE:**

The person who registers the Web App must record the generated secret key. You can return to the Management Portal to see the Client App ID, but the portal only shows the Secret Key when you register that app.

For more information, refer to your Microsoft Azure documentation.

## Adding Azure Targets

To add Azure targets, select **Cloud Management > Azure** on the Target Configuration page, and provide the following information:

**NOTE:**

For information about how to get these credentials, see the Green Circle article, [“Cloud Control: Azure Target Setup”](#)

- Name  
The display name that will be used to identify the target in the Target List. This is for display in the UI only; it does not need to match any internal name.
- Tenant ID  
The ID of the tenant you want to manage in your Azure subscription.
- Client App ID  
The Client/App ID of the Web App that gives Turbonomic access to resources in your Azure subscription.
- Client Secret Key  
The secret key for the Web App.

## Firewall and Proxy Access

To use Azure with a proxy or firewall, it must be configured to allow unrestricted access to the following URLs:

- `ratecard.azure-api.net`

- `management.azure.com`
- `login.microsoftonline.com`
- `*.core.windows.net`

## Memory Statistics

For Turbonomic to collect memory statistics in Azure, you must enable the collection of these statistics on the VMs in your environment. You can do this as you deploy your VMs, or you can enable the counters after the fact on VMs you have already deployed. For more information, see [Enabling Collection of Memory Statistics: Azure \(on page 100\)](#).

## Actions

Turbonomic recommends actions for the cloud target supply chain as follows.

Entity Type	Action
Virtual Machines (Cloud)	<ul style="list-style-type: none"> <li>• Scale up to template (based on VMem / VCPU)</li> <li>• Scale down to template (based on VMem / VCPU)</li> <li>• Move Virtual Machine (intra-cloud)</li> </ul> <p><b>NOTE:</b> This is a destructive move- data / applications are not preserved. This action also requires both a Turbonomic merge policy and the moved VM to be a Linux VM with template configuration.</p>

## Monitored Resources

Turbonomic monitors the following resources for the cloud target supply chain:

Entity Type	Commodity
Virtual Machine (Cloud)	<ul style="list-style-type: none"> <li>• Virtual Memory (VMem) The utilization of the VMem allocated to the hosting VM Measured in Kilobytes (KB)</li> <li>• Virtual CPU (VCPU) The utilization of the VCPU allocated to the hosting VM Measured in Megahertz (MHz)</li> <li>• Storage Amount The utilization of the datastore's capacity Measured in Megabytes (MB)</li> <li>• Storage Access Operations Per Second (IOPS) The utilization of IOPS allocated for the VStorage on the VM Measured in IOPS</li> <li>• Net Throughput Rate of message delivery over a port Measured in KB/s</li> <li>• I/O Throughput</li> </ul>

Entity Type	Commodity
	The throughput to the underlying storage for the entity Measured in KB/s <ul style="list-style-type: none"> <li>Latency</li> </ul> The utilization of latency allocated for the VStorage on the VM Measured in milliseconds (ms)
Database Server	<ul style="list-style-type: none"> <li>Virtual Memory (VMem) The utilization of the VMem allocated to the hosting VM Measured in Kilobytes (KB)</li> <li>Virtual CPU (VCPU) The utilization of the VCPU allocated to the hosting VM Measured in Megahertz (MHz)</li> <li>Storage Amount The utilization of the datastore's capacity Measured in Megabytes (MB)</li> <li>I/O Throughput The throughput to the underlying storage for the entity Measured in KB/s</li> <li>Latency The utilization of latency allocated for the VStorage on the VM Measured in milliseconds (ms)</li> </ul>

## Microsoft Enterprise Agreement

You can configure Turbonomic to manage Azure subscriptions within the context of an Enterprise Agreement (EA). An EA target enables Turbonomic to use custom pricing and discover reserved instances. When you configure an EA target, Turbonomic uses that richer pricing information to calculate workload size and RI coverage for your Azure environment.

To enable Turbonomic management of Azure EA environments, you must configure both an EA target and at least one service principle target. For more information about service principal targets, see [Adding Azure Targets \(on page 36\)](#).

### Prerequisites

- Microsoft Azure EA access key
- You must ensure that **DA View Charges** and **AO View Charges** are both enabled in the EA Portal (located under **Manage**). If you just enabled these settings, it can take up to 24 hours for the changes to take effect. For more information, see [Troubleshoot enterprise cost views](#) in the Microsoft Azure documentation.

## Adding Microsoft Enterprise Agreement Targets

To add a Microsoft Enterprise Agreement target, select the **Cloud Management > Microsoft Enterprise Agreement** option on the Target Configuration page and provide the following information:

- **Target Name**  
A user-friendly name that will identify the target
- **Enrollment Number**  
Enterprise Agreement enrollment number (found in your EA admin account at ea.azure.com)
- **API Key**  
The API Access Key for the Enterprise Agreement (found in your EA admin account at ea.azure.com)
- **Proxy Host**  
The IP address of the proxy server used, if any
- **Proxy Port**  
The port number of the proxy server
- **Proxy User**  
The username of the proxy user used to authenticate
- **Proxy Password**  
The password of the proxy user used to authenticate

When you add the target and it validates, Turbonomic:

- Recognizes any existing Azure targets in your environment that are part of the EA
- Updates these targets with custom prices from the EA
- Discovers RIs in these targets

Note that this can take up to 24 hours, as target stitching occurs after the next bill processing cycle.

**NOTE:** Turbonomic does not generate actions on the EA target specifically, but for the underlying service principal targets. For information about actions and monitored resources for Azure targets, see [Adding Azure Targets \(on page 36\)](#).



# Azure Enterprise Agreements

You can configure Turbonomic to manage Azure subscriptions within the context of an Enterprise Agreement (EA). An EA defines specific pricing, including the pricing for Reserved Instances (RIs). When you configure an EA target, and set the EA key to your Azure targets, Turbonomic uses that richer pricing information to calculate workload placement and RI coverage for your Azure environment.

To enable Turbonomic management of Azure EA environments, you must configure:

- One Microsoft Enterprise Agreement target
- At least one Service Principal target that can discover the underlying Azure subscriptions

For information about Azure targets, see [Microsoft Azure \(on page 36\)](#).

In the Targets View, you can identify the targets related to Azure EA as follows:

- EA Targets

The target that discovers the EA to track pricing and RI information. You can have one EA target per Turbonomic deployment. The EA target appears with a star next to the validation date. Expand the entry to see the EA enrollment number, and the Azure subscriptions that participate in the EA.

- Azure Subscription Targets

The targets that manage the workloads in your Azure environment. These are discovered by Service Principal targets. Note that not all subscription targets *necessarily* participate in the EA. Expand these entries to see the related Service Principal target. For members of the EA, you can see the related EA target as well.

Subscriptions that do not participate in the EA appear as Standalone targets.

**NOTE:**

In rare circumstances, you can have a subscription that is not in use – The subscription has no workloads associated with it. In this case, Turbonomic identifies the subscription as Standalone. This is because the target cannot discover any cost or usage information that would relate the subscription to its EA.

- Service Principal Targets

The Azure target that you configure to discover Azure subscription targets. Expand the entry to see the discovered targets. If you have configured an EA target, the entry lists that as well, along with the EA enrollment number.

## Reserved Instances and Azure EA

For Azure environments, Turbonomic can only discover and use RIs if you have configured a Microsoft Enterprise Account target, and if one or more subscriptions participate in that EA.

To discover and manage RIs in Azure environments, Turbonomic uses both the EA target and the associated subscription targets. On its own, a subscription target exposes costs for pay-as-you-go pricing. The EA target discovers pricing for the available RI instance types. Turbonomic combines this information to track:

- RI utilization
- RI coverage
- Virtual machine costs (accounting for RIs)

**NOTE:**

This release of Turbonomic does not support RI discovery and management for Classic VMs and Classic Cloud Services. Also, it does not support RI discovery and management for Suppressed Core virtual machines.

## Cost Calculations for Azure Environments

To understand the reported costs in your Azure environment, consider these points:

- For targets that participate in the EA, Turbonomic uses the terms of the given EA, and bases costs on the Offer ID that is effective for the given subscription.
- For VMs in Azure, RI pricing does not include the cost of the OS license. However pricing for on-demand VMs does include the license cost.

**NOTE:**

For Microsoft Azure EA environments, the projected cost for RI Purchase actions might not match associated costs you find in the Microsoft Pricing Calculator.

Turbonomic actions can recommend RI purchases. For these recommendations, the action assumes a free Linux OS, so the cost estimate does not include the OS cost. However, The Microsoft Pricing Calculator does include costs for OS licenses. As a result, when you compare the Turbonomic cost estimates to the values in the Pricing Calculator, it's likely that the two estimates will not match. This difference also affects the Break Even Point that appears in the Recommended RI Purchases chart. Because the recommended purchases do not include Azure costs for OS licenses, the listed Break Even Point can be optimistic.

- For workloads you migrated from on-prem to the Azure cloud, Turbonomic recognizes Azure Hybrid Benefit (AHUB) savings for RIs and on-demand workloads. The costs you see in Turbonomic charts include this benefit. However, remember that recommended actions do not include any license cost, so the actions will not reflect any proposed AHUB savings (see above).
- Turbonomic supports rate cards for workloads that use the pricing set by a Cloud Solution Provider. Note that rate cards only apply to on-demand workloads, and they do not include RI pricing data. For more information, see "Azure Rate Cards" in the *User Guide*.



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## Storage Targets

Adding a storage Target enables Turbonomic to connect to your storage subsystem through an SMI-S provider API or through the controller's native API. Turbonomic uses the target's API to access information about each of the underlying disk arrays, and uses this information to set disk performance characteristics according to the type and capacity of storage. This leads to improved workload placement. Similarly, Turbonomic knows the relationships between storage controllers and disk arrays, and about the location of datastores within those arrays. This information also helps optimize workload placement.

The section below describes the storage supply chain. For information on how to add specific storage targets, the resources Turbonomic can monitor for the various supply chain entities, and the actions it can take to optimize the environment, refer to the target configuration instructions for your specific storage type.

### Supply Chain

Storage targets (storage controllers) add Storage Controller and Disk Array entities to the supply chain. Disk Array entities in turn host Storage entities (datastores).

### Entity Mapping

Turbonomic Mapping	EMC VMAX	HPE 3Par	NetApp	Pure
Storage	Volume (Regular, Thin, Meta)	Virtual Volume	Volume	Volume
Disk Array	Disk Group or Thin Pool	CPG	Aggregate	Shelf Array
Storage Controller	VMAX Array	Controller	Controller / Filer	Controller

### Actions

Turbonomic recommends actions for storage targets as follows.

**NOTE:**

This is a general list of actions for storage managed by storage controllers. Specific actions Turbonomic can recommend, and which actions it can automate depends on the actual technology — Not all actions make sense for all types of storage. For example, Turbonomic can automate a datastore move across disk arrays or storage controllers for NetApp in C mode, but not for other storage technologies.

You can see how actions differ per technology in each section that describes adding a specific type of Storage Manager target.

Entity Type	Action
Storage	<ul style="list-style-type: none"> <li>Start Storage</li> <li>Provision Storage</li> <li>Suspend Storage</li> <li>Move (only with Storage Targets configured)</li> <li>Resize (only with Storage Targets configured)</li> </ul>
Disk Arrays	<ul style="list-style-type: none"> <li>Provision Disk Array</li> <li>Start Disk Array</li> <li>Suspend Disk Array</li> <li>Move Disk Array (for NetApp Cluster-Mode, only)</li> <li>Move Virtual Machine</li> <li>Move Datastore</li> </ul>
Storage Controller	<ul style="list-style-type: none"> <li>Provision Storage Controller (recommendation only)</li> </ul>

**Monitored Resources**

Turbonomic monitors the following storage resources:

Entity Type	Commodity
Storage	<ul style="list-style-type: none"> <li>Storage Amount The utilization of the datastore's capacity Measured in Megabytes (MB)</li> <li>Storage Provisioned The utilization of the datastore's capacity, including overprovisioning. Measured in Megabytes (MB)</li> <li>Storage Access Operations Per Second (IOPS) The summation of the read and write access operations per second on the datastore Measured in Operations per second</li> <li>Latency The utilization of latency on the datastore</li> </ul>

Entity Type	Commodity
	Measured in Milliseconds (ms)
Disk Array	<p><b>NOTE:</b> Not all targets provide all possible commodities. For example, some storage controllers do not expose CPU activity. When a metric is not collected, its widget in the UI will display no data.</p> <ul style="list-style-type: none"> <li>                     Storage Amount                      The utilization of the Disk Array's capacity.                      Measured in Megabytes (MB)                 </li> <li>                     Storage Provisioned                      The utilization of the Disk Array's capacity, including overprovisioning.                      Measured in Megabytes (MB)                 </li> <li>                     Storage Access Operations Per Second (IOPS)                      The summation of the read and write access operations per second on the disk array                      Measured in Operations per second                 </li> <li>                     Latency                      The utilization of latency, computed from the latency of each device in the disk array.                      Measured in milliseconds (ms)                 </li> </ul>
Storage Controller	<p><b>NOTE:</b> Not all targets provide all possible commodities. For example, some storage controllers do not expose CPU activity. When a metric is not collected, its widget in the UI will display no data.</p> <ul style="list-style-type: none"> <li>                     CPU                      The utilization of the Storage Controller's CPU in use                      Measured in Megahertz (MHz)                 </li> <li>                     Storage Amount                      The utilization of the storage controller's capacity. The storage allocated to a storage controller is the total of all the physical space available to aggregates managed by that storage controller                      Measured in Megabytes (MB)                 </li> </ul>

## EMC ScaleIO

EMC ScaleIO is an example of Software-Defined Storage for the datacenter. It creates a Virtual SAN overlaying commodity infrastructure that consists of multiple LAN-connected Servers with locally attached commodity Storage. It presents a standard Block Storage interface to Applications accessing the Virtual SAN.

Turbonomic communicates with the EMC ScaleIO system via the REST API Gateway.

### Prerequisites

- EMC ScaleIO 2.x or 3.x
- A service account that Turbonomic can use to connect to the ScaleIO Gateway.

## Adding EMC ScaleIO Targets

To add EMC ScaleIO targets, select the **Storage > EMC ScaleIO** option on the Target Configuration page and provide the following information:

- Address  
The IP or host name of the Gateway.
- Username  
The Username for the Gateway service account.
- Password  
The Password for the Gateway service account.

## Entity Comparison

After validating the new target, Turbonomic discovers the connected storage entities. This table compares terms used in EMC ScaleIO to those used in Turbonomic:

EMC ScaleIO Name	Turbonomic Entity
Volume	Storage
Storage Pool	Disk Array
Protection Domain	Storage Controller

## Supported Actions

For each discovered entity, Turbonomic can execute or recommend certain actions, as outlined below.

Entity Type	Can Be Automated	Recommendations only
Storage	Provision (Cloning)	Resize (Disabled by default)
Disk Array		Resize Disk Array
Protection Domain		Provision (Cloning)

## Monitored Resources

Turbonomic monitors the following storage resources:

Entity Type	Commodity
Storage	<p><b>NOTE:</b> Not all targets provide all possible commodities. For example, some storage controllers do not expose CPU activity. When a metric is not collected, its widget in the UI will display no data.</p> <ul style="list-style-type: none"> <li>• Storage Amount The utilization of the datastore's capacity Measured in Megabytes (MB)</li> <li>• Storage Provisioned The utilization of the datastore's capacity, including overprovisioning.</li> </ul>

Entity Type	Commodity
	<p>Measured in Megabytes (MB)</p> <ul style="list-style-type: none"> <li>Storage Access Operations Per Second (IOPS)</li> </ul> <p>The summation of the read and write access operations per second on the datastore</p> <p>Measured in Operations per second</p>
Disk Array	<p><b>NOTE:</b> Not all targets provide all possible commodities. For example, some storage controllers do not expose CPU activity. When a metric is not collected, its widget in the UI will display no data.</p> <ul style="list-style-type: none"> <li>Storage Amount                     <p>The utilization of the Disk Array's capacity.</p> <p>Measured in Megabytes (MB)</p> </li> <li>Storage Provisioned                     <p>The utilization of the Disk Array's capacity, including overprovisioning.</p> <p>Measured in Megabytes (MB)</p> </li> <li>Storage Access Operations Per Second (IOPS)                     <p>The summation of the read and write access operations per second on the disk array</p> <p>Measured in Operations per second</p> </li> <li>Latency                     <p>The utilization of latency, computed from the latency of each device in the disk array.</p> <p>Measured in milliseconds (ms)</p> </li> </ul>
Storage Controller	<ul style="list-style-type: none"> <li>Storage Amount                     <p>The utilization of the storage controller's capacity.</p> <p>Measured in Megabytes (MB)</p> </li> </ul>

## EMC VMAX

Turbonomic supports management of VMAX2 and 3 Series storage arrays. The VMAX series is a family of enterprise storage arrays designed for SAN environments. Turbonomic connects to VMAX storage systems via an EMC SMI-S provider that has the disk arrays added to it. A single SMI-S provider can communicate with one or more disk arrays. When you specify an SMI-S provider as a target, Turbonomic discovers all the added disk arrays.

Turbonomic will create Storage Groups based on the SLO levels defined in VMAX3 Targets. By default, Storage Move actions will respect these SLO levels based on the configured response time.

### Prerequisites

- EMC SMI-S Provider V8.x
- A service account that Turbonomic can use to connect to the EMC SMI-S Provider (typically the default `admin` account)

## Adding VMAX Targets

To add VMAX targets, select the **Storage > VMAX** option on the Target Configuration page and provide the following information:

- Address  
The IP or host name of the SMI-S provider. If using HTTPS, you must follow the IP with :PORT.
- Username  
The Username for the SMI-S provider.
- Password  
The Password for the SMI-S provider.

## Entity Comparison

After validating the new target, Turbonomic discovers the connected storage entities. This table compares terms used in EMC VMAX to those used in Turbonomic:

EMC VMAX Name	Turbonomic Entity
Volume (Regular, Thin, Meta)	Storage
Storage Resource Pool (VMAX3) / Thick Provisioned Pool (earlier)	Disk Array
Storage Group (VMAX3) / Thin Provisioned Pool (earlier)	Logical Pool
VMAX Array	Storage Controller

## Supported Actions

For each discovered entity, Turbonomic can execute or recommend certain actions, as outlined below.

Entity Type	Can Be Automated	Recommendations only
Storage	Provision (Cloning), Delete	Resize (V-Volumes only)
Logical Pool		Resize
Disk Array		Provision

## Monitored Resources

When calculating available storage, Turbonomic excludes disks devoted to the VMAX operating system by default. If these disks are assigned to new raid groups or storage pools, the capacity of those disks will then be considered when calculating the capacity of the Storage Controller.

Turbonomic monitors the following storage resources:

Entity Type	Commodity
Storage	<ul style="list-style-type: none"> <li>• Storage Amount The utilization of the datastore's capacity</li> </ul>



Entity Type	Commodity
	<p>Measured in Megabytes (MB)</p> <ul style="list-style-type: none"> <li>Storage Provisioned</li> </ul> <p>The utilization of the datastore's capacity, including overprovisioning.</p> <p>Measured in Megabytes (MB)</p> <ul style="list-style-type: none"> <li>Storage Access Operations Per Second (IOPS)</li> </ul> <p>The summation of the read and write access operations per second on the datastore</p> <p>Measured in Operations per second</p> <ul style="list-style-type: none"> <li>Latency</li> </ul> <p>The utilization of latency on the datastore</p> <p>Measured in Milliseconds (ms)</p>
Logical Pool	<p><b>NOTE:</b> Not all targets provide all possible commodities. For example, some storage controllers do not expose CPU activity. When a metric is not collected, its widget in the UI will display no data.</p> <ul style="list-style-type: none"> <li>Storage Amount</li> </ul> <p>The utilization of the logical pool's capacity.</p> <p>Measured in Megabytes (MB)</p> <ul style="list-style-type: none"> <li>Storage Provisioned</li> </ul> <p>The utilization of the logical pool's capacity, including overprovisioning.</p> <p>Measured in Megabytes (MB)</p> <ul style="list-style-type: none"> <li>Storage Access Operations Per Second (IOPS)</li> </ul> <p>The summation of the read and write access operations per second on the logical pool.</p> <p>Measured in Operations per second</p> <ul style="list-style-type: none"> <li>Latency</li> </ul> <p>The utilization of latency on the logical pool.</p> <p>Measured in milliseconds (ms)</p>
Disk Array	<p><b>NOTE:</b> Not all targets provide all possible commodities. For example, some storage controllers do not expose CPU activity. When a metric is not collected, its widget in the UI will display no data.</p> <ul style="list-style-type: none"> <li>Storage Amount</li> </ul> <p>The utilization of the Disk Array's capacity.</p> <p>Measured in Megabytes (MB)</p> <ul style="list-style-type: none"> <li>Storage Provisioned</li> </ul> <p>The utilization of the Disk Array's capacity, including overprovisioning.</p> <p>Measured in Megabytes (MB)</p> <ul style="list-style-type: none"> <li>Storage Access Operations Per Second (IOPS)</li> </ul> <p>The summation of the read and write access operations per second on the disk array</p> <p>Measured in Operations per second</p>

Entity Type	Commodity
	<ul style="list-style-type: none"> <li>Latency</li> </ul> <p>The utilization of latency, computed from the latency of each device in the disk array.</p> <p>Measured in milliseconds (ms)</p>
Storage Controller	<ul style="list-style-type: none"> <li>Storage Amount</li> </ul> <p>The utilization of the storage controller's capacity.</p> <p>Measured in Megabytes (MB)</p>

## HPE 3PAR

HPE 3PAR StoreServ systems use controller nodes to manage pools of storage resources and present a single storage system to consumers. Turbonomic communicates with the HPE 3PAR system via both the WSAPI and SMI-S providers that are installed on the 3PAR controller node.

### Prerequisites

- SMI-S Provider enabled and configured on the controller node.
- WSPAI Provider enabled and configured on the controller node.
- A service account on the controller node that Turbonomic can use to connect to the SMI-S and WSPAI providers.

#### NOTE:

For discovery and monitoring, the Turbonomic service account must have the `Browse` permission on all monitored domains. To exclude domains from monitoring, the Turbonomic service account must have no permissions on those domains. For action execution, Turbonomic requires the `Edit` permission.

### Setting Up the SMI-S Provider

The HPE 3PAR SMI-S Provider should be installed on the controller node. It is disabled by default — you must ensure that it is installed properly and running on the controller node.

To enable the SMI-S provider:

1. Log into the HPE 3PAR Command Line Interface (CLI).  
Open a secure shell session (`ssh`) on the controller node. Default credentials are `3paradm/3pardata`.
2. Check the current status of the SMI-S provider.  
In the shell session, execute the command, `showcim`.
3. If the CIM service is not running, start it.  
Execute the command `startcim` to enable the CIM service and the SMI-S provider.

To stop the SMI-S provider, execute the command `stopcim -f -x`.

### Setting Up the WSAPI Provider

The HPE 3PAR WSAPI Provider should be installed on the controller node.

To enable the WSAPI provider:

1. Log into the HPE 3PAR Command Line Interface (CLI).  
Open a secure shell session (ssh) on the controller node. Default credentials are `3paradm/3pardata`.
2. Check the current status of the WSAPI provider.  
In the shell session, execute the command, `showwsapi`.
3. If the WSAPI service is not running, start it by executing the command `startwsapi`.  
Execute the command `set wsapi -http enable` to allow only insecure connections, or `set wsapi -https enable` to allow only secure connections.

To stop the WSAPI provider, execute the command `stopwsapi -f`.

## Adding HPE 3PAR Targets

To add an HPE 3PAR target, select the **Storage > HPE 3Par** option on the Target Configuration page and provide the following information:

- Address  
The name or IP address of the 3PAR controller node.  
By default, the controller provides SMI-S data over port 5988 (HTTP) or port 5989 (HTTPS). If your installation uses a different port for SMI-S, include the port number in the Address field.
- Username/Password  
Credentials for a user account on the controller node.

After validating the new target, Turbonomic discovers the connected storage entities. This table compares terms used in HPE 3PAR to those used in Turbonomic:

HPE 3PAR Name	Turbonomic Entity
Virtual Volume	Storage
CPG	Disk Array
AO Configuration	Logical Pool
Controller	Storage Controller

## Supply Chain

Storage targets (storage controllers) add Storage Controller, Logical Pool and Disk Array entities to the supply chain. Logical Pool and Disk Array entities then host Storage entities (datastores). For a visual representation, see the introductory [Storage Supply Chain \(on page 43\)](#).

## 3Par Adaptive Optimization

Adaptive Optimization (AO) for HPE 3Par enables management of data storage across two or three tiers. AO places storage regions on the appropriate tier in response to periodic analysis that AO performs.

To work with the storage in an AO group, Turbonomic:

- Discovers each Common Provisioning Group (CPG) as a disk array

In the Turbonomic user interface, these disk arrays do not host storage — They appear empty. Turbonomic will not recommend storage moves between these disk arrays, because such moves would conflict with AO block-level placement.

- Creates a single logical pool that hosts all the datastores in an AO group

This logical pool represents the AO group, and it includes all the member CPGs. Turbonomic considers this single logical pool when it performs analysis — It can recommend moving storage into or out of the AO group. Also, Turbonomic aggregates resource capacity in this logical pool. For example, the IOPS capacity for the AO logical pool is a combination of IOPS capacity for the constituent CPGs.

You can see the AO logical pool in the Turbonomic user interface. The display name for this logical pool is the name of the AO Configuration.

## Supported Actions

For each discovered entity, Turbonomic can execute or recommend certain actions, as outlined below.

Entity Type	Can Be Automated	Recommendations only
Storage	Provision, Resize Up/Down, Delete	Move
Disk Array	Provision, Resize Up/Down, Delete	
Logical Pool		Provision, Resize Up/Down, Delete
Storage Controller		Provision

## Monitored Resources

Turbonomic monitors the following storage resources:

Entity Type	Commodity
Storage	<ul style="list-style-type: none"> <li>• Storage Amount The utilization of the datastore's capacity Measured in Megabytes (MB)</li> <li>• Storage Provisioned The utilization of the datastore's capacity, including overprovisioning. Measured in Megabytes (MB)</li> <li>• Storage Access Operations Per Second (IOPS) The summation of the read and write access operations per second on the datastore Measured in Operations per second</li> <li>• Latency The utilization of latency on the datastore Measured in Milliseconds (ms)</li> </ul>
Disk Array	<p><b>NOTE:</b> Not all targets provide all possible commodities. For example, some storage controllers do not expose CPU activity. When a metric is not collected, its widget in the UI will display no data.</p> <ul style="list-style-type: none"> <li>• Storage Amount</li> </ul>

Entity Type	Commodity
	<p>The utilization of the Disk Array's capacity. Measured in Megabytes (MB)</p> <ul style="list-style-type: none"> <li>Storage Provisioned</li> </ul> <p>The utilization of the Disk Array's capacity, including overprovisioning. Measured in Megabytes (MB)</p> <ul style="list-style-type: none"> <li>Storage Access Operations Per Second (IOPS)</li> </ul> <p>The summation of the read and write access operations per second on the disk array Measured in Operations per second</p> <ul style="list-style-type: none"> <li>Latency</li> </ul> <p>The utilization of latency, computed from the latency of each device in the disk array. Measured in milliseconds (ms)</p>
Logical Pool	<p><b>NOTE:</b> Not all targets provide all possible commodities. For example, some storage controllers do not expose CPU activity. When a metric is not collected, its widget in the UI will display no data.</p> <ul style="list-style-type: none"> <li>Storage Amount</li> </ul> <p>The utilization of the logical pool's capacity. Measured in Megabytes (MB)</p> <ul style="list-style-type: none"> <li>Storage Provisioned</li> </ul> <p>The utilization of the logical pool's capacity, including overprovisioning. Measured in Megabytes (MB)</p> <ul style="list-style-type: none"> <li>Storage Access Operations Per Second (IOPS)</li> </ul> <p>The summation of the read and write access operations per second on the logical pool. Measured in Operations per second</p> <ul style="list-style-type: none"> <li>Latency</li> </ul> <p>The utilization of latency on the logical pool. Measured in milliseconds (ms)</p>
Storage Controller	<p><b>NOTE:</b> Not all targets provide all possible commodities. For example, some storage controllers do not expose CPU activity. When a metric is not collected, its widget in the UI will display no data.</p> <ul style="list-style-type: none"> <li>CPU</li> </ul> <p>The utilization of the Storage Controller's CPU in use Measured in Megahertz (MHz)</p> <ul style="list-style-type: none"> <li>Storage Amount</li> </ul> <p>The utilization of the storage controller's capacity. The storage allocated to a storage controller is the total of all the physical space available to aggregates managed by that storage controller Measured in Megabytes (MB)</p>

# NetApp

The Storage Control Module adds support for NetApp filers running the Data ONTAP operating system. NetApp storage controllers are Storage Virtual Machines that manage storage arrays — Vfilers for 7-Mode and Vservers for C-Mode. Turbonomic connects to these storage controllers to support NetApp targets in 7-Mode and Cluster-Mode (C-Mode).

## Prerequisites

- Storage Control Module license
- Transport Layer Security (TLS) is enabled
- A service account Turbonomic can use to connect to the NetApp target

## Enabling TLS

Starting with version 5.4, by default Turbonomic requires Transport Layer Security (TLS) version 1.2 to establish secure communications with targets. NetApp filers have TLS disabled by default, and the latest version they support is TLSv1. If your NetApp target fails to validate on Turbonomic 5.4 or later, this is probably the cause.

If target validation fails because of TLS support, you might see validation errors with the following strings:

- No appropriate protocol  
To correct this error, ensure that you have enabled the latest version of TLS that your target technology supports. If this does not resolve the issue, please contact Turbonomic Technical Support.
- Certificates does not conform to algorithm constraints  
To correct this error, refer to your NetApp documentation for instructions to generate a certification key with a length of 1024 or greater on your target server. If this does not resolve the issue, please contact Turbonomic Technical Support.

For information about enabling TLS, see the Data ONTAP **System Administration Guide** for sections on the SSL protocol.

## Service User Account — Administrator Role

To discover and fully manage NetApp disk arrays, Turbonomic must have a service account that grants privileges to execute commands through the NetApp filer's OnTap API (ontapi). In most cases, you can provide a user account with Administrator privileges:

- **NetApp 7-Mode:** Create the administrator account from the NetApp command line — For example:  

```
useradmin user add Turbonomic -g Administrators
```
- **NetApp C-Mode:** Create the administrator account via the NetApp OnCommand System Manager, or from the NetApp command line — For example:  

```
security login create -role admin -username Turbonomic -application ontapi -authmethod password
```

If you prefer not to grant full administrator rights, see [Creating Restricted Service Accounts In NetApp \(on page 56\)](#)

## Adding NetApp Targets

To add a NetApp target, select the **Storage > NetApp** option on the Target Configuration page and provide the following information:

- Address

The name or IP address of the NetApp Storage Controller.

**7-Mode:** Enter the storage controller address.

**Cluster-Mode (C-Mode):** Enter the cluster management address.

- Username/Password

Credentials for the NetApp service user account that you have configured for Turbonomic to use.

After validating the new target, Turbonomic discovers the connected storage entities. This table compares terms used in NetApp to those used in Turbonomic:

NetApp Name	Turbonomic Entity
Volume	Storage
Aggregate	Disk Array
Controller / Filer	Storage Controller

## Supply Chain

Storage targets (storage controllers) add Storage Controller and Disk Array entities to the supply chain. Disk Array entities then host Storage entities (datastores). For a visual representation, see the introductory [Storage Supply Chain \(on page 43\)](#).

## Supported Actions

For each discovered entity, Turbonomic can execute or recommend certain actions, as outlined below.

Entity Type	Can Be Automated	Recommendations only
Storage	Move (C-Mode only)	Move (7-Mode), Provision, Resize Up
Disk Array		Resize Up, Move (C-Mode only), Provision (C-Mode only)
Storage Controller		Provision

Note that for NetApp in C-Mode, Turbonomic can automate moving a datastore to a disk array on the same storage controller, as well as moves to a disk array on a different storage controller.

## Monitored Resources

Turbonomic monitors the following storage resources:

Entity Type	Commodity
Storage	<ul style="list-style-type: none"> <li>• Storage Amount The utilization of the datastore's capacity Measured in Megabytes (MB)</li> <li>• Storage Provisioned The utilization of the datastore's capacity, including overprovisioning.</li> </ul>

Entity Type	Commodity
	<p>Measured in Megabytes (MB)</p> <ul style="list-style-type: none"> <li>Storage Access Operations Per Second (IOPS)</li> </ul> <p>The summation of the read and write access operations per second on the datastore</p> <p>Measured in Operations per second</p> <ul style="list-style-type: none"> <li>Latency</li> </ul> <p>The utilization of latency on the datastore</p> <p>Measured in Milliseconds (ms)</p>
Disk Array	<p><b>NOTE:</b> Not all targets provide all possible commodities. For example, some storage controllers do not expose CPU activity. When a metric is not collected, its widget in the UI will display no data.</p> <ul style="list-style-type: none"> <li>Storage Amount</li> </ul> <p>The utilization of the Disk Array's capacity.</p> <p>Measured in Megabytes (MB)</p> <ul style="list-style-type: none"> <li>Storage Provisioned</li> </ul> <p>The utilization of the Disk Array's capacity, including overprovisioning.</p> <p>Measured in Megabytes (MB)</p> <ul style="list-style-type: none"> <li>Storage Access Operations Per Second (IOPS)</li> </ul> <p>The summation of the read and write access operations per second on the disk array</p> <p>Measured in Operations per second</p> <ul style="list-style-type: none"> <li>Latency</li> </ul> <p>The utilization of latency, computed from the latency of each device in the disk array.</p> <p>Measured in milliseconds (ms)</p>
Storage Controller	<p><b>NOTE:</b> Not all targets provide all possible commodities. For example, some storage controllers do not expose CPU activity. When a metric is not collected, its widget in the UI will display no data.</p> <ul style="list-style-type: none"> <li>CPU</li> </ul> <p>The utilization of the Storage Controller's CPU in use</p> <p>Measured in Megahertz (MHz)</p> <ul style="list-style-type: none"> <li>Storage Amount</li> </ul> <p>The utilization of the storage controller's capacity. The storage allocated to a storage controller is the total of all the physical space available to aggregates managed by that storage controller</p> <p>Measured in Megabytes (MB)</p>

## Restricted Service Accounts In NetApp

While Turbonomic prefers a NetApp service account with administrator rights, it is possible to create an account that has limited access, by following the steps outlined below, depending on NetApp mode.



## NetApp 9.x Restricted Service Account Setup

If you prefer to use a service account that does not have full administrator rights:

1. Log into the NetApp filer from a command shell.
2. Create a role and assign it permission to execute each of the following commands:

For example:

```
security login role create -role RoleName -cmddirname "storage aggregate show"  
-vserver Cluster-Name
```

The required capabilities are listed below:

- cluster identity modify
- cluster identity show
- lun create
- lun igroup create
- lun igroup modify
- lun igroup show
- lun mapping create
- lun mapping delete
- lun mapping show
- lun modify
- lun show
- network interface create
- network interface delete
- network interface modify
- network interface show
- statistics show
- storage aggregate create
- storage aggregate modify
- storage aggregate show
- storage disk show
- system controller flash-cache show
- system node modify
- system node show
- version
- volume create
- volume modify
- volume move modify
- volume move show
- volume move start
- volume qtree create
- volume qtree show
- volume show
- volume snapshot create

- volume snapshot modify
  - volume snapshot show
  - vserver create
  - vserver fcp nodename
  - vserver iscsi nodename
  - vserver modify
  - vserver options
  - vserver show
3. For execution privileges, execute the following commands for the given role, where `Role-Name` is the name of the role you are creating, and `Cluster-Name` identifies the cluster you want the role to affect. You must execute these commands individually to set privileges that affect each individual cluster:
- `security login role create -role Role-Name -access all -cmddirname "volume offline" -vserver Cluster-Name`
  - `security login role create -role Role-Name -access all -cmddirname "volume unmount" -vserver Cluster-Name`
  - `security login role create -role Role-Name -access all -cmddirname "volume move" -vserver Cluster-Name`
  - `security login role create -role Role-Name -access all -cmddirname "volume delete" -vserver Cluster-Name`
4. Create a user that will use the newly-created role.
- For example:
- ```
security login create -User-Name Turbonomic -r TurbonomicRole
```
5. Enter a password for the new user when prompted.
6. Give the user access to the `ssh` and `ontapi` applications by using the following commands, replacing `Role-Name` and `User-Name` with the role and user you created:
- ```
security login create -role Role-Name -username User-Name -application ontapi
-authmethod password

security login create -role Role-Name -username User-Name -application ssh
-authmethod password
```

## NetApp 7-Mode Restricted Service Account Setup

If you prefer to use a service account that does not have full administrator rights:

1. Log into the NetApp filer from a command shell.
2. Create a role with API privileges.

For example:

```
useradmin role add TurbonomicRole <capabilities>]
```

where `<capabilities>` is a comma-separated list of capabilities assigned to the role. The required capabilities are listed below:

- `api-aggr-list-info`
- `api-disk-list-info`
- `api-fcp-node-get-name`
- `api-flash-device-list-info`

- `api-igroup-list-info`
- `api-iscsi-node-get-name`
- `api-lun-initiator-list-map-info`
- `api-lun-map-list-info`
- `api-lun-list-info`
- `api-net-ifconfig-get`
- `api-nfs-exportfs-list-rules-2`
- `api-options-list-info`
- `api-system-get-info`
- `api-system-get-version`
- `api-volume-list-info`
- `api-snapshot-list-info`
- `api-perf-object-get-instances`
- `api-perf-object-instance-list-info`
- `api-perf-object-counter-list-info`
- `api-qtree-list`
- `security-api-vfiler`
- `api-vfiler-list-info`
- `api-volume-options-list-info`
- `login-http-admin`
- `login-*`

Note that the last login capability (`login-*`) may be necessary for external users.

**Execution capabilities:**

- `api-volume-create`
- `api-volume-size`
- `api-volume-offline`
- `api-volume-online`
- `api-volume-destroy`
- `api-aggr-add`
- `api-aggr-create`
- `api-aggr-offline`
- `api-aggr-online`
- `api-aggr-destroy`

3. Create a group and assign the role.

For example:

```
useradmin add TurbonomicGroup -r TurbonomicRole
```

4. Create a user that is a member of the group.

For example:

```
useradmin user add Turbonomic -g TurbonomicGroup
```

5. Enter a password for the new user when prompted.

## NetApp C-Mode Restricted Service Account Setup

If you prefer to use a service account that does not have full administrator rights:

1. Log into the NetApp filer from a command shell.
2. Create a role and assign it permission to execute each of the following commands:
  - `aggr-get-iter`
  - `igroup-get-iter`
  - `cluster-identity-get`
  - `lun-map-get-iter`
  - `net-interface-get-iter`
  - `storage-disk-get-iter`
  - `system-get-node-info-iter`
  - `volume-get-iter`
  - `vserver-get-iter`
  - `fcp-node-get-name`
  - `flash-device-get-iter`
  - `iscsi-node-get-name`
  - `options-list-info`
  - `mtree-list-iter`
  - `system-get-version`
  - `lun-get-iter`
  - `snapshot-get-iter`
  - `perf-object-get-instances`
  - `volume-get-iter`
  - `volume-move-get-iter`
  - `volume-move-start`

For example, to enable volume offline, execute the following:

```
security login role create -role TurbonomicRole -access all -cmddirname "volume  
offline" -vserver <cluster_name>
```

3. Create a user based on the role you create.

Give the user access to the `ssh` and `ontapi` applications. For example:

```
security login create -role TurbonomicRole -username Turbonomic -application ontap  
i -authmethod password
```

```
security login create -role VMTurboRole -username VMTurbo -application ssh -authmet  
hod password
```

# Pure Storage

Turbonomic supports management of Pure Storage FlashArray systems. Note that one Pure Storage target manages a single Pure Storage FlashArray instance. The storage devices in the array are all flash storage — to analyze IOPS capacity, Turbonomic uses the setting made for SSD Disks in the Policy View.

Because of the improved performance of Pure Storage arrays, Turbonomic intelligently moves more demanding workloads to these datastores. Turbonomic analysis is also able to incorporate Pure Storage deduplication and compression when recommending actions.

## Prerequisites

- A service account Turbonomic can use to connect to the FlashArray  
This account needs privileges to execute commands through the Pure Storage API — Typically the default `pureuser` administrative account.

## Adding Pure Storage Targets

To add a Pure Storage target, select the **Storage > Pure Storage** option on the Target Configuration page and provide the following information:

- Address  
The name or IP address of the Pure Storage FlashArray.
- Username/Password  
Credentials for the service account Turbonomic can use to connect to the FlashArray. The Username must not contain the domain. For example, `Username=jjsmith` is correct, while `Username=myDomain\jjsmith` will result in a failure to validate.
- Secure connection  
When checked, uses SSL to connect to the Pure target. Most Pure installations do not accept insecure connections. If you receive an error when adding the target with secure connections disabled, try re-adding with this option enabled.

After validating the new target, Turbonomic discovers the connected storage entities. This table compares terms used in Pure to those used in Turbonomic:

Pure Name	Turbonomic Entity
Volume	Storage
Shelf Array	Disk Array
Controller	Storage Controller

## Supply Chain

Storage targets (storage controllers) add Storage Controller and Disk Array entities to the supply chain. Disk Array entities then host Storage entities (datastores). For a visual representation, see the introductory [Storage Supply Chain \(on page 43\)](#).

## Supported Actions

For each discovered entity, Turbonomic can execute or recommend certain actions, as outlined below.

Entity Type	Can Be Automated	Recommendations only
Storage		Resize Up
Disk Array		
Storage Controller		Provision

Pure Storage assigns all the disks managed by a storage controller to a single array, with a fixed form-factor. There are no actions to perform for an array — For example, there is no action to move a disk array from one storage controller to another. Likewise, there are no actions to move or provision volumes because of the fixed form-factor.

## Monitored Resources

Turbonomic monitors the following storage resources:

Entity Type	Commodity
Storage	<ul style="list-style-type: none"> <li>Storage Amount The utilization of the datastore's capacity Measured in Megabytes (MB)</li> <li>Storage Provisioned The utilization of the datastore's capacity, including overprovisioning. Measured in Megabytes (MB)</li> <li>Storage Access Operations Per Second (IOPS) The summation of the read and write access operations per second on the datastore Measured in Operations per second</li> <li>Latency The utilization of latency on the datastore Measured in Milliseconds (ms)</li> </ul>
Disk Array	<p><b>NOTE:</b> Not all targets provide all possible commodities. For example, some storage controllers do not expose CPU activity. When a metric is not collected, its widget in the UI will display no data.</p> <ul style="list-style-type: none"> <li>Storage Amount The utilization of the Disk Array's capacity. Measured in Megabytes (MB)</li> <li>Storage Provisioned The utilization of the Disk Array's capacity, including overprovisioning. Measured in Megabytes (MB)</li> <li>Storage Access Operations Per Second (IOPS) The summation of the read and write access operations per second on the disk array</li> </ul>

Entity Type	Commodity
	<p>Measured in Operations per second</p> <ul style="list-style-type: none"> <li>Latency</li> </ul> <p>The utilization of latency, computed from the latency of each device in the disk array.</p> <p>Measured in milliseconds (ms)</p>
Storage Controller	<p><b>NOTE:</b> Not all targets provide all possible commodities. For example, some storage controllers do not expose CPU activity. When a metric is not collected, its widget in the UI will display no data.</p> <ul style="list-style-type: none"> <li>CPU</li> </ul> <p>The utilization of the Storage Controller's CPU in use</p> <p>Measured in Megahertz (MHz)</p> <ul style="list-style-type: none"> <li>Storage Amount</li> </ul> <p>The utilization of the storage controller's capacity. The storage allocated to a storage controller is the total of all the physical space available to aggregates managed by that storage controller</p> <p>Measured in Megabytes (MB)</p>



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## Guest OS Process Targets

Turbonomic supports the following Guest OS Process targets:

- AppDynamics 4.1+
- AppInsights 4.1+
- DynaTrace 1.1+
- NewRelic 4.1+
- SNMP (Simple Network Management Protocol)
- WMI (Windows Management Instrumentation)

### Supply Chain

Guest Process targets add Application entities to the supply chain. You can navigate to each individual application server to see specific details.

### Actions

Turbonomic recommends actions for the Guest OS Process supply chain as follows.

**NOTE:**

This is a general list of actions for entities discovered for applications. You can see how actions differ per technology in each section that describes adding a specific type of application target.

Entity Type	Action
Applications	<p>Without discovered Guest OS Processes or Application Servers, Turbonomic doesn't perform actions on applications. Instead, it performs resize actions on the host VMs. If host utilization is high enough on the physical machine running the application VM, Turbonomic may also recommend provisioning a new host.</p> <p>For specific application servers, see the individual application entry.</p>
Virtual Machines	<ul style="list-style-type: none"><li>• Provision additional resources (VMem, VCPU)</li><li>• Move Virtual Machine</li><li>• Move Virtual Machine Storage</li></ul>



Entity Type	Action
	<ul style="list-style-type: none"> <li>Reconfigure Storage</li> <li>Reconfigure Virtual Machine</li> </ul>

## Monitored Resources

Turbonomic monitors the following resources for the Guest OS Process supply chain:

Entity Type	Commodity
WMI/SNMP Application	<ul style="list-style-type: none"> <li>Virtual Memory (VMem) The utilization of the VMem allocated to the hosting VM Measured in Kilobytes (KB)</li> <li>Virtual CPU (VCPU) The utilization of the VCPU allocated to the hosting VM Measured in Megahertz (MHz)</li> </ul>
Virtual Machine	<ul style="list-style-type: none"> <li>Virtual Memory (VMem) The utilization of the VMem allocated to the hosting VM Measured in Kilobytes (KB)</li> <li>Virtual CPU (VCPU) The utilization of the VCPU allocated to the hosting VM Measured in Megahertz (MHz)</li> <li>Virtual Storage (VStorage) The utilization of the virtual storage capacity allocated for the VM Measured in Kilobytes (KB)</li> <li>Storage Access Operations Per Second (IOPS) The utilization of IOPS allocated for the VStorage on the VM Measured in IOPS</li> <li>Latency The utilization of latency allocated for the VStorage on the VM Measured in milliseconds (ms)</li> </ul>

## AppDynamics

Turbonomic supports workload management of the application infrastructure monitored by AppDynamics, via adding the AppDynamics instance to Turbonomic as a target.

The Turbonomic integration with AppDynamics provides a full-stack view of your environment, from application to physical hardware. With information obtained from AppDynamics, Turbonomic is able to make recommendations and

take actions to both assure performance and drive efficiency with the full knowledge of the demands of each individual application.

In its default configuration, the AppDynamics target will collect up to 1100 AppDynamics nodes within the default collection period when a proxy is used, and up to 5000 nodes when no proxy is required. Larger AppDynamics environments are expected to take longer than one cycle to collect complete data.

### Prerequisites

- SaaS or on-prem installation of AppDynamics, version 4.1+
- A valid AppDynamics user account.

For all types of application instances, the service account must have the `Read Only User` role. For monitoring database instances, this user must also have the `DB Monitoring User` role.

**NOTE:**

In newer versions of AppDynamics where these roles are available, they should be used instead:

- Applications and Dashboards Viewer
- Dashboards Viewer
- DB Monitoring User
- Server Monitoring role

### AppDynamics Database Servers

AppDynamics also monitors database servers. In order for your database servers to be correctly stitched to the rest of your environment, you must:

- Enable enhanced metric collection.

For Hyper-V hosts, you must install Hyper-V Integration Services on the target VM hosting the database. For more information, please refer to the following integration services TechNet article:

<https://technet.microsoft.com/en-us/library/dn798297%28v=ws.11%29.aspx>

For VMware hosts, you must install VMware Tools on the target VMs.

- Ensure that the database name in AppDynamics is resolvable to an IP address by the Turbonomic instance. You may need to make changes to your DNS or the file `/etc/resolv.conf` on the Turbonomic instance.

### Entity Comparison

After validating the new target, Turbonomic discovers the connected applications. This table compares terms used in AppDynamics to those used in Turbonomic:

AppDynamics	Turbonomic
Business Application	Business Application
Node	Application Server / Application
Database	Database Server

## Adding an AppDynamics Target

### NOTE:

It is possible to monitor certain applications or database servers with both AppDynamics and Turbonomic, but this must be avoided as it will cause the entities to appear duplicated in the market.

If an application is monitored by AppDynamics, do not add it as a separate Turbonomic application target.

To add an AppDynamics instance as a target, specify:

- Hostname or IP Address  
The host name or IP Address of the AppDynamics instance.
- Username@Account  
Username and account ID with the necessary role(s). The format must be *Username@Account*.
- Password  
Password for the account used to connect to the AppDynamics instance.
- Port  
the port used to connect to the AppDynamics instance. By default, this is set to ports 80 (HTTP) and 443 (HTTPS).  
  
**NOTE:** For SaaS-based AppDynamics instances, you must use port 443.
- Secure Connection  
When checked, Turbonomic will connect via HTTPS. Make sure the required certificate is configured for use on the host.
- Proxy Host  
The address of the proxy used for this target. Only fill out proxy information if you connect to the AppDynamics instance via a proxy.
- Proxy Port  
The port to use with the proxy specified above. By default, this is 8080.
- Proxy Username  
The username to use with the proxy specified above.
- Proxy Password  
The password to use with the proxy specified above.

## Actions

Turbonomic recommends actions for the AppDynamics supply chain as follows.

Entity Type	Action
Application / Application Server	<ul style="list-style-type: none"> <li>• Resize Heap Recommendation only.</li> <li>• Resize Thread Pool Recommendation only.</li> <li>• Resize Connection Capacity Recommendation only.</li> </ul>

Entity Type	Action
	<ul style="list-style-type: none"> <li>• Suspend VM Recommendation only.</li> <li>• Provision VM Recommendation only.</li> </ul>
Virtual Machines	<ul style="list-style-type: none"> <li>• Provision additional resources (VMem, VCPU)</li> <li>• Move Virtual Machine</li> <li>• Move Virtual Machine Storage</li> <li>• Reconfigure Storage</li> <li>• Reconfigure Virtual Machine</li> </ul>

## Monitored Resources

**NOTE:**

The exact resources monitored will differ based on application type. This list includes all resources you may see.

Turbonomic monitors the following resources for the AppDynamics supply chain:

Entity Type	Commodity
Application	<ul style="list-style-type: none"> <li>• Virtual Memory (VMem) The utilization of the VMem consumed from the hosting VM Measured in Kilobytes (KB)</li> <li>• Virtual CPU (VCPU) The utilization of VCPU consumed from the hosting VM Measured in Megahertz (MHz)</li> <li>• Transactions The utilization of the allocated transactions per second for the given application Measured in transactions per second</li> <li>• Heap The utilization of the application server’s heap Measured in Kilobytes (KB)</li> <li>• Response Time The utilization of the server’s allocated response time Measured in Milliseconds (ms)</li> <li>• Threads The utilization of the server’s thread capacity Measured in Threads</li> <li>• Connection The utilization of the connection capacity. Only applicable to database servers Measured in Connections</li> </ul>

Entity Type	Commodity
	<ul style="list-style-type: none"> <li>Garbage Collection The percentage of server uptime spent garbage collecting Measured in of uptime (%)</li> </ul>
Virtual Machine	<ul style="list-style-type: none"> <li>Virtual Memory (VMem) The utilization of the VMem allocated to the hosting VM Measured in Kilobytes (KB)</li> <li>Virtual CPU (VCPU) The utilization of the VCPU allocated to the hosting VM Measured in Megahertz (MHz)</li> <li>Virtual Storage (VStorage) The utilization of the virtual storage capacity allocated for the VM Measured in Kilobytes (KB)</li> <li>Storage Access Operations Per Second (IOPS) The utilization of IOPS allocated for the VStorage on the VM Measured in IOPS</li> <li>Latency The utilization of latency allocated for the VStorage on the VM Measured in milliseconds (ms)</li> </ul>

## Application Insights

Turbonomic supports workload management of the application infrastructure monitored by Application Insights via the Turbonomic integration, which provides a full-stack view of your environment, from application to hosting server. With information obtained from Application Insights, Turbonomic is able to make recommendations and take actions to both assure performance and drive efficiency with the full knowledge of the demands of each individual application.

### Prerequisites

- A valid Application Insights user account with the same permissions detailed for [Microsoft Azure \(on page 36\)](#) targets.

### Entity Comparison

After validating the new target, Turbonomic discovers the connected applications. This table compares terms used in Application Insights to those used in Turbonomic:

Application Insights	Turbonomic
Application (with heap)	Application Server
Application (without heap)	Application

Application Insights	Turbonomic
Application (Database)	SQL Server
Hosting Server	Virtual Machine

## Adding an Application Insights Target

**NOTE:**

If an application is monitored by Application Insights or Azure, do not add it as a separate Turbonomic application target.

To add Application Insights as a target, specify:

- **Unique Target Description**  
A user-created name that will appear in the Turbonomic UI.
- **Tenant Name**  
The tenant associated to the Azure subscription associated to Application Insights.
- **Azure Subscription ID**  
The ID of the Azure subscription with access to the Azure target associated to Application Insights.
- **Client App ID**  
The Client/App ID of the Web App that gives Turbonomic access to resources in your Azure subscription.
- **Client Secret Key**  
The secret key for the Web App.
- **Offer ID**  
If applicable, the Azure Offer ID related to the Azure subscription.
- **Enrollment Number**  
If an Azure EA account, the enrollment number associated to the Azure subscription.

## Stitching Application Insights Applications to the Turbonomic Environment

Each application monitored by Application Insights can have several associated applications, and each of these applications can be deployed on a different hosting server. Likewise, a hosting server may host multiple groups or partial groups of multiple applications.

In order to accurately stitch metrics from Application Insights, the host name or IP address of the hosting server must be discoverable through the Application Insights instance. For most monitored application instances, this is automatic. If the hosting server is not discoverable, Azure tags on the application can be provided to indicate the IP address or hostname.

You can provide an Azure tag in the following name : value format:

```
Turbonomic-Host-Name : RoleInstance=hostname;RoleInstance=hostname;RoleInstance=hostname;
```

In the preceding example, `RoleInstance` is the name of the application instance, and `hostname` is the hosting server. For example: `Turbonomic-Host-Name : cluster-app-a=120.120.120.10;cluster-app-b=120.120.120.11;cluster-app-c=120.120.120.12;`

**NOTE:** If these tags are provided, they will replace any values discovered through the Application Insights API.

## Actions

Turbonomic recommends actions for the Application Insights supply chain as follows.

Entity Type	Action
Application / Application Server	<ul style="list-style-type: none"> <li>• Resize Heap Recommendation only.</li> <li>• Resize Thread Pool Recommendation only.</li> <li>• Resize Connection Capacity Recommendation only.</li> <li>• Suspend VM Recommendation only.</li> <li>• Provision VM Recommendation only.</li> </ul>
Virtual Machines	<ul style="list-style-type: none"> <li>• Provision additional resources (VMem, VCPU)</li> <li>• Move Virtual Machine</li> <li>• Move Virtual Machine Storage</li> <li>• Reconfigure Storage</li> <li>• Reconfigure Virtual Machine</li> </ul>

## Monitored Resources

**NOTE:**

The exact resources monitored will differ based on application type. This list includes all resources you may see.

Turbonomic monitors the following resources for the Application Insights supply chain:

Entity Type	Commodity
Application	<ul style="list-style-type: none"> <li>• Virtual Memory (VMem) The utilization of the VMem consumed from the hosting VM Measured in Kilobytes (KB)</li> <li>• Virtual CPU (VCPU) The utilization of VCPU consumed from the hosting VM Measured in Megahertz (MHz)</li> <li>• Transactions The utilization of the allocated transactions per second for the given application Measured in transactions per second</li> <li>• Heap The utilization of the application server's heap Measured in Kilobytes (KB)</li> </ul>

Entity Type	Commodity
	<ul style="list-style-type: none"> <li>• <b>Response Time</b> The utilization of the server’s allocated response time Measured in Milliseconds (ms)</li> <li>• <b>Threads</b> The utilization of the server’s thread capacity Measured in Threads</li> <li>• <b>Connection</b> The utilization of the connection capacity. Only applicable to database servers Measured in Connections</li> <li>• <b>Garbage Collection</b> The percentage of server uptime spent garbage collecting Measured in of uptime (%)</li> </ul>
Virtual Machine	<ul style="list-style-type: none"> <li>• <b>Virtual Memory (VMem)</b> The utilization of the VMem allocated to the hosting VM Measured in Kilobytes (KB)</li> <li>• <b>Virtual CPU (VCPU)</b> The utilization of the VCPU allocated to the hosting VM Measured in Megahertz (MHz)</li> <li>• <b>Virtual Storage (VStorage)</b> The utilization of the virtual storage capacity allocated for the VM Measured in Kilobytes (KB)</li> <li>• <b>Storage Access Operations Per Second (IOPS)</b> The utilization of IOPS allocated for the VStorage on the VM Measured in IOPS</li> <li>• <b>Latency</b> The utilization of latency allocated for the VStorage on the VM Measured in milliseconds (ms)</li> </ul>

## New Relic

Turbonomic supports workload management of the application infrastructure monitored by New Relic via the Turbonomic integration, which provides a full-stack view of your environment, from application instance to host. With information obtained from New Relic, Turbonomic is able to make recommendations and take actions to both assure performance and drive efficiency with the full knowledge of the demands of each individual application.



## Prerequisites

- A valid New Relic user account that includes either APM or infrastructure monitoring.

## Entity Comparison

After validating the new target, Turbonomic discovers the connected applications. This table compares terms used in New Relic to those used in Turbonomic:

New Relic	Turbonomic
This entity has no direct correlation to a New Relic entity. Instead, a Business Application is a group of application instances of the same language.	Business Application
APM: Application instance (with heap)	Application Server
APM: Application instance (without heap)	Application
Infra: Database	Database Server
Infra: Host	Virtual Machine

## Adding a New Relic Target

### NOTE:

If an application is monitored by New Relic, do not add it as a separate Turbonomic application target.

To add New Relic as a target, specify:

- Account ID  
The New Relic Account ID.
- REST API Key  
The REST API Key *provided by the New Relic platform*. For more information, see [Understand New Relic API Keys](#).
- GraphQL API Key  
The REST API Key *provided by the GraphQL service*. This is not identical to the REST API Key above. For more information, see [Generate a new API key in the NerdGraph GraphQL Explorer](#).
- EU Region  
If checked, Turbonomic will use the EU API endpoints.
- Proxy Host (Optional)  
The IP of the Proxy Host.
- Proxy Port (Optional)  
The port required by the proxy.
- Proxy Username (Optional)  
The username required by the proxy.
- Proxy Password (Optional)  
The password required by the proxy.

## Supported Applications and Databases

The following applications and databases are supported for complete Turbonomic metrics. Turbonomic will discover other applications, but may not be able to retrieve metrics.

Application Types	<ul style="list-style-type: none"> <li>• Go</li> <li>• Java</li> <li>• .NET Core</li> <li>• .NET Framework</li> <li>• Node.js</li> <li>• PHP</li> <li>• Python</li> </ul>
Database Types	<ul style="list-style-type: none"> <li>• MongoDB</li> <li>• MSSQL</li> <li>• MySQL</li> <li>• OracleDB</li> </ul>

## Actions

Turbonomic recommends actions for the New Relic supply chain as follows.

Entity Type	Action
Application / Application Server	<ul style="list-style-type: none"> <li>• Resize Heap Recommendation only.</li> <li>• Resize Thread Pool Recommendation only.</li> <li>• Resize Connection Capacity Recommendation only.</li> <li>• Suspend VM Recommendation only.</li> <li>• Provision VM Recommendation only.</li> </ul>
Virtual Machines	<ul style="list-style-type: none"> <li>• Provision additional resources (VMem, VCPU)</li> <li>• Move Virtual Machine</li> <li>• Move Virtual Machine Storage</li> <li>• Reconfigure Storage</li> <li>• Reconfigure Virtual Machine</li> </ul>

## Monitored Resources

**NOTE:**

The exact resources monitored will differ based on application type. This list includes all resources you may see.

Turbonomic monitors the following resources for the New Relic supply chain:

Entity Type	Commodity
Application	<ul style="list-style-type: none"> <li data-bbox="342 296 1338 426"> <p>• Virtual Memory (VMem) The utilization of the VMem consumed from the hosting VM Measured in Kilobytes (KB)</p> </li> <li data-bbox="342 436 1338 567"> <p>• Virtual CPU (VCPU) The utilization of VCPU consumed from the hosting VM Measured in Megahertz (MHz)</p> </li> <li data-bbox="342 577 1338 707"> <p>• Transactions The utilization of the allocated transactions per second for the given application Measured in transactions per second</p> </li> <li data-bbox="342 718 1338 848"> <p>• Heap The utilization of the application server's heap Measured in Kilobytes (KB)</p> </li> <li data-bbox="342 858 1338 989"> <p>• Response Time The utilization of the server's allocated response time Measured in Milliseconds (ms)</p> </li> <li data-bbox="342 999 1338 1129"> <p>• Threads The utilization of the server's thread capacity Measured in Threads</p> </li> <li data-bbox="342 1140 1338 1270"> <p>• Connection The utilization of the connection capacity. Only applicable to database servers Measured in Connections</p> </li> <li data-bbox="342 1281 1338 1411"> <p>• Garbage Collection The percentage of server uptime spent garbage collecting Measured in of uptime (%)</p> </li> </ul>
Virtual Machine	<ul style="list-style-type: none"> <li data-bbox="342 1430 1338 1560"> <p>• Virtual Memory (VMem) The utilization of the VMem allocated to the hosting VM Measured in Kilobytes (KB)</p> </li> <li data-bbox="342 1570 1338 1701"> <p>• Virtual CPU (VCPU) The utilization of the VCPU allocated to the hosting VM Measured in Megahertz (MHz)</p> </li> <li data-bbox="342 1711 1338 1841"> <p>• Virtual Storage (VStorage) The utilization of the virtual storage capacity allocated for the VM Measured in Kilobytes (KB)</p> </li> <li data-bbox="342 1852 1338 1925"> <p>• Storage Access Operations Per Second (IOPS) The utilization of IOPS allocated for the VStorage on the VM</p> </li> </ul>

Entity Type	Commodity
	Measured in IOPS <ul style="list-style-type: none"> <li>• Latency</li> </ul> The utilization of latency allocated for the VStorage on the VM Measured in milliseconds (ms)

## Dynatrace

Turbonomic supports discovery of applications that are managed by the Dynatrace platform. Turbonomic includes the discovered information about these applications in its calculations for VM actions.

### Prerequisites

- A Dynatrace Server instance running in your environment.
 

This instance must be configured to monitor applications running in your environment.
- Managed VMs that are running applications managed by Dynatrace.
 

For Turbonomic to discover applications through Dynatrace, the applications must be running on VMs in your environment. Also, these VMs must be managed by hypervisors that you have configured as Turbonomic targets.
- A valid Dynatrace user account.
 

The account must provide read-only access to the application data that is gathered by the Dynatrace server.

### Adding a Dynatrace Target

#### NOTE:

It is possible to monitor certain applications or database servers with both Dynatrace and Turbonomic. You should avoid such a configuration because it can cause Turbonomic to generate duplicate entities in the market.

If you monitor an application via a Dynatrace server, and you configure that Dynatrace server as a Turbonomic target, then be sure you have not added that application as a separate application target in Turbonomic.

To add a Dynatrace server instance as a target, specify:

- Hostname or IP Address
 

The host name or IP and endpoint, separated by a slash. For example, `10.10.10.10/e/b70e3eb2-e82b-4c13-a5a4-560d9865841r`
- API Token
 

The token that Turbonomic will use to authenticate its calls to the Dynatrace API. This token must have permission to execute GET methods via the Dynatrace API.
- Proxy Host
 

The address of the proxy used for this target. Only fill out proxy information if you connect to the Dynatrace server via a proxy.
- Proxy Port
 

The port to use with the proxy specified above. By default, this is 8080.

- Proxy Username  
The username for the account to log into the proxy specified above.
- Proxy Password  
The password to use with the proxy specified above.

## Actions

Turbonomic does not recommend actions for Dynatrace applications. However, it considers resource utilization by these applications when recommending actions for the underlying VMs.

## Monitored Resources

### NOTE:

The exact resources monitored will differ based on application type. This list includes all resources you may see.

Turbonomic monitors the following resources for the Dynatrace supply chain:

Entity Type	Commodity
Application	<ul style="list-style-type: none"> <li>• Virtual Memory (VMem) The utilization of the VMem allocated to the hosting VM Measured in Kilobytes (KB)</li> <li>• Virtual CPU (VCPU) The utilization of the VCPU allocated to the hosting VM Measured in Megahertz (MHz)</li> <li>• Transactions The utilization of the allocated transactions per second for the given virtual application Measured in transactions per second</li> <li>• Response Time The utilization of the server's allocated response time Measured in Milliseconds (ms)</li> <li>• Threads The utilization of the server's thread capacity Measured in Threads</li> <li>• Connection The utilization of the connection capacity. Only applicable to database servers Measured in Connections</li> <li>• Garbage Collection The percentage of server uptime spent garbage collecting Measured in of uptime (%)</li> </ul>
Virtual Machine	<ul style="list-style-type: none"> <li>• Virtual Memory (VMem) The utilization of the VMem allocated to the hosting VM</li> </ul>

Entity Type	Commodity
	<p>Measured in Kilobytes (KB)</p> <ul style="list-style-type: none"> <li>Virtual CPU (VCPU)</li> </ul> <p>The utilization of the VCPU allocated to the hosting VM</p> <p>Measured in Megahertz (MHz)</p> <ul style="list-style-type: none"> <li>Virtual Storage (VStorage)</li> </ul> <p>The utilization of the virtual storage capacity allocated for the VM</p> <p>Measured in Kilobytes (KB)</p> <ul style="list-style-type: none"> <li>Storage Access Operations Per Second (IOPS)</li> </ul> <p>The utilization of IOPS allocated for the VStorage on the VM</p> <p>Measured in IOPS</p> <ul style="list-style-type: none"> <li>Latency</li> </ul> <p>The utilization of latency allocated for the VStorage on the VM</p> <p>Measured in milliseconds (ms)</p>

# SNMP

Turbonomic will discover application and operating system resources using SNMP (Simple Network Management Protocol) on Linux hosts in your entire environment, or a portion of your environment, based on scope.

## Prerequisites

- Underlying VM host targets added to Turbonomic (for discovery)
- SNMP service enabled/configured on target VMs

**NOTE:**

For Hyper-V hosts, you must install Hyper-V Integration Services on the target VMs. For more information, please refer to the following integration services TechNet article:

<https://technet.microsoft.com/en-us/library/dn798297%28v=ws.11%29.aspx>

For VMware hosts, you must install VMware Tools on the target VMs.

## Adding SNMP Targets

To add SNMP targets, select the **Guest OS Processes > SNMP** option on the Target Configuration page and provide the following information:

- Target Name
 

The display name that will be used to identify the target in the Target List. This is for display in the UI only; it does not need to match any internal name.
- Scope

Turbonomic will search for SNMP applications using the port entered above on the VMs found within the set scope. This scope can be set to the entire environment, single or multiple clusters, or particular virtual machines. Select this option and choose the scope for application discovery.

**NOTE:**

A single scope (target) must not contain more than 500 virtual machines. Turbonomic recommends utilization of multiple WMI targets for environments exceeding this limit.

- Community

The SNMP v2c community string Turbonomic will use to connect to the application

- Port number

The Port number Turbonomic will use to connect to the virtual machines hosting the application

- Full Validation

When selected, Turbonomic will require every VM in the selected scope to be a valid target. If Turbonomic is unable to authenticate a VM in the scope, the target will not validate and data will not be collected.

- Enable SNMPv3

When checked, Turbonomic will use SNMPv3 to connect to the virtual machines in the selected scope

- SNMPv3 Username/Securityname

The Username or Securityname that Turbonomic will use to connect to the virtual machines hosting the application

- SNMPv3 Enable Privacy

When checked, Turbonomic will encrypt using the privacy password to keep the connection private.

- SNMPv3 Authentication Password

The Authentication Password Turbonomic will use to connect to the virtual machines in the selected scope. This allows requests to be authenticated, confirming the sender's identity.

- SNMPv3 Privacy Password

The Privacy Password Turbonomic will use to connect to the virtual machines in the selected scope. For requests to be encrypted, the SNMP manager and the SNMP agent must share knowledge of the privacy password associated with the username.

- SHA-1 For Authentication

When checked, Turbonomic will use SHA-1 Authentication to connect to the virtual machines in the selected scope. When unchecked, Turbonomic uses MD5

- AES For Privacy

When checked, Turbonomic will use AES 128 to connect to the virtual machines in the selected scope. When unchecked, Turbonomic uses DES

**NOTE:**

Turbonomic does not support AES 192 or 256 for SNMP targets.

## Supported Actions

For each discovered entity within the application supply chain, Turbonomic can execute or recommend certain actions, as outlined below.

Entity Type	Action
Applications	<p>Without discovered Guest OS Processes or Application Servers, Turbonomic doesn't perform actions on applications. Instead, it performs resize actions on the host VMs. If host utilization is high enough on the physical machine running the application VM, Turbonomic may also recommend provisioning a new host.</p> <p>For specific application servers, see the individual application entry.</p>
Virtual Machines	<ul style="list-style-type: none"> <li>• Provision additional resources (VMem, VCPU)</li> <li>• Move Virtual Machine</li> <li>• Move Virtual Machine Storage</li> <li>• Reconfigure Storage</li> <li>• Reconfigure Virtual Machine</li> </ul>

### Monitored Resources

Turbonomic monitors the following resources for the application supply chain:

Entity Type	Commodity
WMI/SNMP Application	<ul style="list-style-type: none"> <li>• Virtual Memory (VMem) The utilization of the VMem allocated to the hosting VM Measured in Kilobytes (KB)</li> <li>• Virtual CPU (VCPU) The utilization of the VCPU allocated to the hosting VM Measured in Megahertz (MHz)</li> </ul>
Virtual Machine	<ul style="list-style-type: none"> <li>• Virtual Memory (VMem) The utilization of the VMem allocated to the hosting VM Measured in Kilobytes (KB)</li> <li>• Virtual CPU (VCPU) The utilization of the VCPU allocated to the hosting VM Measured in Megahertz (MHz)</li> <li>• Virtual Storage (VStorage) The utilization of the virtual storage capacity allocated for the VM Measured in Kilobytes (KB)</li> <li>• Storage Access Operations Per Second (IOPS) The utilization of IOPS allocated for the VStorage on the VM Measured in IOPS</li> <li>• Latency The utilization of latency allocated for the VStorage on the VM Measured in milliseconds (ms)</li> </ul>



# Enabling SNMP

Turbonomic requires that SNMP is enabled and configured in order to discover Guest Processes. While these steps will change slightly between OS versions, this topic gives you the general instructions:

## Enabling SNMP v2

1. Obtain and install the SNMP server package for your version of Linux. This is commonly called `net-snmp` in most package managers. Also install the `net-snmp-utils` package if it is available
2. Configure the SNMP daemon by editing `/etc/snmp/snmpd.conf` or running `snmpconf -i` at the command line in order to verify that:
  - SNMPv2c is enabled
  - A read-only community name has been set. This community name will be used by Turbonomic to communicate with the VM

### NOTE:

The community name you select must have at least read-only access to all OIDs in the system.

3. Configure the daemon to listen on a public interface. Most default installations only listen on `127.0.0.1`
4. Start the SNMP daemon process

These long form and short form sample `snmpd.conf` files illustrate the necessary changes.

### Long form, VACM:

```
# First, map the community name "mycommunity1" into a "security name"
# sec.name source community
com2sec notConfigUser default mycommunity1
# Second, map the security name into a group name:
# groupName securityModel securityName
group notConfigGroup v2c notConfigUser
# Finally, grant the group read-only access to any OID.
# group context sec.model sec.level prefix read write notif
access notConfigGroup "" any noauth exact all none none
```

### Short form, older syntax:

```
rocommunity mycommunity1 default system
```

### Verify Your SNMP Setup

Verify that your SNMP setup is successful by using the following command from a remote machine, replacing the community string and IP address:

```
snmpwalk -Os -v 2c -c COMMUNITY_STRING IP_ADDRESS iso.3.6.1.2.1.1.1
```

If successful, the command will return the kernel version of the machine (similar to the output of `uname -a`)

## Enabling SNMP v3

1. Obtain and install the SNMP server package for your version of Linux.
 

Most package managers call this package `net-snmp`. To verify your configuration in step 5 below, you should also install the `net-snmp-utils` package on the Turbonomic VM.
2. Stop the SNMP service.
3. Create the SNMPv3 user.

Execute the following command:

```
net-snmp-config --create-snmpv3-user [-ro] [-A authpass] [-X privpass] [-a MD5|SHA]
[-x DES|AES] [username]
```

For example, the command:

```
i. net-snmp-create-v3-user -ro -A snmpv3authPass -a SHA -X snmpv3encPass -x AES
snmpv3user
```

results in output similar to:

adding the following line to /var/lib/net-snmp/snmpd.conf:

```
createUser snmpv3user SHA "snmpv3authPass" AES snmpv3encPass adding the following
line to /etc/snmp/snmpd.conf:
```

```
rouser snmpv3user
```

#### 4. Secure the SNMP daemon.

Use a host firewall to only allow requests from source IP addresses you know, and which need to query the system.

#### 5. Verify your SNMP setup.

To verify the configuration, you can execute the following command on the Turbonomic VM:

```
snmpwalk -v3 -u snmpv3user -A snmpv3authPass -a SHA -X snmpv3encPass -x AES -l
authPriv <TargetIP>
```

## WMI

Turbonomic will discover application and operating system resources using WMI (Windows Management Instrumentation) in your entire environment, or a portion of your environment, based on scope.

### Prerequisites

- Underlying VM host targets added to Turbonomic (for discovery)
- A WMI user account Turbonomic can use to connect to the WMI targets. This account can either be an administrator user, or a non-administrator belonging to certain local user groups. For a full list of requirements, see [Creating a WMI User Account \(on page 84\)](#)
- WMI enabled on target VMs. For assistance in enabling WMI, see [Enabling WMI \(on page 85\)](#).

#### NOTE:

For Hyper-V hosts, you must install Hyper-V Integration Services on the target VMs. For more information, please refer to the following integration services TechNet article:

<https://technet.microsoft.com/en-us/library/dn798297%28v=ws.11%29.aspx>

For VMware hosts, you must install VMware Tools on the target VMs.

## Adding WMI Targets

To add WMI targets, select the **Guest OS Processes > WMI** option on the Target Configuration page and provide the following information:

- **Target Name**  
The display name that will be used to identify the target in the Target List. This is for display in the UI only; it does not need to match any internal name.
- **Username**  
The username Turbonomic will use to connect to the WinRM service on the Virtual Machine hosting the application. This should not include the Active Directory domain.
- **Password**  
The password Turbonomic will use to connect to the WinRM service on the Virtual Machine hosting the application.
- **Scope**  
Turbonomic will search for Windows applications on the VMs found within the set scope. This scope can be set to the entire environment, single or multiple clusters, or particular virtual machines. Select this option and choose the scope for application discovery.

**NOTE:**

A single scope (target) must not contain more than 500 virtual machines. Turbonomic recommends utilization of multiple WMI targets for environments exceeding this limit.

- **Domain Name**  
The Active Directory domain used by Turbonomic in conjunction with the Username for authentication. Leave blank for local accounts.
- **Full Validation**  
When selected, Turbonomic will require every VM in the selected scope to be a valid target. If Turbonomic is unable to authenticate a VM in the scope, the target will not validate and data will not be collected.

## Supported Actions

For each discovered entity within the application supply chain, Turbonomic can execute or recommend certain actions, as outlined below.

Entity Type	Action
Applications	<p>Without discovered Guest OS Processes or Application Servers, Turbonomic doesn't perform actions on applications. Instead, it performs resize actions on the host VMs. If host utilization is high enough on the physical machine running the application VM, Turbonomic may also recommend provisioning a new host.</p> <p>For specific application servers, see the individual application entry.</p>
Virtual Machines	<ul style="list-style-type: none"> <li>• Provision additional resources (VMem, VCPU)</li> <li>• Move Virtual Machine</li> <li>• Move Virtual Machine Storage</li> <li>• Reconfigure Storage</li> <li>• Reconfigure Virtual Machine</li> </ul>

## Monitored Resources

Turbonomic monitors the following resources for the container supply chain:

Entity Type	Commodity
WMI/SNMP Application	<ul style="list-style-type: none"> <li data-bbox="435 352 1271 485">• Virtual Memory (VMem) The utilization of the VMem allocated to the hosting VM Measured in Kilobytes (KB)</li> <li data-bbox="435 491 1271 623">• Virtual CPU (VCPU) The utilization of the VCPU allocated to the hosting VM Measured in Megahertz (MHz)</li> </ul>
Virtual Machine	<ul style="list-style-type: none"> <li data-bbox="435 648 1271 781">• Virtual Memory (VMem) The utilization of the VMem allocated to the hosting VM Measured in Kilobytes (KB)</li> <li data-bbox="435 787 1271 919">• Virtual CPU (VCPU) The utilization of the VCPU allocated to the hosting VM Measured in Megahertz (MHz)</li> <li data-bbox="435 926 1271 1058">• Virtual Storage (VStorage) The utilization of the virtual storage capacity allocated for the VM Measured in Kilobytes (KB)</li> <li data-bbox="435 1064 1271 1197">• Storage Access Operations Per Second (IOPS) The utilization of IOPS allocated for the VStorage on the VM Measured in IOPS</li> <li data-bbox="435 1203 1271 1335">• Latency The utilization of latency allocated for the VStorage on the VM Measured in milliseconds (ms)</li> </ul>

## Creating a WMI User Account

The service account Turbonomic uses to connect to WMI should be an Active Directory domain account.

Some enterprises require that the service account does not grant full administrator rights. In that case, you can create a restricted service account for WMI:

1. Add the account to each of the following local groups:
  - WinRMRemoteWMIUsers\_\_ (Or Remote Management Users)
  - Performance Monitor Users

**NOTE:**

These groups are standard Windows Server 2012 security groups. If you are using an earlier version of Windows Server and do not see these groups, contact Turbonomic Support for assistance.

2. Grant permissions to the account.

In the WMI Management console, grant the `Enable Account` and `Remote Enable` advanced security permissions to the service account:

- Open the WMI Management console (`wmimgmt`).
- Right-click **WMI Control (Local)** and choose **Properties**.
- Go to the **Security** tab and then click **Security** to display the **Security for Root** dialog.
- Click **Advanced**, select the service account, and click **Edit**.
- Confirm that **This namespace and subnamespace** is selected.
- Select **Enable Account** and **Remote Enable** and click **OK**.

## Enabling WMI

### Enabling Discovery

To enable Turbonomic discovery of Windows-based Guest Processes, you must configure and enable WMI with WinRM, usually by using a group policy for AD Domains.

When local credentials are provided to Turbonomic, NTLM is the authentication mechanism. When domain credentials are provided, either NTLM or Kerberos can be specified.

**NOTE:**

If Kerberos is specified, the IP address of the target must be resolvable to a host name using DNS.

While these steps will change slightly between Windows Server versions, the general instructions are:

1. Open an elevated PowerShell prompt on the virtual machine(s) to be discovered as a WMI Target.
2. Enable the WS-Management protocol and set the default configuration for remote management.

Execute `winrm quickconfig`.

3. Enable the WinRM *Negotiate* authentication scheme.

This policy is enabled by default. To enable this policy if it is disabled, execute `winrm set winrm/config/service/auth '{@Negotiate="true"}'`.

4. Set the WinRM `AllowUnencrypted` property to `true` if non-SSL connections are preferred.

This property must be set on both the server and the client. Note that setting this value to `true` does not mean that WMI passes sensitive data in an unencrypted form. It will send only the content of the SOAP messages as plain text:

- Server setting:

```
winrm set winrm/config/service '{@AllowUnencrypted="true"}
```

- Client setting:

```
winrm set winrm/config/client '{@AllowUnencrypted="true"}
```

5. Restart the Remote Registry service.

After restarting the Remote Registry service, Turbonomic will discover the WMI targets.

## SSL Connections

To connect using SSL, then a certificate must be assigned to WinRM, and an SSL listening socket enabled. Turbonomic will accept self-signed certificates. Complete details can be found in the official WinRM documentation.

Some example SSL-related commands:

- List certificates on the system:

```
ls cert://localmachine/my
```

- Find Thumbprint for the default certificate:

```
7B56C33F029E7605D5C58E5597D0A077FE1D7F1C CN=winsql-server1.corp.mycorp.com
```

- Enable SSL listener:

```
winrm create winrm/config/listener?Address=*+Transport=HTTPS @{Hostname="winsql-server1.corp.mycorp.com";CertificateThumbprint="7B56C33F029E7605D5C58E5597D0A077FE1D7F1C";Port=}
```



---

## Fabric Targets

A fabric target is a service that unites compute, network and storage access into a cohesive system. When you connect Turbonomic to fabric targets, it monitors the performance and resource consumption of your fabric interconnects, IO modules, chassis, and Blade Servers to assure application performance while also utilizing resources as efficiently as possible.

Once connected, Turbonomic discovers the blades that host the VMs, the chassis and datastores that provide resources to the blades, the IO modules and fabric interconnects that provide network resources, and the virtual datastores that provide storage resources to the VMs.

As part of this process, Turbonomic will stitch information from the fabric target and the associated hypervisor targets together, to provide deeper insight into the state of the hardware, and information related to the applications and VM's running on the hypervisor-stitched blades.

### Supply Chain

Fabric targets add IO Module, Fabric Interconnect, Domain, and Chassis entities to the supply chain. The Chassis entities host physical machines (blade servers) — The physical machines also consume network connection commodities from IO Modules. The Fabric Interconnect supplies connectivity to the overall network, and also hosts the UCS Manager for UCS Targets. The Domain serves as the bottom-level pool of network resource, supplying the Fabric Interconnect.

### Supported Fabric Targets

Turbonomic supports the following fabric targets:

- Cisco UCS

### Monitored Resources

Turbonomic monitors the following resources for the fabric supply chain:

Entity Type	Commodity
Virtual Machine	<ul style="list-style-type: none"><li>• Virtual Memory (VMem) The utilization of the VMem allocated to the hosting VM Measured in Kilobytes (KB)</li></ul>

Entity Type	Commodity
	<ul style="list-style-type: none"> <li>• Virtual CPU (VCPU) The utilization of the VCPU allocated to the hosting VM Measured in Megahertz (MHz)</li> <li>• Virtual Storage (VStorage) The utilization of the virtual storage capacity allocated for the VM Measured in Kilobytes (KB)</li> <li>• Storage Access Operations Per Second (IOPS) The utilization of IOPS allocated for the VStorage on the VM Measured in IOPS</li> <li>• Latency The utilization of latency allocated for the VStorage on the VM Measured in milliseconds (ms)</li> </ul>
Blade	<ul style="list-style-type: none"> <li>• Net The utilization of data through the Blade's network adapters Measured in Kilobytes per second (KB/s)</li> <li>• Treated as a Physical Machine of the underlying Hypervisor (see below) CPU, Mem, etc.</li> </ul>
Physical Machine	<ul style="list-style-type: none"> <li>• Memory (Mem) The utilization of the PM's memory reserved or in use Measured in Kilobytes (KB)</li> <li>• CPU The utilization of the PM's CPU reserved or in use Measured in Megahertz (MHz)</li> <li>• IO The utilization of the PM's IO adapters Measured in Kilobytes per second (KB/s)</li> <li>• Net The utilization of data through the PM's network adapters Measured in Kilobytes per second (KB/s)</li> <li>• Swap The utilization of the PM's swap space Measured in Kilobytes (KB)</li> <li>• Balloon The utilization of shared memory among VMs running on the host. ESX-only Measured in Kilobytes (KB)</li> <li>• CPU Ready</li> </ul>



Entity Type	Commodity
	The utilization of the PM's allocated ready queue capacity (measured in Kbytes) that is in use, for 1, 2, and 4 CPU ready queues. ESX-only Measured in Megahertz (MHz)
I/O Module	<ul style="list-style-type: none"> <li>NetThroughput Rate of message delivery over a port Measured in Megabits per second (Mb/s)</li> </ul>
Fabric Interconnect	<ul style="list-style-type: none"> <li>NetThroughput Rate of message delivery over a port Measured in Mb/s</li> <li>PortChannel Amalgamation of ports with a shared net throughput and utilization Measured in Mb/s</li> </ul>

## Cisco UCS Manager

The Cisco Unified Computing System (UCS) Manager is a management solution that participates in server, fabric, and storage provisioning, device discovery, inventory, configuration, diagnostics, monitoring, fault detection, auditing, and statistics collection.

UCS integrates all of these resources in a scalable multi-chassis platform to converge administration onto a single point. Managing these various entities on a network fabric with Turbonomic enables automation at the hardware level, including automated provisioning of hosts.

### Prerequisites

- A service account Turbonomic can use to connect to UCS Manager

### Adding UCS Targets

To add a UCS target, select the **Fabric** category and choose one of the UCS Fabric options to match the version of UCS you want to manage. Then provide the following information:

- Address:** The IP address of the UCS Manager

This gives access to the Fabric Manager that resides on the interconnect.

Turbonomic connects to the UCS Manager via the HTTPS protocol by default. In order to force the HTTP protocol, the Address must be entered in one of two ways. For example, an IP of 8.8.8.8 must be entered as `http://8.8.8.8` or by using a specific HTTP port, such as `8.8.8.8:80`.

- Username/Password:** The credentials of the account Turbonomic will use to connect to UCS Manager.

specify the IP address and credentials for UCS Manager. Turbonomic discovers the fabric interfaces associated with that manager.

**NOTE:**

When providing a username, if the account is managed in Active Directory you must include the domain in case-sensitive spelling. For example, `MyDomain\john` is not the same as `mydomain\john`. For local user accounts, just provide the username.

## Supply Chain

Fabric targets add IO Module, Fabric Interconnect (Switch), Domain, and Chassis entities to the supply chain. The Chassis entities host physical machines — The physical machines also consume network connection commodities from IO Modules. The Fabric Interconnect supplies connectivity to the overall network, and also hosts the UCS Manager. The Domain serves as the bottom-level pool of network resource, supplying the Fabric Interconnect.

## Actions

Turbonomic recommends actions for the various entities of the UCS Fabric Network as follows:

Entity Type	Action
Virtual Machines	<ul style="list-style-type: none"> <li>Provision additional resources (VMem, VCPU)</li> <li>Move Virtual Machine</li> <li>Move Virtual Machine Storage</li> <li>Reconfigure Storage</li> <li>Reconfigure Virtual Machine</li> </ul>
Physical Machines	<ul style="list-style-type: none"> <li>Start Physical Machine</li> <li>Provision Physical Machine</li> <li>Suspend Physical Machine</li> </ul>
Chassis	<ul style="list-style-type: none"> <li>Provision New Chassis</li> </ul>
Fabric Interconnect	<ul style="list-style-type: none"> <li>Add Port to Port Channel</li> <li>Remove Port from Port Channel</li> <li>Add Port</li> </ul>
DPod (if Network Flow target is present)	<ul style="list-style-type: none"> <li>Provision new DPod</li> </ul>

## Monitored Resources

Turbonomic monitors the following commodities of the UCS target:

Entity Type	Commodity
Virtual Machine	<ul style="list-style-type: none"> <li>Virtual Memory (VMem) The utilization of the VMem allocated to the hosting VM Measured in Kilobytes (KB)</li> <li>Virtual CPU (VCPU) The utilization of the VCPU allocated to the hosting VM Measured in Megahertz (MHz)</li> <li>Virtual Storage (VStorage)</li> </ul>

Entity Type	Commodity
	<p>The utilization of the virtual storage capacity allocated for the VM Measured in Kilobytes (KB)</p> <ul style="list-style-type: none"> <li>Storage Access Operations Per Second (IOPS)</li> </ul> <p>The utilization of IOPS allocated for the VStorage on the VM Measured in IOPS</p> <ul style="list-style-type: none"> <li>Latency</li> </ul> <p>The utilization of latency allocated for the VStorage on the VM Measured in milliseconds (ms)</p>
Physical Machine	<ul style="list-style-type: none"> <li>Memory (Mem) The utilization of the PM's memory reserved or in use Measured in Kilobytes (KB)</li> <li>CPU The utilization of the PM's CPU reserved or in use Measured in Megahertz (MHz)</li> <li>IO The utilization of the PM's IO adapters Measured in Kilobytes per second (KB/s)</li> <li>Net The utilization of data through the PM's network adapters Measured in Kilobytes per second (KB/s)</li> <li>Swap The utilization of the PM's swap space Measured in Kilobytes (KB)</li> <li>Balloon The utilization of shared memory among VMs running on the host. ESX-only Measured in Kilobytes (KB)</li> <li>CPU Ready The utilization of the PM's allocated ready queue capacity (measured in Kbytes) that is in use, for 1, 2, and 4 CPU ready queues. ESX-only Measured in Megahertz (MHz)</li> </ul>
Chassis	<ul style="list-style-type: none"> <li>Power Electricity being consumed by the Chassis Measured in Watts (W)</li> <li>Temperature Temperature of the internals of the Chassis</li> </ul>

Entity Type	Commodity
	Measured in degrees Celsius (C)
I/O Module	<ul style="list-style-type: none"> <li>• NetThroughput Rate of message delivery over a port Measured in Megabits per second (Mb/s)</li> </ul>
Fabric Interconnect	<ul style="list-style-type: none"> <li>• NetThroughput Rate of message delivery over a port Measured in Mb/s</li> <li>• PortChannel Amalgamation of ports with a shared net throughput and utilization Measured in Mb/s</li> </ul>
DPod (if Network Flow target is present)	<ul style="list-style-type: none"> <li>• Memory (Mem) The utilization of the DPod's memory reserved or in use Measured in Kilobytes (KB)</li> <li>• CPU The utilization of the DPod's CPU reserved or in use Measured in Megahertz (MHz)</li> <li>• Storage The utilization of the storage attached to the DPod Measured in Kilobytes (KB)</li> <li>• Flow The utilization of the network flow capacity utilized by the DPod. This is divided into Flow1 (Low Cost) and Flow2 (Medium Cost) utilization Measured in Kilobytes per second (KB/s)</li> </ul>

## HPE OneView

HPE OneView is a management solution that streamlines provisioning and lifecycle management across compute, storage, and fabric. Through a unified API, infrastructure can be configured, monitored, updated, and re-purposed.

HPE OneView integrates all of these resources in a scalable multi-enclosure platform to converge administration onto a single point. Managing these various entities on a network fabric with Turbonomic enables automation at the hardware level, including automated provisioning of hosts.

### Prerequisites

- A service account Turbonomic can use to connect to HPE OneView.
- HPE OneView 2.0 and compatible hardware.

## Adding HPE OneView Targets

To add a HPE OneView as a target, select the **Fabric** category and choose the HPE OneView radio button. Then provide the following information:

- **Address:** The IP address of the HPE OneView target

This gives access to the Fabric Manager that resides on the VM.

Turbonomic uses the HTTPS protocol by default. In order to force the HTTP protocol, the Address must be entered in one of two ways. For example, an IP of 8.8.8.8 must be entered as `http://8.8.8.8` or by using a specific HTTP port, such as `8.8.8.8:80`.

- **Username/Password:** The credentials of the account Turbonomic will use to connect to the HPE OneView target.

specify the IP address and credentials for HPE OneView. Turbonomic discovers the fabric interfaces associated with that instance.

### NOTE:

When providing a username, if the account is managed in Active Directory you must include the domain in case-sensitive spelling. For example, `MyDomain\john` is not the same as `mydomain\john`. For local user accounts, just provide the username.

## Supply Chain

Fabric targets add IO Module, Fabric Interconnect (Switch), Domain, and Chassis entities to the supply chain. The Chassis entities host physical machines — The physical machines also consume network connection commodities from IO Modules. The Fabric Interconnect supplies connectivity to the overall network. The Domain serves as the bottom-level pool of network resource, supplying the Fabric Interconnect.

### NOTE:

For HPE OneView targets, the "Fabric Interconnect" entity exists as a false "Switch", and only as a pass-through for network resources. Unlike other fabric targets, such as UCS, there is no physical hardware that serves this function.

## Actions

Turbonomic recommends actions for the various entities of the HPE OneView Fabric Network as follows:

Entity Type	Action
Virtual Machines	<ul style="list-style-type: none"> <li>• Provision additional resources (VMem, VCPU)</li> <li>• Move Virtual Machine</li> <li>• Move Virtual Machine Storage</li> <li>• Reconfigure Storage</li> <li>• Reconfigure Virtual Machine</li> </ul>
Physical Machines	<ul style="list-style-type: none"> <li>• Start Physical Machine</li> <li>• Provision Physical Machine</li> <li>• Suspend Physical Machine</li> </ul>
Fabric Interconnect	<ul style="list-style-type: none"> <li>• Add Port to Port Channel</li> <li>• Remove Port from Port Channel</li> </ul>

Entity Type	Action
	<ul style="list-style-type: none"> <li>Add Port</li> </ul>
DPod (if Network Flow target is present)	<ul style="list-style-type: none"> <li>Provision new DPod</li> </ul>

## Monitored Resources

Turbonomic monitors the following commodities of the HPE OneView target:

Entity Type	Commodity
Virtual Machine	<ul style="list-style-type: none"> <li>Virtual Memory (VMem) The utilization of the VMem allocated to the hosting VM Measured in Kilobytes (KB)</li> <li>Virtual CPU (VCPU) The utilization of the VCPU allocated to the hosting VM Measured in Megahertz (MHz)</li> <li>Virtual Storage (VStorage) The utilization of the virtual storage capacity allocated for the VM Measured in Kilobytes (KB)</li> <li>Storage Access Operations Per Second (IOPS) The utilization of IOPS allocated for the VStorage on the VM Measured in IOPS</li> <li>Latency The utilization of latency allocated for the VStorage on the VM Measured in milliseconds (ms)</li> </ul>
Physical Machine	<ul style="list-style-type: none"> <li>Memory (Mem) The utilization of the PM's memory reserved or in use Measured in Kilobytes (KB)</li> <li>CPU The utilization of the PM's CPU reserved or in use Measured in Megahertz (MHz)</li> <li>IO The utilization of the PM's IO adapters Measured in Kilobytes per second (KB/s)</li> <li>Net The utilization of data through the PM's network adapters Measured in Kilobytes per second (KB/s)</li> <li>Swap The utilization of the PM's swap space</li> </ul>

Entity Type	Commodity
	<p>Measured in Kilobytes (KB)</p> <ul style="list-style-type: none"> <li>Balloon</li> </ul> <p>The utilization of shared memory among VMs running on the host. ESX-only</p> <p>Measured in Kilobytes (KB)</p> <ul style="list-style-type: none"> <li>CPU Ready</li> </ul> <p>The utilization of the PM's allocated ready queue capacity (measured in Kbytes) that is in use, for 1, 2, and 4 CPU ready queues. ESX-only</p> <p>Measured in Megahertz (MHz)</p>
Storage	<ul style="list-style-type: none"> <li>Storage Amount</li> </ul> <p>The utilization of the datastore's capacity</p> <p>Measured in Megabytes (MB)</p> <ul style="list-style-type: none"> <li>Storage Provisioned</li> </ul> <p>The utilization of the datastore's capacity, including overprovisioning.</p> <p>Measured in Megabytes (MB)</p> <ul style="list-style-type: none"> <li>Storage Access Operations Per Second (IOPS)</li> </ul> <p>The summation of the read and write access operations per second on the datastore</p> <p>Measured in Operations per second</p> <ul style="list-style-type: none"> <li>Latency</li> </ul> <p>The utilization of latency on the datastore</p> <p>Measured in Milliseconds (ms)</p>
I/O Module	<ul style="list-style-type: none"> <li>NetThroughput</li> </ul> <p>Rate of message delivery over a port</p> <p>Measured in Megabits per second (Mb/s)</p>
Fabric Interconnect	<ul style="list-style-type: none"> <li>NetThroughput</li> </ul> <p>Rate of message delivery over a port</p> <p>Measured in Mb/s</p> <ul style="list-style-type: none"> <li>PortChannel</li> </ul> <p>Amalgamation of ports with a shared net throughput and utilization</p> <p>Measured in Mb/s</p>
DPod (if Network Flow target is present)	<ul style="list-style-type: none"> <li>Memory (Mem)</li> </ul> <p>The utilization of the DPod's memory reserved or in use</p> <p>Measured in Kilobytes (KB)</p> <ul style="list-style-type: none"> <li>CPU</li> </ul> <p>The utilization of the DPod's CPU reserved or in use</p> <p>Measured in Megahertz (MHz)</p>

Entity Type	Commodity
	<ul style="list-style-type: none"><li data-bbox="444 233 581 260">• Storage The utilization of the storage attached to the DPod Measured in Kilobytes (KB)</li><li data-bbox="444 373 548 401">• Flow The utilization of the network flow capacity utilized by the DPod. This is divided into Flow1 (Low Cost) and Flow2 (Medium Cost) utilization Measured in Kilobytes per second (KB/s)</li></ul>





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## Appendix — Target Configuration

This appendix contains topics that are related to configuring Turbonomic targets.

### Cisco Unified Computing System

#### UCS Blade Provisioning

When managing a UCS fabric target, Turbonomic can provision any blade servers that are installed in a chassis but not currently in operation. If the workload demands more physical compute resources, Turbonomic can automatically direct UCS to provision a blade, or it can recommend that you provision a blade and you can execute the action from the To Do list. To enable this capability, you must perform two basic steps:

- Configure the way UCS and vCenter Server manage information as blades are provisioned

To enable Turbonomic to perform automatic provisioning of UCS blades, you must configure UCS to work with vCenter Server as they both manage resources such as server pools, policies, and Service Profile Templates. This ensures that as Turbonomic directs the UCS Manager to provision a new blade, vCenter Server will recognize that the new physical host is available. Once vCenter Server can recognize the new blade, Turbonomic can direct vCenter Server to move workloads onto the server.

Turbonomic provisions new blades based on the service profiles of operating blades. To enable this, the configuration must include Service Profile Templates, and the operating blades must be bound to these templates.

For information about configuration that enables automated provisioning of blades, see the Cisco Communities post, “UCS PowerTool and VMware PowerCLI automated management of Auto-deploy” at the following location:

[https://communities.cisco.com/community/technology/datacenter/ucs\\_management/cisco\\_ucs\\_developed\\_integrations/blog/2013/09/16/ucs-powertool-and-vmware-powercli-automated-management-of-auto-deploy](https://communities.cisco.com/community/technology/datacenter/ucs_management/cisco_ucs_developed_integrations/blog/2013/09/16/ucs-powertool-and-vmware-powercli-automated-management-of-auto-deploy)

This post includes a video that shows “a joint PowerShell integration utilizing both Cisco UCS PowerTool and VMware PowerCLI.” You can also download the scripts from this post and modify them as necessary for your deployment.

- Set the Host Provision action to Automate or Manual for the blade servers. By default, Turbonomic sets the Host Provision action to Recommend.

For any hosts other than blade servers managed by UCS, Turbonomic cannot provision hosts automatically or manually. Instead, it recommends that you provision a host, and you then install the physical machine and wire it to the network.

In a UCS deployment you can have blade servers installed in the chassis and ready to provision. In that case, Turbonomic can direct UCS to provision a new blade to meet workload demands. For these servers, you can set the Host Provision action to Automated or Manual.

**NOTE:**

It's important that you only set Automated or Manual host provisioning to UCS blades. If you set Host Provision to Automated for other types of hosts, Turbonomic will attempt to perform the action and fail. As a result, you might never see the recommendation to provision a new host of that type.

Turbonomic groups blade servers by chassis. To restrict Automated or Manual settings to blade servers, use this group. You can set the action mode for all blade servers in your environment, or you can set the mode differently for individual chassis.

## Enabling Collection of Memory Statistics: AWS

So Turbonomic can collect memory statistics in your AWS environment, you must set up your VMs to publish statistics via CloudWatch. The steps to do this are different depending on the OS running on your VMs.

### AWS Memory Statistics: Linux VMs

To enable memory statistics on Linux VMs, you must set up your VMs to publish metrics to CloudWatch. You must meet the following requirements:

- Your Linux image must have the SSM Agent installed

By default, Linux AMIs dated 2017.09 and later include an installed SSM Agent.

- Access to the CloudWatch service

Your AWS Instance must have internet access or direct access to CloudWatch so it can push data to CloudWatch.

- Access to AWS System Manager

The user account must include an attached AmazonEC2RoleforSSM Policy. As a minimum, the policy must have the following permissions:

- AmazonEC2ReadOnlyAccess
- AmazonS3ReadOnlyAccess
- AmazonRDSReadOnlyAccess
- AmazonEC2RoleforSSM
- CloudWatchFullAccess
- AmazonSSMFullAccess

In addition, you must install the CloudWatch agent on your VMs. To configure the agent, add the following JSON as the EC2 Parameter Store:

```

{
  "agent": {
    "metrics_collection_interval": 60,
    "logfile": "/opt/aws/amazon-cloudwatch-agent/logs/amazon-cloudwatch-agent.log"
  },
  "metrics": {
    "metrics_collected": {
      "mem": {
        "measurement": [
          {"name": "used", "rename": "MemoryUsed"},
          {"name": "mem_available", "rename": "MemoryAvailable"}
        ]
      }
    },
    "append_dimensions": {
      "InstanceId": "${aws:InstanceId}"
    }
  }
}

```

For more information about enabling Windows memory statistics for AWS, see the Green Circle article, [“Setting up CloudWatch with your Linux Instances on AWS”](#).

## AWS Memory Statistics: Windows VMs

To enable memory statistics on Windows VMs, you must enable AWS SSM:

- Ensure the AWS SSM Agent is installed on your VMs
- Create an IAM Role that supports AWS SSM. The role must have the following permissions at a minimum:
  - AmazonEC2ReadOnlyAccess
  - AmazonS3ReadOnlyAccess
  - AmazonRDSReadOnlyAccess
  - AmazonEC2RoleforSSM
  - CloudWatchFullAccess
  - AmazonSSMFullAccess
- Assign the IAM role to the VMs that you want to manage.

After you enable AWS SSM, you must deploy the following JSON file to configure CloudWatch.

```

{
  "IsEnabled": true,
  "EngineConfiguration": {
    "Components": [
      {
        "FullName": "AWS.EC2.Windows.CloudWatch.PerformanceCounterComponent.PerformanceCounterInputComponent,AWS.EC2.Windows.CloudWatch",
        "Id": "PerformanceCounter",
        "Parameters": {
          "CategoryName": "Memory",
          "CounterName": "Committed Bytes",
          "DimensionName": "InstanceId",

```

```

    "DimensionValue": "{instance_id}",
    "InstanceName": "",
    "MetricName": "MemoryUsed",
    "Unit": "bytes"
  },
  {
    "FullName": "AWS.EC2.Windows.CloudWatch.PerformanceCounterComponent.Performance
CounterInputComponent,AWS.EC2.Windows.CloudWatch",
    "Id": "PerformanceCounter2",
    "Parameters": {
      "CategoryName": "Memory",
      "CounterName": "Available Bytes",
      "DimensionName": "InstanceId",
      "DimensionValue": "{instance_id}",
      "InstanceName": "",
      "MetricName": "MemoryAvailable",
      "Unit": "bytes"
    }
  },
  {
    "FullName": "AWS.EC2.Windows.CloudWatch.CloudWatch.CloudWatchOutputCompone
nt,AWS.EC2.Windows.CloudWatch",
    "Id": "CloudWatch",
    "Parameters": {
      "AccessKey": "",
      "NameSpace": "Windows System",
      "Region": "",
      "SecretKey": ""
    }
  }
],
"Flows": {
  "Flows": [
    "(PerformanceCounter,PerformanceCounter2), CloudWatch"
  ]
},
"PollInterval": "00:05:00"
}
}

```

For more information about enabling Windows memory statistics for AWS, see the Green Circle article, [“AWS Memory Stats - Windows”](#).

## Enabling Collection of Memory Statistics: Azure

For Turbonomic to collect memory statistics in Azure, you must enable the collection of these statistics on the VMs in your environment. You can do this as you deploy your VMs, or you can enable the counters after the fact on VMs you have already deployed. For each VM, open the Azure Portal and navigate to Diagnostics Settings. Then enable the metrics for your VMs:

To enable the collection of memory statistics in Azure environments, open the Azure Portal, and then navigate to **Diagnostic Settings**. Then enable the metrics for your VMs:

- For Windows VMs
  - Navigate to **Performance Counters**, display **Basic**, and enable the performance counters for the VM.
- For Linux VMs
  - For supported Linux versions, Azure automatically deploys the Linux Diagnostics Extension v2.3 to gather these metrics. Refer to Microsoft Azure documentation for supported Linux OS versions. For unsupported versions, you can enable the statistics manually:
    1. Set **Status** to ON.
    2. For **Storage Account**, specify the storage that will retain the metric data.
    3. Enable **Basic Metrics** and then click **Save**.
    4. Navigate to **Metrics** in the Azure Portal and enable the metrics to collect.

For more information about enabling memory statistics for Azure, see the Green Circle article, [“Enable Basic Metrics on Azure - Manually”](#).

## Enabling Windows Remote Management

Turbonomic communicates with your Hyper-V servers using Web Services Management (WS-Management), which is implemented on Microsoft platforms using Windows Remote Management (WinRM). The following steps show how to enable WinRM on a single host, using the command line.

1. Ensure Windows Firewall is running on the host.

For you to configure WinRM successfully, Windows Firewall must be running on the host. For more information, see the Microsoft Knowledge Base article #2004640 (<http://support.microsoft.com/kb/2004640>).

2. Set up an SPN for the host machine.

The machine must have an SPN of the form, `protocol/host_address`. For example, `WSMAN/10.99.9.2`.

To get a list of SPNs for the machine, execute the following in the command window:

```
setspn -l <vmm-server-name>
```

If there is no valid SPN in the list, create one by running the command:

```
setspn -A protocol/host-address:port where port is optional
```

For example, `setspn -A WSMAN/10.99.9.2:VMM-02`

3. Set up the Windows Remote Management (WinRM) service to run on startup.

Run the `quickconfig` utility to set up the WinRM service. The `quickconfig` utility:

- Configures the WinRM service to auto-start
- Configures basic authentication and disables unencrypted traffic
- Creates a firewall exception for the current user profile
- Configures a listener for HTTP and HTTPS on any IP address
- Enables remote shell access

To run `quickconfig`, log into a command window as Administrator on the host machine. Then execute the following commands:

```
winrm quickconfig
```

Enter `y` to accept the `quickconfig` changes

#### 4. Set permissions on the host machine.

Execute the following commands in the command window to modify the settings made by `quickconfig`:

- To set the memory capacity for remote shells:

```
winrm set winrm/config/winrs @{MaxMemoryPerShellMB="1024" }
```

- To set up an unsecured HTTP connection:

```
winrm set winrm/config/service @{AllowUnencrypted="true" }
```

```
winrm set winrm/config/service/Auth @{Basic="true" }
```

These steps showed you how to enable WinRM for a single host. Some users find the following methods useful for enabling WinRM on multiple hosts:

- [EnablingWinRmViaGlobal Policy Objects \(on page 102\)](#)
- [EnablingWinRMViaPowerShell \(on page 103\)](#)

## Enabling WinRM Via Global Policy Objects

You can configure WinRM for all of your Hyper-V targets by creating and linking a Global Policy Object (GPO) within the Hyper-V domain and applying the GPO to all servers.

Follow the steps below to enable Windows Remote Management (WinRM) for your Hyper-V targets.

For additional information, you can also see the Green Circle article, [Application Discovery: GPO for necessary Registry Changes](#)

1. On the AD domain controller, open the Group Policy Management Console (GPMC). If the GPMC is not installed, see <https://technet.microsoft.com/en-us/library/cc725932.aspx>.
2. Create a new Global Policy Object:
  - a. In the GPMC tree, right-click **Group Policy Objects** within the domain containing your Hyper-V servers.
  - b. Choose **Create a GPO in this domain**, and link it here.
  - c. Enter a name for the new GPO and click **OK**.
3. Specify the computers that need access:
  - a. Select the new GPO from the tree.
  - b. On the **Scope** tab, under **Security Filtering**, specify the computer or group of computers you want to grant access. Make sure you include all of your Hyper-V targets.
4. Right-click the new GPO and choose **Edit** to open the Group Policy Management Editor.
5. Configure the WinRM Service:
  - a. In the Group Policy Management Editor, select **Computer Configuration > Policies > Administrative Templates > Windows Components > Windows Remote Management (WinRM) > WinRM Service**.
  - b. Double-click each of following settings and configure as specified:

Allow automatic configuration of listeners (“Allow remote server management through WinRM” on older versions of Windows Server):	Enabled IPv4 filter: *
--	---------------------------

Allow Basic authentication:	Enabled
Allow unencrypted traffic:	Enabled

6. Configure the WinRM service to run automatically:
  - a. In the Group Policy Management Editor, expand **Computer Configuration > Preferences > Control Panel Settings**.
  - b. Under Control Panel Settings, right-click Services and choose **New > Service**.
  - c. In the New Service Properties window, configure the following settings:

Startup:	Automatic
Service name:	WinRM
Service option:	Service start

7. Enable Windows Remote Shell:
  - a. In the Group Policy Management Editor, select **Computer Configuration > Policies > Administrative Templates > Windows Components > Windows Remote Shell**.
  - b. Double-click the following setting and configure as specified:

Allow Remote Shell Access:	Enabled
----------------------------	---------

8. Add a Windows Firewall exception:
  - a. In the Group Policy Management Editor, open **Computer Configuration > Windows Settings > Security Settings > Windows Firewall > Windows Firewall**.
  - b. Under Windows Firewall, right-click **Inbound Rules** and choose **New > Rule**.
  - c. In the New Inbound Rule Wizard, select **Predefined: Windows Remote Management and Allow the connection**.

The new group policy will be applied during the next policy process update. To apply the new policy immediately, execute the following command at a Powershell prompt:

```
gpupdate /force
```

## Enabling WinRM Via PowerShell

Using PsExec, you can run quickconfig on all your Hyper-V servers and change the default settings remotely. PsExec is a component of PsTools, which you can download from <https://technet.microsoft.com/en-us/sysinternals/bb897553.aspx>.

1. Create a text file containing the Hyper-V host names, for example:
 

```
hp-vx485
hp-vx486
```
2. Since Turbonomic requires changes to the default quickconfig settings, create a batch file containing the following command:
 

```
@echo off Powershell.exe Set-WSManQuickConfig -Force Powershell.exe Set-Item WSMAN:\localhost\Shell\MaxMemoryPerShellMB 1024
```

**NOTE:**

If you are connecting via HTTP, you must include the following command:

```
Powershell.exe Set-Item WSMAN:\localhost\Service\AllowUnencrypted -Value $True
```

3. Use PsExec to enable WinRM on the remote servers:

```
.\PsExec.exe @<hosts_file_path> -u <username> -p <password> -c <batch_file_path>
```

**NOTE:**

If you get an error message when executing this command, add the `-h` option (`.\PsExec.exe -h`).

## Secure Setup of WSMAN

Turbonomic provides a secure option for Hyper-V/VMM Targets which requires that WSMAN be set up securely. Use PowerShell to generate a self-signed certificate, and create an HTTPS WinRM listener.

**NOTE:**

For clustered Hyper-V targets, you do not need to create a listener on each host. Only create a listener on the host that is being added to the "Address" field in the Target Configuration.

To enable secure WSMAN on your Hyper-V host:

1. Generate a self-signed certificate using the following command:

```
New-SelfSignedCertificate -CertstoreLocation Cert:\LocalMachine\My -DnsName  
"myhost.example.org"
```

2. Find the thumbprint for the certificate for the host:

```
Get-childItem cert:\LocalMachine\My
```

3. Create an HTTPS WinRM listener for the host with the thumbprint you've found:

```
winrm create winrm/config/Listener?Address=*+Transport=HTTPS  
'@{Hostname="myhost.example.org"; CertificateThumbprint="THUMBPRINT_YOU_FOUND"}'
```

4. Verify the presence of configured listeners:

```
Get-WSManInstance -ResourceURI winrm/config/listener -Enumerate
```