



# **Turbonomic**

## **7.17 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
- Fabric Managers
  - Cisco UCS 3.1+
  - HPE OneView 3.00.04+
- Guest OS Processes
  - AppDynamics 4.1+
- 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
- Orchestrator Targets
  - Action Script
- Storage Managers
  - NetApp Cmode/7mode using ONTAP 8.0+ (excluding AFF and SolidFire)

- EMC VMAX using SMI-S 8.1+
- Pure Storage F-series and M-series arrays
- HP 3PAR InForm OS 3.2.2+, 3PAR SMI-S, 3PAR WSAPI

## 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.

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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 \(page 32\)](#).

### 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></ul>

Entity Type	Action
	<ul style="list-style-type: none"> <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>
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> </ul>

Entity Type	Commodity
	<ul style="list-style-type: none"> <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 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> </ul>

Entity Type	Commodity
	<ul style="list-style-type: none"> <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>
<p>Datacenter</p>	<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</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 Kilobytes (KB)
Provider Virtual Datacenter	<ul style="list-style-type: none"> <li data-bbox="363 449 1523 583">                         • Memory (Mem)                          The utilization of the Datacenter's memory reserved or in use                          Measured in Kilobytes (KB)                     </li> <li data-bbox="363 604 1523 739">                         • CPU                          The utilization of the Datacenter's CPU reserved or in use                          Measured in Megahertz (MHz)                     </li> <li data-bbox="363 760 1523 894">                         • 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="363 947 1523 1081">                         • Memory (Mem)                          The utilization of the Datacenter's memory reserved or in use                          Measured in Kilobytes (KB)                     </li> <li data-bbox="363 1102 1523 1236">                         • CPU                          The utilization of the Datacenter's CPU reserved or in use                          Measured in Megahertz (MHz)                     </li> <li data-bbox="363 1257 1523 1392">                         • Storage                          The utilization of the storage attached to the Consumer vDC.                          Measured in Kilobytes (KB)                     </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 \(page 26\)](#).

**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 \(page 72\)](#).

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 \(page 15\)](#)
- Configure remote management on each Hyper-V server. Refer to [Enabling Windows Remote Management \(page 72\)](#)
- 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 \(page 73\)](#)).

- 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.

## 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, 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)</li> </ul>

Entity Type	Commodity
	<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</li> </ul>

Entity Type	Commodity
	The utilization of latency on the datastore 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> <p>• Memory (Mem)                              The utilization of the PM's memory reserved or in use                              Measured in Kilobytes (KB)</p> </li> <li> <p>• CPU                              The utilization of the PM's CPU reserved or in use                              Measured in Megahertz (MHz)</p> </li> <li> <p>• IO                              The utilization of the PM's IO adapters                              Measured in Kilobytes per second (KB/s)</p> </li> <li> <p>• Net                              The utilization of data through the PM's network adapters                              Measured in Kilobytes per second (KB/s)</p> </li> <li> <p>• Swap                              The utilization of the PM's swap space                              Measured in Kilobytes (KB)</p> </li> <li> <p>• Balloon                              The utilization of shared of memory among VMs running on the host. ESX-only                              Measured in Kilobytes (KB)</p> </li> <li> <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>

## 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:

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` 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**.

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 \(page 22\)](#)).

## 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.

- **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.

- **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 you're using to connect to the vCenter. 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.

## 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 \(page 23\)](#)).

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 data-bbox="363 457 1187 590">                     • Virtual Memory (VMem)                      The utilization of the VMem allocated to the hosting VM                      Measured in Kilobytes (KB)                 </li> <li data-bbox="363 611 1062 743">                     • Virtual CPU (VCPU)                      The utilization of the VCPU allocated to the hosting VM                      Measured in Megahertz (MHz)                 </li> <li data-bbox="363 764 1187 896">                     • Virtual Storage (VStorage)                      The utilization of the virtual storage capacity allocated for the VM                      Measured in Kilobytes (KB)                 </li> <li data-bbox="363 917 1117 1050">                     • Storage Access Operations Per Second (IOPS)                      The utilization of IOPS allocated for the VStorage on the VM                      Measured in IOPS                 </li> <li data-bbox="363 1071 1149 1203">                     • 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 data-bbox="363 1268 1045 1400">                     • Memory (Mem)                      The utilization of the PM's memory reserved or in use                      Measured in Kilobytes (KB)                 </li> <li data-bbox="363 1421 997 1554">                     • CPU                      The utilization of the PM's CPU reserved or in use                      Measured in Megahertz (MHz)                 </li> <li data-bbox="363 1575 889 1707">                     • IO                      The utilization of the PM's IO adapters                      Measured in Kilobytes per second (KB/s)                 </li> <li data-bbox="363 1728 1097 1860">                     • Net                      The utilization of data through the PM's network adapters                      Measured in Kilobytes per second (KB/s)                 </li> <li data-bbox="363 1881 477 1915">                     • Swap                 </li> </ul>

Entity Type	Commodity
	<p>The utilization of the PM's swap space 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 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 Measured in Megahertz (MHz)</p>
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> <li>IO The utilization of the PM's IO adapters</li> </ul>

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

Entity Type	Commodity
	Measured in Kilobytes (KB)

## 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

Turbonomic Activity	Required Privileges
	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>• Memory (Mem) The utilization of the Datacenter's memory reserved or in use Measured in Kilobytes (KB)</li> <li>• CPU The utilization of the Datacenter's CPU reserved or in use Measured in Megahertz (MHz)</li> </ul>

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

## 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 \(page 72\)](#)
- 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 \(page 71\)](#).

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 \(page 15\)](#).

- 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 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> </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>
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 Measured in Kilobytes (KB)</li> </ul>

Entity Type	Commodity
	<ul style="list-style-type: none"> <li data-bbox="363 275 1461 405"> <p>• CPU The utilization of the PM's CPU reserved or in use Measured in Megahertz (MHz)</p> </li> <li data-bbox="363 430 889 560"> <p>• IO The utilization of the PM's IO adapters Measured in Kilobytes per second (KB/s)</p> </li> <li data-bbox="363 585 1094 716"> <p>• Net The utilization of data through the PM's network adapters Measured in Kilobytes per second (KB/s)</p> </li> <li data-bbox="363 741 862 871"> <p>• Swap The utilization of the PM's swap space Measured in Kilobytes (KB)</p> </li> <li data-bbox="363 896 1305 1026"> <p>• Balloon The utilization of shared memory among VMs running on the host. ESX-only Measured in Kilobytes (KB)</p> </li> <li data-bbox="363 1052 1459 1213"> <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 Megahertz (MHz)</p> </li> </ul>
<p>Datacenter</p>	<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 data-bbox="363 1392 1045 1522"> <p>• Memory (Mem) The utilization of the PM's memory reserved or in use Measured in Kilobytes (KB)</p> </li> <li data-bbox="363 1547 995 1677"> <p>• CPU The utilization of the PM's CPU reserved or in use Measured in Megahertz (MHz)</p> </li> <li data-bbox="363 1703 889 1833"> <p>• IO The utilization of the PM's IO adapters Measured in Kilobytes per second (KB/s)</p> </li> <li data-bbox="363 1858 456 1883"> <p>• Net</p> </li> </ul>

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



## 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.</li> </ul>

Entity Type	Commodity
	<p>Measured in Megabytes (MB)</p> <ul style="list-style-type: none"> <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	<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	<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 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

EMC VMAX Name	Turbonomic Entity
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 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)
Logical Pool	<ul style="list-style-type: none"> <li data-bbox="370 363 1458 506">                         • Storage Amount                          The utilization of the logical pool's capacity.                          Measured in Megabytes (MB)                     </li> <li data-bbox="370 516 1458 659">                         • Storage Provisioned                          The utilization of the logical pool's capacity, including overprovisioning.                          Measured in Megabytes (MB)                     </li> <li data-bbox="370 669 1458 812">                         • Storage Access Operations Per Second (IOPS)                          The summation of the read and write access operations per second on the logical pool.                          Measured in Operations per second                     </li> <li data-bbox="370 823 1458 966">                         • Latency                          The utilization of latency on the logical pool.                          Measured in milliseconds (ms)                     </li> </ul>
Disk Array	<ul style="list-style-type: none"> <li data-bbox="370 1014 1458 1157">                         • Storage Amount                          The utilization of the Disk Array's capacity.                          Measured in Megabytes (MB)                     </li> <li data-bbox="370 1167 1458 1310">                         • Storage Provisioned                          The utilization of the Disk Array's capacity, including overprovisioning.                          Measured in Megabytes (MB)                     </li> <li data-bbox="370 1320 1458 1463">                         • 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 data-bbox="370 1474 1458 1617">                         • Latency                          The utilization of latency, computed from the latency of each device in the disk array.                          Measured in milliseconds (ms)                     </li> </ul>
Storage Controller	<ul style="list-style-type: none"> <li data-bbox="370 1665 1458 1808">                         • Storage Amount                          The utilization of the storage controller's capacity.                          Measured in Megabytes (MB)                     </li> </ul>

# 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`.

- 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 \(page 32\)](#).

## 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.</li> </ul>

Entity Type	Commodity
	<p>Measured in Megabytes (MB)</p> <ul style="list-style-type: none"> <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	<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>
Logical Pool	<ul style="list-style-type: none"> <li>Storage Amount The utilization of the logical pool's capacity. Measured in Megabytes (MB)</li> <li>Storage Provisioned The utilization of the logical pool'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 logical pool. Measured in Operations per second</li> <li>Latency The utilization of latency on the logical pool.</li> </ul>

Entity Type	Commodity
	Measured in milliseconds (ms)
Storage Controller	<ul style="list-style-type: none"> <li data-bbox="272 394 941 525">           • CPU            The utilization of the Storage Controller's CPU in use            Measured in Megahertz (MHz)         </li> <li data-bbox="272 546 1461 714">           • 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>

## 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 \(page 45\)](#)

## 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

NetApp Name	Turbonomic Entity
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 \(page 32\)](#).

## 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. Measured in Megabytes (MB)</li> <li>Storage Access Operations Per Second (IOPS)</li> </ul>

Entity Type	Commodity
	<p>The summation of the read and write access operations per second on the datastore Measured in Operations per second</p> <ul style="list-style-type: none"> <li>Latency The utilization of latency on the datastore Measured in Milliseconds (ms)</li> </ul>
Disk Array	<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	<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>

## 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 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.

### Inspection capabilities:

- 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`
  - `fcg-node-get-name`
  - `flash-device-get-iter`
  - `iscsi-node-get-name`
  - `options-list-info`
  - `qtree-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 ontapi -authmethod password
```

```
security login create -role VMTurboRole -username VMTurbo -application ssh -authmethod 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.
- 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 \(page 32\)](#).

## 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	<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	<ul style="list-style-type: none"> <li>• CPU The utilization of the Storage Controller's CPU in use</li> </ul>

Entity Type	Commodity
	<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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# 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.

## 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).
- 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> <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 data-bbox="344 380 1421 506"> <p>• Virtual Memory (VMem) The utilization of the VMem allocated to the hosting VM Measured in Kilobytes (KB)</p> </li> <li data-bbox="344 533 1421 659"> <p>• Virtual CPU (VCPU) The utilization of the VCPU allocated to the hosting VM Measured in Megahertz (MHz)</p> </li> <li data-bbox="344 686 1421 812"> <p>• Transactions The utilization of the allocated transactions per second for the given virtual application Measured in transactions per second</p> </li> <li data-bbox="344 840 1421 966"> <p>• Heap The utilization of the application server's heap Measured in Kilobytes (KB)</p> </li> <li data-bbox="344 993 1421 1119"> <p>• Response Time The utilization of the server's allocated response time Measured in Milliseconds (ms)</p> </li> <li data-bbox="344 1146 1421 1272"> <p>• Threads The utilization of the server's thread capacity Measured in Threads</p> </li> <li data-bbox="344 1299 1421 1425"> <p>• Connection The utilization of the connection capacity. Only applicable to database servers Measured in Connections</p> </li> <li data-bbox="344 1453 1421 1579"> <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="344 1654 1421 1780"> <p>• Virtual Memory (VMem) The utilization of the VMem allocated to the hosting VM Measured in Kilobytes (KB)</p> </li> <li data-bbox="344 1808 1421 1879"> <p>• Virtual CPU (VCPU) The utilization of the VCPU allocated to the hosting VM</p> </li> </ul>

Entity Type	Commodity
	<p>Measured in Megahertz (MHz)</p> <ul style="list-style-type: none"><li data-bbox="342 327 699 359">• Virtual Storage (VStorage) The utilization of the virtual storage capacity allocated for the VM Measured in Kilobytes (KB)</li><li data-bbox="342 485 922 516">• Storage Access Operations Per Second (IOPS) The utilization of IOPS allocated for the VStorage on the VM Measured in IOPS</li><li data-bbox="342 642 483 674">• Latency The utilization of latency allocated for the VStorage on the VM Measured in milliseconds (ms)</li></ul>



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## 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 data-bbox="310 457 1024 590"> <p>• Virtual Memory (VMem) The utilization of the VMem allocated to the hosting VM Measured in Kilobytes (KB)</p> </li> <li data-bbox="310 611 1008 743"> <p>• Virtual CPU (VCPU) The utilization of the VCPU allocated to the hosting VM Measured in Megahertz (MHz)</p> </li> <li data-bbox="310 764 1133 896"> <p>• Virtual Storage (VStorage) The utilization of the virtual storage capacity allocated for the VM Measured in Kilobytes (KB)</p> </li> <li data-bbox="310 917 1065 1050"> <p>• Storage Access Operations Per Second (IOPS) The utilization of IOPS allocated for the VStorage on the VM Measured in IOPS</p> </li> <li data-bbox="310 1071 1094 1203"> <p>• Latency The utilization of latency allocated for the VStorage on the VM Measured in milliseconds (ms)</p> </li> </ul>
Blade	<ul style="list-style-type: none"> <li data-bbox="310 1266 1071 1398"> <p>• Net The utilization of data through the Blade's network adapters Measured in Kilobytes per second (KB/s)</p> </li> <li data-bbox="310 1419 1200 1501"> <p>• Treated as a Physical Machine of the underlying Hypervisor (see below) CPU, Mem, etc.</p> </li> </ul>
Physical Machine	<ul style="list-style-type: none"> <li data-bbox="310 1556 995 1688"> <p>• Memory (Mem) The utilization of the PM's memory reserved or in use Measured in Kilobytes (KB)</p> </li> <li data-bbox="310 1709 943 1841"> <p>• CPU The utilization of the PM's CPU reserved or in use Measured in Megahertz (MHz)</p> </li> <li data-bbox="310 1862 386 1896"> <p>• IO</p> </li> </ul>

Entity Type	Commodity
	<p>The utilization of the PM's IO adapters 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 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>
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> </ul>

Entity Type	Action
	<ul style="list-style-type: none"> <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) 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</li> </ul>

Entity Type	Commodity
	<p>Measured in IOPS</p> <ul style="list-style-type: none"> <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 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 data-bbox="444 363 984 491">                             • 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 data-bbox="444 552 927 680">                             • NetThroughput                              Rate of message delivery over a port                              Measured in Mb/s                         </li> <li data-bbox="444 705 1295 833">                             • 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 data-bbox="444 892 1151 1020">                             • Memory (Mem)                              The utilization of the DPod's memory reserved or in use                              Measured in Kilobytes (KB)                         </li> <li data-bbox="444 1045 1101 1173">                             • CPU                              The utilization of the DPod's CPU reserved or in use                              Measured in Megahertz (MHz)                         </li> <li data-bbox="444 1199 1089 1327">                             • Storage                              The utilization of the storage attached to the DPod                              Measured in Kilobytes (KB)                         </li> <li data-bbox="444 1352 1484 1522">                             • 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> <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</li> </ul>

Entity Type	Commodity
	<p>Measured in Kilobytes (KB)</p> <ul style="list-style-type: none"> <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 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</li> </ul>

Entity Type	Commodity
	<p>Measured in Megabytes (MB)</p> <ul style="list-style-type: none"> <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>
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</li> </ul>

Entity Type	Commodity
	<p>The utilization of the network flow capacity utilized by the DPod. This is divided into Flow1 (Low Cost) and Flow2 (Medium Cost) utilization</p> <p>Measured in Kilobytes per second (KB/s)</p>



---

## Action Script Server

Turbonomic uses remote servers to execute action scripts. Managing the processes remotely means that you do not install custom code on the Turbonomic server, which eliminates associated security risks there. However, you are responsible for maintaining the security of your action script server, to ensure the integrity of your custom code.

### Resource Requirements for the Server

The remote server can be a VM or a container. The capacity you configure for the server depends entirely on the processes you intend to run on it. Turbonomic does not impose any special resource requirements on the server.

### Configuring Command Execution

To support execution of your scripts, you must install any software that is necessary to run the scripts. This includes libraries, language processors, or other processes that your scripts will invoke.

Turbonomic invokes the scripts as commands on the server. The server must run an SSH service that you have configured to support command execution and SFTP operations. At this time, Turbonomic has tested action scripts with the OpenSSH `sshd` daemon.

The standard port for SSH is 22. You can configure a different port, and provide that for admins who configure the server as an Action Script target.

Note that an action script can invoke any process you have deployed on the remote server. You do not have to run scripts *per se*. However, you must be able to invoke the processes from the command line. The script manifest gives Turbonomic the details it needs to build the command line invocation of each script.

### Configuring the Action Script User Account

To execute the scripts on your server, Turbonomic logs on via a user account that is authorized to execute the scripts from the command line. You provide the user credentials when you configure the Action Script target. To support this interaction, the user account must meet the following requirements:

- Public Key

The user must have a public key in the `.ssh/authorized_keys` file. When you configure the Action Script target, you provide this as the Private Token for the target.

- **Security for the `.ssh` Directory**

The Action Script User should be the only user with authorized access. You should set file permissions to `600`.

- **Supported Shells**

The Action Script User shell can be either the Bourne shell (usually at `/bin/sh`) or the Bourne-Again shell (usually at `/bin/bash`). Turbonomic passes parameters as it invokes your scripts. At this time it only supports script execution through these shells.

## Handling Action Script Timeouts

Turbonomic limits script execution to 30 minutes. If a script exceeds this limit, Turbonomic sends a `SIGTERM` to terminate the execution of the process.

Note that Turbonomic does not make any other attempt to terminate a process. For example you could implement the script so it traps the `SIGTERM` and continues to run. The process should terminate at the soonest safe opportunity. However, if the process does not terminate, then you must implement some way to terminate it outside of Turbonomic. Note that a runaway process continues to use its execution thread. This can block other processes (action scripts or primary processes) if there are no more threads in the pool.

## Adding Action Script Targets to Turbonomic

To add an Action Script target, select the **Orchestration > Action Script** option on the Target Configuration page and provide the following information:

- **Name or Address:** The IP address of the Cisco APIC.
- **Script Path:** The path on the server to the location of the Action Script Manifest. For more information, see "Deploying the Action Script Manifest" in the *User Guide*.
- **Port:** The port for the SSH connection. Commonly port 22.
- **User ID:** The user name for SSH access into the server.
- **Private Token:** The public key for the user that is set up in the `.ssh/authorized_keys` file on the server.
- **Public Host Key:** Optionally you can provide a public key on the host.



---

## Appendix — Target Configuration

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

### 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
```

# 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 \(page 73\)](#)
- [EnablingWinRMViaPowerShell \(page 74\)](#)

## 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
```

- 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`).

## Port Configuration

To support communication between Turbonomic and the API endpoints of your intended target, provide bidirectional access for the following ports:

Target	Port(s)
Vcenter (Monitoring)	80, 443
Vcenter (Tags)	443, 10443
Hyper-V	5985, 5986
VMM	5985, 5986
VMAX	5988, 5989
Pure	80, 443
HPE 3PAR	5988, 5989, 8080
NetApp	80, 443
Cisco UCS	80, 443

# 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.