Workload Optimization Manager 1.2
Target Configuration Guide
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Target Configuration

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

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

You can assign instances of the following technologies as Workload Optimization Manager targets:

- **Hypervisors**
  - Citrix XenServer 5.6.x and 6.x
  - IBM PowerVM
  - Microsoft Hyper-V 2008 R2, Hyper-V 2012, and Hyper-V 2012 R2
  - RHEV-M (RedHat Enterprise Virtualization Manager) versions 3.x
  - VMware vCenter 4.1 – 6.5 running with ESX 3.x, 4.x, 5.x, and 6.x

- **Private Cloud Managers**
  - CloudStack 4.0 – 4.6
  - Microsoft System Center 2012 Virtual Machine Manager and System Center 2012 R2 Virtual Machine Manager
  - VMware vCloud Director 1.0 – 5.1
  - OpenStack havana, Icehouse, juno, kilo, and Mitaka
Public Cloud Services
- Amazon AWS
  - us-east-1
  - us-east-2
  - us-west-1
  - us-west-2
  - ca-central-1
  - ap-south-1
  - ap-southeast-1
  - ap-southeast-2
  - ap-northeast-1
  - ap-northeast-2
  - eu-central-1
  - eu-west-1
  - eu-west-2
  - sa-east-1
- Microsoft Azure
- IBM SoftLayer

Application Servers
- IBM WebSphere Application Server, version 8.0.0.9 or greater
- Oracle WebLogic versions 11g or 12c
- JBoss Application Server 7.0 and later – JBoss Deployment Manager using jboss-eap-6.3
- Apache Tomcat, versions 6.x, 7.x and 8.0.x
- JVM Application

Database Servers
- Microsoft SQL Server 2008 R2, 2012, and 2014
- Oracle 11g R2 and 12c
- MySQL 5.5.26 and higher, and all 5.6 releases

Guest OS Processes
- WMI on Windows Server 2008R2 or later
- SNMP with v2c connection

Microsoft Applications
- Microsoft Exchange

Load Balancers
- Citrix NetScaler
- **Application Containers**
  - Docker API 1.2 or greater
  - Kubernetes 1.4 or greater

- **Storage Managers**
  - NetApp Storage Systems running Data ONTAP version 8.x or 9.0
  - EMC VMAX 2 and 3
  - EMC VNX Series Storage Systems
  - EMC VPLEX
  - EMC XtremIO
  - Pure Storage FlashArray
  - HPE 3PAR StoreServ
  - Nutanix
  - Dell Compellent

- **Fabric Managers**
  - Cisco UCS 2.0 and higher
  - Cisco UCS Central
  - HPE OneView

- **Network Flow Collectors**
  - NetFlow/sFlow: NFDUMP – Cisco provides an OVA download with NFDUMP preconfigured for NetFlow and sFlow collection
  - Arista EOS+
  - Cisco APIC 1.0, 1.2.x, and 2.x
  - Cisco Tetration and Tetration-M versions 1.1 and higher

- **Datacenter Orchestrators**
  - UCS Director 5.0+

- **Workload Optimization Manager Targets**

  To configure an aggregated deployment of Workload Optimization Manager, you can assign Workload Optimization Manager servers as targets. The versions of target instances must match the version of the aggregating instance.
Adding and Removing Target Virtual Management Servers

The target services your Workload Optimization Manager 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 Workload Optimization Manager activities you want to perform. For example, the following list shows how vCenter privileges correspond to activities Workload Optimization Manager can perform:

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

Adding Targets

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

Typical information you provide includes:

- **Target Type** – Choose among the supported VM Management technologies (Hypervisor, Cloud Management, Load Balancer, etc.)
  
  After you choose the technology, then choose the specific target type for that technology. For example, for Hypervisor technology, the types you can choose include vCenter, RHEV, Hyper-V, and XenServer.

- **Hostname or IP address** – The address of the target service you want to add

- **User Name** – A valid account username for the target service

- **Password** – A password for the target service account

Editing and Removing Targets

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

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

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

One of the first steps in any Workload Optimization Manager deployment is to connect to the hypervisors within your environment. Once connected, Workload Optimization Manager 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 Workload Optimization Manager extends the supply chain analysis into the components that make up the disk array. For more information, see Storage Targets on page 65.

Actions

Workload Optimization Manager 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.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Machines</td>
<td>■ Provision additional resources (VMem, VCPU)</td>
</tr>
<tr>
<td></td>
<td>■ Move Virtual Machine</td>
</tr>
<tr>
<td></td>
<td>■ Move Virtual Machine Storage</td>
</tr>
<tr>
<td></td>
<td>■ Reconfigure Storage</td>
</tr>
<tr>
<td></td>
<td>■ Reconfigure Virtual Machine</td>
</tr>
<tr>
<td>Physical Machines</td>
<td>■ Start Physical Machine</td>
</tr>
<tr>
<td></td>
<td>■ Provision Physical Machine</td>
</tr>
<tr>
<td></td>
<td>■ Suspend Physical Machine</td>
</tr>
</tbody>
</table>
Monitored Resources

Workload Optimization Manager monitors the following resources for the hypervisor supply chain:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>VirtualMachine</td>
<td>• Virtual Memory (VMem)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the VMem allocated to the hosting VM</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td></td>
<td>• Virtual CPU (VCPU)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the VCPU allocated to the hosting VM</td>
</tr>
<tr>
<td></td>
<td>Measured in Megahertz (MHz)</td>
</tr>
<tr>
<td></td>
<td>• Virtual Storage (VStorage)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the virtual storage capacity allocated for the VM</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td></td>
<td>• Storage Access Operations Per Second (IOPS)</td>
</tr>
<tr>
<td></td>
<td>The utilization of IOPS allocated for the VStorage on the VM</td>
</tr>
<tr>
<td></td>
<td>Measured in IOPS</td>
</tr>
<tr>
<td></td>
<td>• Latency</td>
</tr>
<tr>
<td></td>
<td>The utilization of latency allocated for the VStorage on the VM</td>
</tr>
<tr>
<td></td>
<td>Measured in milliseconds (ms)</td>
</tr>
<tr>
<td>Physical Machine</td>
<td>• Memory (Mem)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the PM's memory reserved or in use</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td></td>
<td>• CPU</td>
</tr>
<tr>
<td></td>
<td>The utilization of the PM's CPU reserved or in use</td>
</tr>
<tr>
<td></td>
<td>Measured in Megahertz (MHz)</td>
</tr>
<tr>
<td></td>
<td>• IO</td>
</tr>
<tr>
<td></td>
<td>The utilization of the PM's IO adapters</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes per second (KB/s)</td>
</tr>
<tr>
<td></td>
<td>• Net</td>
</tr>
<tr>
<td></td>
<td>The utilization of data through the PM's network adapters</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes per second (KB/s)</td>
</tr>
<tr>
<td></td>
<td>• Swap</td>
</tr>
<tr>
<td></td>
<td>The utilization of the PM's swap space</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
</tbody>
</table>
- **Balloon**
  The utilization of shared memory among VMs running on the host. ESX-only
  Measured in Kilobytes (KB)

- **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)

### Storage

- **Storage Amount**
  The utilization of the datastore's capacity
  Measured in Megabytes (MB)

- **Storage Provisioned**
  The utilization of the datastore's capacity, including overprovisioning.
  Measured in Megabytes (MB)

- **Storage Access Operations Per Second (IOPS)**
  The utilization of the storage access operations per second on the datastore
  Measured in Operations per second

- **Latency**
  The utilization of latency on the datastore
  Measured in Milliseconds (ms)

### Datacenter

**NOTE:** For datacenter entities, Workload Optimization Manager does not monitor resources directly from the datacenter, but from the physical machines in the datacenter.

- **Memory (Mem)**
  The utilization of the PM’s memory reserved or in use
  Measured in Kilobytes (KB)

- **CPU**
  The utilization of the PM’s CPU reserved or in use
  Measured in Megahertz (MHz)

- **IO**
  The utilization of the PM’s IO adapters
  Measured in Kilobytes per second (KB/s)

- **Net**
  The utilization of data through the PM’s network adapters
  Measured in Kilobytes per second (KB/s)

- **Swap**
  The utilization of the PM’s swap space
  Measured in Kilobytes (KB)

- **Balloon**
  The utilization of shared memory among VMs running on the host. ESX-only
  Measured in Kilobytes (KB)

- **CPU Ready**
  The utilization of the PM’s allocated ready queue capacity that is in use, for 1, 2, and 4 CPU ready queues. This is ESX-only.
IBM PowerVM

Workload Optimization Manager connects with IBM PowerVM servers through the IBM Hardware Management Console (HMC) to manage logical partitions (LPARs), virtual I/O servers (VIOS), and the associated network and storage.

The components of IBM PowerVM map to entities in the Workload Optimization Manager supply chain as follows:

<table>
<thead>
<tr>
<th>PowerVM Name</th>
<th>Workload Optimization Manager Entity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frame</td>
<td>Physical Machine</td>
</tr>
<tr>
<td>Node</td>
<td>N/A – A source of compute resources contained within the frame, but not described in the Workload Optimization Manager user interface as a separate entity</td>
</tr>
<tr>
<td>LPAR or VIOS</td>
<td>Virtual Machine</td>
</tr>
<tr>
<td>Fabric</td>
<td>Storage</td>
</tr>
</tbody>
</table>

Prerequisites

- IBM Hardware Management Console (HMC) 8.3 or higher with the Performance and Capacity Monitoring API and data collection enabled.
- A service account Workload Optimization Manager can use to connect to your HMC. To generate actions, the account must have HMC Viewer permission and access to the HMC Capacity and Performance Monitoring API. To automate actions the account must have HMC Root permissions.

**NOTE:** To discover utilization (Mem, CPU, etc.) on HMC frames, the account’s user permissions must include the List Utilization Data permission for each frame.
To accurately monitor LPAR memory, and to recommend actions based on LPAR memory utilization:

- Each LPAR must use an AIX operating system
- Each LPAR must have SNMP enabled

When you specify an HMC target, you specify an SNMP port and a community name — The values you provide for the target should match the SNMP configuration on the LPARs that the HMC manages.

If you do not enable SNMP connections to a given LPAR, then Workload Optimization Manager successfully manages that LPAR but it cannot read memory utilization from the LPAR. Without SNMP to an LPAR running AIX, Workload Optimization Manager gets memory consumption values from the Hardware Management Console. HMC memory values are not based on actual utilization in the LPAR.

Adding PowerVM Targets

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

- Address
  The name or IP address of the Hardware Management Console.
- Username/Password
  Credentials for the service account Workload Optimization Manager can use to connect to the HMC.
- SNMP Port
  An SNMP port common to the LPARs managed by the target HMC.
- SNMP Community
  The SNMP community common to the LPARs managed by the target HMC.

After discovering your target, Workload Optimization Manager creates a group named AIX-vioses-auto to contain discovered VMs. Under some circumstances, the PowerVM configuration does not provide the information Workload Optimization Manager needs to create this group. To fix this issue, see the following IBM workaround: [http://www-01.ibm.com/support/docview.wss?uid=isg3T1024482;](http://www-01.ibm.com/support/docview.wss?uid=isg3T1024482;).

Resizing Down Virtual I/O Servers

If you do not want to receive "Resize down" recommendations for your virtual I/O servers, you can disable this on the Policy tab as follows:

- In the Policy Editor, select Action > VM
- In the Scope pane, expand Folders and select AIX-vioses-auto
- For the Resize down action in the Action Mode Settings table, enable Override and change the value to Disabled
- Click Apply Settings Change
Supported Actions

Workload Optimization Manager supports the following actions for IBM PowerVM entities:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Can Be Automated</th>
<th>Recommendations Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Machine</td>
<td>Move, Resize Down, Resize Up</td>
<td>Start, Suspend, Terminate, Provision, Reconfigure</td>
</tr>
<tr>
<td>Physical Machine</td>
<td></td>
<td>Start, Suspend, Terminate, Provision</td>
</tr>
</tbody>
</table>

Monitored Resources

Workload Optimization Manager monitors the following resources for the hypervisor supply chain:

**Virtual Machine**
- **Virtual Memory (VMem)**
  - The utilization of the VMem allocated to the hosting VM
  - Measured in Kilobytes (KB)
- **Virtual CPU (VCPU)**
  - The utilization of the VCPU allocated to the hosting VM
  - Measured in Megahertz (MHz)
- **Virtual Storage (VStorage)**
  - The utilization of the virtual storage capacity allocated for the VM
  - Measured in Kilobytes (KB)
- **Storage Access Operations Per Second (IOPS)**
  - The utilization of IOPS allocated for the VStorage on the VM
  - Measured in IOPS
- **Latency**
  - The utilization of latency allocated for the VStorage on the VM
  - Measured in milliseconds (ms)

**Physical Machine**
- **Memory (Mem)**
  - The utilization of the PM's memory reserved or in use
  - Measured in Kilobytes (KB)
- **CPU**
  - The utilization of the PM's CPU reserved or in use
  - Measured in Megahertz (MHz)
- **IO**
  - The utilization of the PM's IO adapters
  - Measured in Kilobytes per second (KB/s)
- **Net**
  - The utilization of data through the PM's network adapters
  - Measured in Kilobytes per second (KB/s)
- **Swap**
  - The utilization of the PM's swap space
  - Measured in Kilobytes (KB)
Balloon
The utilization of shared memory among VMs running on the host. ESX-only
Measured in Kilobytes (KB)

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)

Storage

Storage Amount
The utilization of the datastore’s capacity
Measured in Megabytes (MB)

Storage Provisioned
The utilization of the datastore’s capacity, including overprovisioning. Measured in Megabytes (MB)

Storage Access Operations Per Second (IOPS)
The utilization of the storage access operations per second on the datastore
Measured in Operations per second

Latency
The utilization of latency on the datastore
Measured in Milliseconds (ms)

Datacenter

NOTE: For datacenter entities, Workload Optimization Manager does not monitor resources directly from the datacenter, but from the physical machines in the datacenter.

Memory (Mem)
The utilization of the PM’s memory reserved or in use
Measured in Kilobytes (KB)

CPU
The utilization of the PM’s CPU reserved or in use
Measured in Megahertz (MHz)

IO
The utilization of the PM’s IO adapters
Measured in Kilobytes per second (KB/s)

Net
The utilization of data through the PM’s network adapters
Measured in Kilobytes per second (KB/s)

Swap
The utilization of the PM’s swap space
Measured in Kilobytes (KB)

Balloon
The utilization of shared of memory among VMs running on the host. ESX-only
Measured in Kilobytes (KB)

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)
Hyper-V

If you have a small number of Hyper-V hosts in your environment, you can add them individually as Workload Optimization Manager 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 Workload Optimization Manager 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 Workload Optimization Manager 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 Virtual Machine Manager on page 47.

**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 Creating A Service User Account on page 16.

For accurate SMB storage calculations, Workload Optimization Manager requires a VMM target.

Prerequisites

- Create a service account that Workload Optimization Manager can use to connect to your Hyper-V servers. See "Creating a Service User Account in Hyper-V" in the User Guide
- Configure remote management on each Hyper-V server. See Creating A Service User Account on page 16.

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. Cisco 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**
  
  Workload Optimization Manager 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 Global Policy Objects on page 186).

- **Username**

  The username of a service account Workload Optimization Manager 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.

  **NOTE:** If your Hyper-V hosts are running in a Nutanix environment, you must understand pinning a Nutanix Controller VM. For more information, see Controller VM Pinning on page 91.

### Hyper-V SDK Probe Properties

Workload Optimization Manager offers the capability to adjust certain properties of the probe. In general, this tweaking will not be necessary. If adjustment is needed, the file can be found in the
/srv/tomcat/webapps/vmturbo/probe-jars/{probe}/resources folder. This target has the following properties:

<table>
<thead>
<tr>
<th>Setting</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>maxEnvelopeSize</td>
<td>Maximum size of SOAP response envelope</td>
</tr>
<tr>
<td>timeout</td>
<td>Determines the timeout in milliseconds for both initial connection and discovery, and maximum period between data packets</td>
</tr>
<tr>
<td>conversionObjectsBatchSize</td>
<td>Maximum amount of internal objects that should be converted into EntityDTO in one batch</td>
</tr>
<tr>
<td>queriesThreadPoolCoreSize</td>
<td>Number of threads that will remain in the thread pool even if idle timeout is exceeded. This number should be lower or equal to queriesThreadPoolMaximumSize</td>
</tr>
<tr>
<td>queriesThreadPoolMaximumSize</td>
<td>Maximum number of threads that will be used by the thread pool</td>
</tr>
<tr>
<td>queriesThreadPoolIdleTimeout</td>
<td>Time in seconds before a thread will time out if number of active threads are above queriesThreadPoolCoreSize</td>
</tr>
<tr>
<td>hostThreadPoolCoreSize</td>
<td>Number of threads that will remain in the thread pool responsible for simultaneous discovery of host instances. This number should be lower or equal to hostThreadPoolMaximumSize</td>
</tr>
<tr>
<td>hostThreadPoolMaximumSize</td>
<td>Maximum number of threads that will be used by the thread pool responsible for simultaneous discovery of host instances</td>
</tr>
<tr>
<td>Variable</td>
<td>Description</td>
</tr>
<tr>
<td>----------</td>
<td>-------------</td>
</tr>
<tr>
<td><code>hostThreadPoolIdleTimeout</code></td>
<td>Time in seconds before a thread will time out if number of active threads are above <code>hostThreadPoolCoreSize</code></td>
</tr>
<tr>
<td><code>clusterThreadPoolCoreSize</code></td>
<td>Number of threads that will remain in the thread pool for handling requests to Hyper-V targets. This number should be lower or equal to <code>clusterThreadPoolMaximumSize</code></td>
</tr>
<tr>
<td><code>clusterThreadPoolMaximumSize</code></td>
<td>Maximum number of threads that will be used by the thread pool responsible for handling requests to Hyper-V hosts</td>
</tr>
<tr>
<td><code>clusterThreadPoolIdleTimeout</code></td>
<td>Time in seconds before a thread will time out if number of active threads are above <code>clusterThreadPoolCoreSize</code></td>
</tr>
<tr>
<td><code>hypervCommonThreadPoolCoreSize</code></td>
<td>Number of threads that will remain in the thread pool responsible for miscellaneous SDK tasks</td>
</tr>
<tr>
<td><code>hypervCommonThreadPoolMaximumSize</code></td>
<td>Maximum number of threads that will be used by the thread pool responsible for miscellaneous SDK tasks. This number should be lower or equal to <code>hypervCommonThreadPoolMaximumSize</code></td>
</tr>
<tr>
<td><code>hypervCommonThreadPoolIdleTimeout</code></td>
<td>Time in seconds before a thread will time out if number of active threads are above <code>hypervCommonThreadPoolCoreSize</code></td>
</tr>
<tr>
<td><code>actionStepCheckSucceededTimeout</code></td>
<td>Time in milliseconds to wait before triggering the next step in an action chain</td>
</tr>
<tr>
<td><code>actionStepCheckAmount</code></td>
<td>Number of times to poll for an action is complete before failure</td>
</tr>
<tr>
<td><code>actionStepCheckTimeout</code></td>
<td>Time in milliseconds between action checks</td>
</tr>
<tr>
<td><code>requestsPerHost</code></td>
<td>Maximum number of simultaneous requests per host</td>
</tr>
</tbody>
</table>

**NOTE:** To improve the performance of discovery in large environments (25+ Hosts), increase the following settings:

- `queriesThreadPoolMaximumSize`
- `hostThreadPoolMaximumSize`
- `clusterThreadPoolMaximumSize`

This increases the number of threads that the probe uses to discover your environment. As you increase the number of threads, you may need to increase the amount of memory allocated to Workload Optimization Manager.
Supported Actions

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

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Can Be Automated</th>
<th>Recommendations Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Machine</td>
<td>Start, Move, Suspend, Storage Move, Resize Down, Resize Up</td>
<td>Terminate, Provision, Reconfigure</td>
</tr>
<tr>
<td>Physical Machine</td>
<td>Start, Suspend</td>
<td>Terminate, Provision</td>
</tr>
<tr>
<td>Storage</td>
<td></td>
<td>Provision</td>
</tr>
</tbody>
</table>

Monitored Resources

Workload Optimization Manager monitors the following resources for the hypervisor supply chain:

**Entity Type**

**Virtual Machine**

- **Virtual Memory (VMem)**
  The utilization of the VMem allocated to the hosting VM Measured in Kilobytes (KB)
- **Virtual CPU (VCPU)**
  The utilization of the VCPU allocated to the hosting VM Measured in Megahertz (MHz)
- **Virtual Storage (VStorage)**
  The utilization of the virtual storage capacity allocated for the VM Measured in Kilobytes (KB)
- **Storage Access Operations Per Second (IOPS)**
  The utilization of IOPS allocated for the VStorage on the VM Measured in IOPS
- **Latency**
  The utilization of latency allocated for the VStorage on the VM Measured in milliseconds (ms)

**Physical Machine**

- **Memory (Mem)**
  The utilization of the PM’s memory reserved or in use Measured in Kilobytes (KB)
- **CPU**
  The utilization of the PM’s CPU reserved or in use Measured in Megahertz (MHz)
- **IO**
  The utilization of the PM’s IO adapters Measured in Kilobytes per second (KB/s)
- **Net**
  The utilization of data through the PM’s network adapters Measured in Kilobytes per second (KB/s)
- **Swap**
  The utilization of the PM’s swap space Measured in Kilobytes (KB)
Storage

- Storage Amount
  The utilization of the datastore's capacity
  Measured in Megabytes (MB)
- Storage Provisioned
  The utilization of the datastore's capacity, including overprovisioning.
  Measured in Megabytes (MB)
- Storage Access Operations Per Second (IOPS)
  The utilization of the storage access operations per second on the datastore
  Measured in Operations per second
- Latency
  The utilization of latency on the datastore
  Measured in Milliseconds (ms)

Datacenter

**NOTE:** For datacenter entities, Workload Optimization Manager does not monitor resources directly from the datacenter, but from the physical machines in the datacenter.

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

Creating A Service User Account

The service account Workload Optimization Manager 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 Cisco 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.

Red Hat Enterprise Virtualization (RHEV-M)

Red Hat Enterprise Virtualization Manager (RHEV-M) provides centralized management of Red Hat hypervisors. To manage Red Hat hypervisors, you specify a RHEV-M instance as a target.

Prerequisites

- A service account Workload Optimization Manager can use to connect to the RHEV-M server. The account must have administrator privileges on RHEV-M.

Adding RHEV-M Targets

To add RHEV-M targets, select the Hypervisors > RHEV-M option on the Target Configuration page and provide the following information:

- Address

  The name or IP address of the RHEV-M console. Workload Optimization Manager defaults to port 443. If your RHEV-M uses a port other than 443, append the port number to the address. For example, RHEV-M 3.0 uses port 8443 — You would specify the following address:<RHEV-M_IP_ADDRESS>:8443.
Username/Password

Credentials for the service account Workload Optimization Manager can use to connect to RHEV-M. If you’re connecting using an account that is not the internal admin account, specify `<domain>\<username>` for the username.

Supported Actions

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

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Can Be Automated</th>
<th>Recommendations Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Machine</td>
<td>Start, Move, Suspend, Storage Move, Resize Down, Resize Up</td>
<td>Terminate, Provision, Reconfigure</td>
</tr>
<tr>
<td>Physical Machine</td>
<td>Start, Suspend</td>
<td>Terminate, Provision</td>
</tr>
<tr>
<td>Datastore (“Storage”)</td>
<td></td>
<td>Provision</td>
</tr>
</tbody>
</table>

Monitored Resources

Workload Optimization Manager monitors the following resources for the hypervisor supply chain:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
</table>
| Virtual Machine        | ■ Virtual Memory (VMem)  
The utilization of the VMem allocated to the hosting VM  
Measured in Kilobytes (KB)  
■ Virtual CPU (VCPU)  
The utilization of the VCPU allocated to the hosting VM  
Measured in Megahertz (MHz)  
■ Virtual Storage (VStorage)  
The utilization of the virtual storage capacity allocated for the VM  
Measured in Kilobytes (KB)  
■ Storage Access Operations Per Second (IOPS)  
The utilization of IOPS allocated for the VStorage on the VM  
Measured in IOPS  
■ Latency  
The utilization of latency allocated for the VStorage on the VM  
Measured in milliseconds (ms) |
| Physical Machine       | ■ Memory (Mem)  
The utilization of the PM's memory reserved or in use  
Measured in Kilobytes (KB)  
■ CPU  
The utilization of the PM's CPU reserved or in use  
Measured in Megahertz (MHz)  
■ IO  
The utilization of the PM's IO adapters  
Measured in Kilobytes per second (KB/s) |
The utilization of data through the PM's network adapters  
Measured in Kilobytes per second (KB/s)

The utilization of the PM's swap space  
Measured in Kilobytes (KB)

The utilization of shared memory among VMs running on the host. ESX-only  
Measured in Kilobytes (KB)

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)

The utilization of the datastore's capacity  
Measured in Megabytes (MB)

The utilization of the datastore's capacity, including overprovisioning.  
Measured in Megabytes (MB)

The utilization of the storage access operations per second on the datastore  
Measured in Operations per second

The utilization of latency on the datastore  
Measured in Milliseconds (ms)

For datacenter entities, Workload Optimization Manager does not monitor resources directly from the datacenter, but from the physical machines in the datacenter.

The utilization of the PM's memory reserved or in use  
Measured in Kilobytes (KB)

The utilization of the PM's CPU reserved or in use  
Measured in Megahertz (MHz)

The utilization of the PM's IO adapters  
Measured in Kilobytes per second (KB/s)

The utilization of data through the PM's network adapters  
Measured in Kilobytes per second (KB/s)

The utilization of the PM's swap space  
Measured in Kilobytes (KB)

The utilization of shared memory among VMs running on the host. ESX-only  
Measured in Kilobytes (KB)
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)

Provider Virtual Datacenter

Memory (Mem)
The utilization of the Datacenter’s memory reserved or in use
Measured in Kilobytes (KB)

CPU
The utilization of the Datacenter’s CPU reserved or in use
Measured in Megahertz (MHz)

Storage
The utilization of the storage attached to the Provider vDC.
Measured in Kilobytes (KB)

Consumer Virtual Datacenter

Memory (Mem)
The utilization of the Datacenter’s memory reserved or in use
Measured in Kilobytes (KB)

CPU
The utilization of the Datacenter’s CPU reserved or in use
Measured in Megahertz (MHz)

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

vCenter Server

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

Prerequisites

A service user account Workload Optimization Manager can use to connect to your vCenter and execute actions (see Creating A Service User Account In vCenter on page 24).

General Considerations Before Target Addition

Linked vCenters:
For linked vCenters, you must add each vCenter separately. Workload Optimization Manager 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 Workload Optimization Manager 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. Cisco recommends that you do not add multiple vCenter targets that manage the same datastore.
Restrict Workload Optimization Manager Access to Specific Clusters:

When you add a vCenter target, Workload Optimization Manager 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 Cisco 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 service account Workload Optimization Manager can use to connect to the vCenter Server. Include the domain if required (<domain>\<username>).

**NOTE:** If your VMware hypervisors are running in a Nutanix environment, you must understand pinning a Nutanix Controller VM. For more information, see Controller VM Pinning on page 91.

vCenter Post-Addition Imports

In addition to discovering entities managed by the hypervisor, Workload Optimization Manager also imports a wide range of vSphere settings, such as Host DRS rules, annotations, Resource Pools, and DRS HA settings (See "Other Information Imported From vCenter" in the User Guide).

**NOTE:** Workload Optimization Manager does not import Storage DRS settings.

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

To configure Operations Manager to support cross vCenter vMotion recommendations, you must create a Workload Placement Segment that merges the clusters on the different vCenters. To create a merge segment:

- On the Policy > Workload Placement page, click the Add Segment button.
- In the Segment Editor window, select the Merge option and add the vCenter clusters to merge.

**NOTE:** Since Workload Optimization Manager 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 Workload Optimization Manager will not initiate VSS → VDS vMotions, vSphere may do so. If this happens, Workload Optimization Manager 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.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Can Be Automated</th>
<th>Recommendations Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Machine</td>
<td>Start, Move, Suspend, Storage Move, Resize Down, Resize Up</td>
<td>Terminate, Provision, Reconfigure</td>
</tr>
<tr>
<td>Physical Machine</td>
<td>Start, Suspend</td>
<td>Terminate, Provision</td>
</tr>
<tr>
<td>Storage</td>
<td></td>
<td>Provision</td>
</tr>
</tbody>
</table>

Monitored Resources

Workload Optimization Manager monitors the following resources for the hypervisor supply chain:

Virtual Machine

- **Virtual Memory (VMem)**
  The utilization of the VMem allocated to the hosting VM
  Measured in Kilobytes (KB)
- **Virtual CPU (VCPU)**
  The utilization of the VCPU allocated to the hosting VM
  Measured in Megahertz (MHz)
- **Virtual Storage (VStorage)**
  The utilization of the virtual storage capacity allocated for the VM
  Measured in Kilobytes (KB)
- **Storage Access Operations Per Second (IOPS)**
  The utilization of IOPS allocated for the VStorage on the VM
  Measured in IOPS
- **Latency**
  The utilization of latency allocated for the VStorage on the VM
  Measured in milliseconds (ms)

Physical Machine

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

- **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)

### Storage

- **Storage Amount**
  The utilization of the datastore's capacity
  Measured in Megabytes (MB)

- **Storage Provisioned**
  The utilization of the datastore's capacity, including overprovisioning.
  Measured in Megabytes (MB)

- **Storage Access Operations Per Second (IOPS)**
  The utilization of the storage access operations per second on the datastore
  Measured in Operations per second

- **Latency**
  The utilization of latency on the datastore
  Measured in Milliseconds (ms)

### Datacenter

**NOTE:** For datacenter entities, Workload Optimization Manager does not monitor resources directly from the datacenter, but from the physical machines in the datacenter.

- **Memory (Mem)**
  The utilization of the PM’s memory reserved or in use
  Measured in Kilobytes (KB)

- **CPU**
  The utilization of the PM’s CPU reserved or in use
  Measured in Megahertz (MHz)

- **IO**
  The utilization of the PM’s IO adapters
  Measured in Kilobytes per second (KB/s)

- **Net**
  The utilization of data through the PM’s network adapters
  Measured in Kilobytes per second (KB/s)

- **Swap**
  The utilization of the PM’s swap space
  Measured in Kilobytes (KB)

- **Balloon**
  The utilization of shared memory among VMs running on the host. ESX-only
  Measured in Kilobytes (KB)

- **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)
Provider Virtual Datacenter

- Memory (Mem)
  The utilization of the Datacenter’s memory reserved or in use
  Measured in Kilobytes (KB)
- CPU
  The utilization of the Datacenter’s CPU reserved or in use
  Measured in Megahertz (MHz)
- Storage
  The utilization of the storage attached to the Provider vDC.
  Measured in Kilobytes (KB)

Consumer Virtual Datacenter

- Memory (Mem)
  The utilization of the Datacenter’s memory reserved or in use
  Measured in Kilobytes (KB)
- CPU
  The utilization of the Datacenter’s CPU reserved or in use
  Measured in Megahertz (MHz)
- Storage
  The utilization of the storage attached to the Consumer vDC.
  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 Workload Optimization Manager 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 Workload Optimization Manager activities:

<table>
<thead>
<tr>
<th>Workload Optimization Manager Activity</th>
<th>Required Privileges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitoring</td>
<td>Read-only for all entity types</td>
</tr>
<tr>
<td>Recommend Actions</td>
<td>Read-only for all entity types</td>
</tr>
<tr>
<td>Wasted Storage Reporting</td>
<td>Datastore &gt; Browse Datastore</td>
</tr>
<tr>
<td>Execute VM Move (vMotion)</td>
<td>Resource &gt; Migrate</td>
</tr>
<tr>
<td></td>
<td>Resource &gt; Query Vmotion</td>
</tr>
<tr>
<td></td>
<td>Resource &gt; Modify Resource Pool</td>
</tr>
<tr>
<td></td>
<td>Resource &gt; Assign VM to Resource Pool</td>
</tr>
<tr>
<td>Workload Optimization Manager Activity</td>
<td>Required Privileges</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Execute VM Storage Move (svMotion)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Datastore &gt; Allocate Space</td>
</tr>
<tr>
<td></td>
<td>Datastore &gt; Browse Datastore</td>
</tr>
<tr>
<td></td>
<td>Datastore &gt; Configure Datastore</td>
</tr>
<tr>
<td></td>
<td>Datastore &gt; Move Datastore</td>
</tr>
<tr>
<td></td>
<td>Datastore &gt; Remove File</td>
</tr>
<tr>
<td></td>
<td>Datastore &gt; Update Virtual Machine Files</td>
</tr>
<tr>
<td></td>
<td>Datastore Cluster &gt; Configure a Datastore Cluster</td>
</tr>
<tr>
<td></td>
<td>Resource &gt; Assign VM to Resource Pool</td>
</tr>
<tr>
<td></td>
<td>Resource &gt; Migrate</td>
</tr>
<tr>
<td></td>
<td>Resource &gt; Relocate</td>
</tr>
<tr>
<td></td>
<td>Resource &gt; Modify Resource Pool</td>
</tr>
<tr>
<td></td>
<td>Resource &gt; Move Resource Pool</td>
</tr>
<tr>
<td></td>
<td>Resource &gt; Query VMotion</td>
</tr>
<tr>
<td></td>
<td>Virtual Machine &gt; Configuration &gt; Change Resource</td>
</tr>
<tr>
<td></td>
<td>Virtual Machine &gt; Configuration &gt; Swap File Placement</td>
</tr>
<tr>
<td><strong>NOTE:</strong></td>
<td>Datastore Cluster permissions only apply to vSphere 5.x</td>
</tr>
<tr>
<td>Execute VM Resize</td>
<td></td>
</tr>
<tr>
<td>Discover tags</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Virtual Machine &gt; Configuration &gt; Change CPU Count</td>
</tr>
<tr>
<td></td>
<td>Virtual Machine &gt; Configuration &gt; Change Resources</td>
</tr>
<tr>
<td></td>
<td>Virtual Machine &gt; Configuration &gt; Memory</td>
</tr>
<tr>
<td></td>
<td>Virtual Machine &gt; Interaction &gt; Reset</td>
</tr>
<tr>
<td></td>
<td>Virtual Machine &gt; Interaction &gt; Power Off</td>
</tr>
<tr>
<td></td>
<td>Virtual Machine &gt; Interaction &gt; Power On</td>
</tr>
<tr>
<td></td>
<td>Global &gt; Global tags</td>
</tr>
<tr>
<td></td>
<td>In addition, you must open ports 10443 and 7443 on the target server</td>
</tr>
</tbody>
</table>
XenServer

XenServer is a virtualization platform that provides centralized management of virtual resources. The XenServer environment configures hosts as resource pools with shared storage. A resource pool always has at least one physical node that serves as the resource pool master. The master exposes an administration interface, and forwards commands to other members of the pool. Workload Optimization Manager connects to a pool through the resource pool master — you specify the resource pool master as a target.

Prerequisites

- A service account Workload Optimization Manager can use to connect to the XenServer host that serves as a resource pool master. In addition, this account must have administrator privileges on all hosts in the resource pool.

- For full integration, XenServer 6.1 or higher with the Performance Monitoring Enhancements Pack is required. Earlier versions of the API do not provide Workload Optimization Manager with storage IOPS and latency information.

- All hosts in the environment must have their clocks synchronized via NTP. Workload Optimization Manager is unable to collect utilization data from XenServer hosts if they are not time synchronized.

Adding XenServer Targets

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

- Address
  
  The name or IP address of the Resource Pool Master.

- Username/Password

  Credentials for the service account Workload Optimization Manager can use to connect to the Resource Pool Master.

Supported Actions

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Can Be Automated</th>
<th>Recommendations Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Machine</td>
<td>Start, Move, Suspend, Resize Down, Resize Up</td>
<td>Terminate, Provision, Storage Move, Reconfigure</td>
</tr>
<tr>
<td>Physical Machine</td>
<td>Start, Suspend, Terminate, Provision</td>
<td></td>
</tr>
<tr>
<td>Datastore (“Storage”)</td>
<td></td>
<td>Provision</td>
</tr>
</tbody>
</table>

Monitored Resources

Workload Optimization Manager monitors the following resources for the hypervisor supply chain:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Machine</td>
<td>Virtual Memory (VMem)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the VMem allocated to the hosting VM</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
</tbody>
</table>
Virtual CPU (VCPU)
The utilization of the VCPU allocated to the hosting VM
Measured in Megahertz (MHz)

Virtual Storage (VStorage)
The utilization of the virtual storage capacity allocated for the VM
Measured in Kilobytes (KB)

Storage Access Operations Per Second (IOPS)
The utilization of IOPS allocated for the VStorage on the VM
Measured in IOPS

Latency
The utilization of latency allocated for the VStorage on the VM
Measured in milliseconds (ms)

Physical Machine

Memory (Mem)
The utilization of the PM's memory reserved or in use
Measured in Kilobytes (KB)

CPU
The utilization of the PM's CPU reserved or in use
Measured in Megahertz (MHz)

IO
The utilization of the PM's IO adapters
Measured in Kilobytes per second (KB/s)

Net
The utilization of data through the PM's network adapters
Measured in Kilobytes per second (KB/s)

Swap
The utilization of the PM's swap space
Measured in Kilobytes (KB)

Balloon
The utilization of shared memory among VMs running on the host. ESX-only
Measured in Kilobytes (KB)

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)

Storage

Storage Amount
The utilization of the datastore's capacity
Measured in Megabytes (MB)

Storage Provisioned
The utilization of the datastore's capacity, including overprovisioning.
Measured in Megabytes (MB)

Storage Access Operations Per Second (IOPS)
The utilization of the storage access operations per second on the datastore
Measured in Operations per second

Latency
The utilization of latency on the datastore
Measured in Milliseconds (ms)
NOTE: For datacenter entities, Workload Optimization Manager does not monitor resources directly from the datacenter, but from the physical machines in the datacenter.

- Memory (Mem)
  The utilization of the PM's memory reserved or in use
  Measured in Kilobytes (KB)

- CPU
  The utilization of the PM's CPU reserved or in use
  Measured in Megahertz (MHz)

- IO
  The utilization of the PM's IO adapters
  Measured in Kilobytes per second (KB/s)

- Net
  The utilization of data through the PM's network adapters
  Measured in Kilobytes per second (KB/s)

- Swap
  The utilization of the PM's swap space
  Measured in Kilobytes (KB)

- Balloon
  The utilization of shared of memory among VMs running on the host. ESX-only
  Measured in Kilobytes (KB)

- 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)
Cloud Management Targets

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

- **Private cloud**
  - Apache CloudStack
  - Microsoft Virtual Machine Manager (VMM)
  - OpenStack Cloud Operating System
  - VMware vCenter Server

- **Public cloud**
  - Amazon Web Services (AWS)
  - IBM SoftLayer
  - Microsoft Azure

- **Hybrid clouds**
  A combination of private and public clouds — Workload Optimization Manager can burst workload out to the public cloud to accommodate peaks in demand. For more information about this configuration, see "Hybrid Cloud Configuration" in the User Guide.

Workload Optimization Manager can manage private and public clouds, ensuring that applications running on the cloud have enough resources to assure performance. For example, if applications on private cloud need more resources, Workload Optimization Manager can recommend that the self-service customer add more virtual resources. Or if necessary, Workload Optimization Manager can provision more physical machines to increase the pool of resources available to all the self-service customers.

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. Workload Optimization Manager discovers and manages these resource pools in relation to the whole datacenter. This enables Workload Optimization Manager 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
Actions

Workload Optimization Manager recommends actions for the cloud target supply chain as follows.

**NOTE:** This is a general list of actions for entities discovered for cloud targets. You can see how actions differ per technology in each section that describes adding a specific type of cloud target.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Machines</td>
<td>■ Provision additional resources (VMem, VCPU)</td>
</tr>
<tr>
<td></td>
<td>■ Move Virtual Machine</td>
</tr>
<tr>
<td></td>
<td>■ Move Virtual Machine Storage</td>
</tr>
<tr>
<td></td>
<td>■ Reconfigure Storage</td>
</tr>
<tr>
<td></td>
<td>■ Reconfigure Virtual Machine</td>
</tr>
<tr>
<td>Physical Machines</td>
<td>■ Start Physical Machine</td>
</tr>
<tr>
<td></td>
<td>■ Provision Physical Machine</td>
</tr>
<tr>
<td></td>
<td>■ Suspend Physical Machine</td>
</tr>
<tr>
<td>Consumer Virtual Datacenters</td>
<td>■ Resize Consumer vDC</td>
</tr>
<tr>
<td></td>
<td>■ Provision Consumer vDC</td>
</tr>
</tbody>
</table>

Monitored Resources

Workload Optimization Manager monitors the following resources for the application server supply chain:

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

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>VirtualMachine</td>
<td>■ Virtual Memory (VMem)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the VMem allocated to the hosting VM</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td></td>
<td>■ Virtual CPU (VCPU)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the VCPU allocated to the hosting VM</td>
</tr>
<tr>
<td></td>
<td>Measured in Megahertz (MHz)</td>
</tr>
<tr>
<td></td>
<td>■ Virtual Storage (VStorage)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the virtual storage capacity allocated for the VM</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td></td>
<td>■ Storage Access Operations Per Second (IOPS)</td>
</tr>
<tr>
<td></td>
<td>The utilization of IOPS allocated for the VStorage on the VM</td>
</tr>
<tr>
<td></td>
<td>Measured in IOPS</td>
</tr>
<tr>
<td></td>
<td>■ Latency</td>
</tr>
<tr>
<td></td>
<td>The utilization of latency allocated for the VStorage on the VM</td>
</tr>
<tr>
<td></td>
<td>Measured in milliseconds (ms)</td>
</tr>
</tbody>
</table>
Physical Machine

- **Memory (Mem)**
  The utilization of the PM's memory reserved or in use
  Measured in Kilobytes (KB)

- **CPU**
  The utilization of the PM's CPU reserved or in use
  Measured in Megahertz (MHz)

- **IO**
  The utilization of the PM's IO adapters
  Measured in Kilobytes per second (KB/s)

- **Net**
  The utilization of data through the PM's network adapters
  Measured in Kilobytes per second (KB/s)

- **Swap**
  The utilization of the PM's swap space
  Measured in Kilobytes (KB)

- **Balloon**
  The utilization of shared memory among VMs running on the host. ESX-only
  Measured in Kilobytes (KB)

- **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)

Datacenter

*NOTE: For datacenter entities, Workload Optimization Manager does not monitor resources directly from the datacenter, but from the physical machines in the datacenter.*

- **Memory (Mem)**
  The utilization of the PM’s memory reserved or in use
  Measured in Kilobytes (KB)

- **CPU**
  The utilization of the PM’s CPU reserved or in use
  Measured in Megahertz (MHz)

- **IO**
  The utilization of the PM’s IO adapters
  Measured in Kilobytes per second (KB/s)

- **Net**
  The utilization of data through the PM’s network adapters
  Measured in Kilobytes per second (KB/s)

- **Swap**
  The utilization of the PM’s swap space
  Measured in Kilobytes (KB)

- **Balloon**
  The utilization of shared memory among VMs running on the host. ESX-only
  Measured in Kilobytes (KB)

- **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)
Provider Virtual Datacenter
- **Memory (Mem)**
  - The utilization of the Datacenter's memory reserved or in use
  - Measured in Kilobytes (KB)
- **CPU**
  - The utilization of the Datacenter's CPU reserved or in use
  - Measured in Megahertz (MHz)
- **Storage**
  - The utilization of the storage attached to the Provider vDC.
  - Measured in Kilobytes (KB)

Consumer Virtual Datacenter
- **Memory (Mem)**
  - The utilization of the Datacenter's memory reserved or in use
  - Measured in Kilobytes (KB)
- **CPU**
  - The utilization of the Datacenter's CPU reserved or in use
  - Measured in Megahertz (MHz)
- **Storage**
  - The utilization of the storage attached to the Consumer vDC.
  - Measured in Kilobytes (KB)

Zone
- **Memory (Mem)**
  - The utilization of the PM's memory reserved or in use
  - Measured in Kilobytes (KB)
- **CPU**
  - The utilization of the PM's CPU reserved or in use
  - Measured in Megahertz (MHz)
- **IO**
  - The utilization of the PM's IO adapters
  - Measured in Kilobytes per second (KB/s)
- **Net**
  - The utilization of data through the PM's network adapters
  - Measured in Kilobytes per second (KB/s)
- **Swap**
  - The utilization of the PM's swap space
  - Measured in Kilobytes (KB)
- **Balloon**
  - The utilization of shared of memory among VMs running on the host. ESX-only
  - Measured in Kilobytes (KB)
- **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)

Region
- **Memory (Mem)**
  - The utilization of the PM's memory reserved or in use
  - Measured in Kilobytes (KB)
- **CPU**
  - The utilization of the PM's CPU reserved or in use
  - Measured in Megahertz (MHz)
- **IO**
  The utilization of the PM's IO adapters
  Measured in Kilobytes per second (KB/s)

- **Net**
  The utilization of data through the PM's network adapters
  Measured in Kilobytes per second (KB/s)

- **Swap**
  The utilization of the PM's swap space
  Measured in Kilobytes (KB)

- **Balloon**
  The utilization of shared of memory among VMs running on the host. ESX-only
  Measured in Kilobytes (KB)

- **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)

---

**Private Cloud**

A private cloud manages resources in pools to support multi-tenancy and self-service provisioning of virtual workloads. Workload Optimization Manager 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 Workload Optimization Manager 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, Workload Optimization Manager 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). Workload Optimization Manager 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.

**NOTE:** Different targets use different names to refer to Virtual Datacenters. In the Workload Optimization Manager supply chain, these entities are all represented by Consumer and Provider VDCs, as follows:
Actions

Workload Optimization Manager recommends actions for private cloud infrastructures as follows:

### Entity Type

#### Provider Virtual Datacenters

Workload Optimization Manager 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

- Resize Consumer vDC
- Provision Consumer vDC

Monitored Resources

Workload Optimization Manager monitors the following private cloud infrastructure resources:

### Entity Type

#### Provider Virtual Datacenter

- **Memory (Mem)**
  - The utilization of the Datacenter's memory reserved or in use
  - Measured in Kilobytes (KB)
- **CPU**
  - The utilization of the Datacenter's CPU reserved or in use
  - Measured in Megahertz (MHz)
- **Storage**
  - The utilization of the storage attached to the Provider vDC.
  - Measured in Kilobytes (KB)

#### Consumer Virtual Datacenter

- **Memory (Mem)**
  - The utilization of the Datacenter's memory reserved or in use
  - Measured in Kilobytes (KB)
- **CPU**
  - The utilization of the Datacenter's CPU reserved or in use
  - Measured in Megahertz (MHz)
- **Storage**
  - The utilization of the storage attached to the Consumer vDC.
  - Measured in Kilobytes (KB)
CloudStack

Apache CloudStack deploys and manages VMs and storage on a multi-tenancy infrastructure. Workload Optimization Manager supports CloudStack servers as targets, in an environment where CloudStack manages the hypervisors that you have specified as Workload Optimization Manager targets. For information about hypervisor targets, see Hypervisor Targets on page 5.

NOTE: After setting a CloudStack server as a target, you must then set the hypervisors that server will manage as targets. If you want Workload Optimization Manager to manage CloudStack without specifying the hypervisor targets as well, please contact technical support.

Adding CloudStack Targets

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

- **Host Name or IP Address**
  Name or IP of the CloudStack Management Server, or the primary server in a Management Server Cluster.
  Workload Optimization Manager assumes port 443 by default. If your system communicates over a different port, specify that port in the address field.
  For example: 10.10.123.45:444

- **Username and Password**
  The credentials must be for a Root Administrator user on the Management Server. In addition, this user must have a generated pair of API and Secret keys for the CloudStack API. Workload Optimization Manager uses the credentials you provide here to log into the CloudStack server and discover the user’s key values.

Other Information Imported from CloudStack

CloudStack supports Affinity Groups to express rules about VM placement — Currently CloudStack supports anti-affinity rules. Workload Optimization Manager discovers these Affinity Groups and imports them as Workload Placement Policies (see "Importing Workload Placement Policies" in the User Guide). Imported rules are enabled by default, but you can disable specific rules if you want.

Actions

Workload Optimization Manager recommends the following actions for Cloudstack targets:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Machines</td>
<td>Provision additional resources (VMem, VCPU)</td>
</tr>
<tr>
<td></td>
<td>Move Virtual Machine</td>
</tr>
<tr>
<td></td>
<td>Move Virtual Machine Storage</td>
</tr>
<tr>
<td></td>
<td>Reconfigure Storage</td>
</tr>
<tr>
<td></td>
<td>Reconfigure Virtual Machine</td>
</tr>
<tr>
<td>Physical Machines</td>
<td>Start Physical Machine</td>
</tr>
<tr>
<td></td>
<td>Provision Physical Machine</td>
</tr>
<tr>
<td></td>
<td>Suspend Physical Machine</td>
</tr>
</tbody>
</table>
Consumer Virtual Datacenters

- Resize Consumer vDC
- Provision Consumer vDC

Monitored Resources

Workload Optimization Manager monitors the following resources for Cloudstack targets:

**Entity Type**

**Commodity**

**VirtualMachine**

- Virtual Memory (VMem)
  The utilization of the VMem allocated to the hosting VM
  Measured in Kilobytes (KB)
- Virtual CPU (VCPU)
  The utilization of the VCPU allocated to the hosting VM
  Measured in Megahertz (MHz)
- Virtual Storage (VStorage)
  The utilization of the virtual storage capacity allocated for the VM
  Measured in Kilobytes (KB)
- Storage Access Operations Per Second (IOPS)
  The utilization of IOPS allocated for the VStorage on the VM
  Measured in IOPS
- Latency
  The utilization of latency allocated for the VStorage on the VM
  Measured in milliseconds (ms)

**Physical Machine**

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

**NOTE:** For datacenter entities, Workload Optimization Manager does not monitor resources directly from the datacenter, but from the physical machines in the datacenter.

- **Memory (Mem)**
  The utilization of the PM’s memory reserved or in use
  Measured in Kilobytes (KB)

- **CPU**
  The utilization of the PM’s CPU reserved or in use
  Measured in Megahertz (MHz)

- **IO**
  The utilization of the PM’s IO adapters
  Measured in Kilobytes per second (KB/s)

- **Net**
  The utilization of data through the PM’s network adapters
  Measured in Kilobytes per second (KB/s)

- **Swap**
  The utilization of the PM’s swap space
  Measured in Kilobytes (KB)

- **Balloon**
  The utilization of shared of memory among VMs running on the host. ESX-only
  Measured in Kilobytes (KB)

- **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)

Provider Virtual Datacenter

- **Memory (Mem)**
  The utilization of the Datacenter's memory reserved or in use
  Measured in Kilobytes (KB)

- **CPU**
  The utilization of the Datacenter's CPU reserved or in use
  Measured in Megahertz (MHz)

- **Storage**
  The utilization of the storage attached to the Provider vDC.
  Measured in Kilobytes (KB)

Consumer Virtual Datacenter

- **Memory (Mem)**
  The utilization of the Datacenter's memory reserved or in use
  Measured in Kilobytes (KB)

- **CPU**
  The utilization of the Datacenter's CPU reserved or in use
  Measured in Megahertz (MHz)

- **Storage**
  The utilization of the storage attached to the Consumer vDC.
  Measured in Kilobytes (KB)
DPod

- Memory (Mem)
  The utilization of the DPod's memory reserved or in use
  Measured in Kilobytes (KB)
- CPU
  The utilization of the DPod's CPU reserved or in use
  Measured in Megahertz (MHz)
- Storage
  The utilization of the storage attached to the DPod
  Measured in Kilobytes (KB)
- 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)

OpenStack

To manage your OpenStack® environment, Workload Optimization Manager connects to the Keystone identity service endpoint. Through this connection, Workload Optimization Manager discovers the other services it needs to control your OpenStack environment. If it discovers the necessary services, then it considers the OpenStack target to be validated.

Workload Optimization Manager  has been tested with hypervisors running Openstack on Red Hat Enterprise Linux and Red Hat RDO.

Prerequisites

Workload Optimization Manager  supports OpenStack version Icehouse or later.

You must have the following services installed and enabled, and Workload Optimization Manager must have access to each service at its administrative endpoint:

- Keystone – Identity service, to support discovery of OpenStack tenants
- Nova – Host and manage cloud computing systems (hypervisors)
- Cinder – Manage block storage (Cinder volumes)
- Ceilometer – Collect and persist data on the utilization of physical and virtual resources (telemetry)
- Gnocchi (Optional) – Collect and persist data on the utilization of physical and virtual resources via a metrics and resources database.

  Workload Optimization Manager  recommends using Gnocchi in addition to ceilometer for more consistent metric collection.

To verify that these services are enabled, Open the Horizon dashboard to the Admin/System page, or execute the following command at the OpenStack command line:

[root@openstack ~] $(keystone_admin)]# keystone service-list

You should see each of the required services in the list.
Adding OpenStack Targets

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

- **Hostname or IP Address**
  Provide the public URL of the Keystone service. The default port is 5000 – Do not provide a port if you want to use the default. For the default port, validation assumes a standard HTTP connection. If you provide a port value (for a port other than 5000), validation assumes a secure HTTPS connection unless you specify the protocol.
  
  For example, **10.10.123.45:5001** will use HTTPS, while **http://10.10.123.45:5775** will use HTTP.

- **Username**
  The account must have an administrator role on the specified tenant. This account must be authenticated by OpenStack.

- **Password**
  The password for the administrator account.

- **Tenant Name**
  The organizational structure within the Compute service that you want to manage. In a basic OpenStack installation this tenant is usually named **admin**.

Enabling Reservations

When you add a valid OpenStack target, Workload Optimization Manager can perform its analysis, recommend actions, and perform actions to assure performance and efficiency in your environment. To support these actions, you do not need to perform other configuration.

Workload Optimization Manager also includes reservations – deployment capabilities that can act as workload orchestration, or be integrated into an existing orchestration system (see the Deploy View in the Workload Optimization Manager user interface). These capabilities include:

- Calculate optimal placement for new workload
- Reserve resources for proposed workload, and include the reservations in real-time and planning analysis

An OpenStack user can use the Workload Optimization Manager placement proposals to deploy workload to the optimal locations.

To enable these capabilities, you must install the Cisco Nova Scheduler plugin that matches your version of OpenStack. For more information, contact your technical support representative.

To fetch the scheduler plugin you want, execute the following commands on the Nova controller (substituting the url to the version of scheduler plugin that you want):

```
cd /usr/lib/python2.6/site-packages/nova/scheduler/
curl -O <URL TO CORRECT VERSION OF vmt_scheduler.py>
```

After you execute these commands to add the plugin to your controller, add the following entries to the file, 
`/etc/nova/nova.conf` under the `[DEFAULT]` section, where you provide the IP address of your Workload Optimization Manager server, and credentials for a Workload Optimization Manager user account that has administrator privileges:
scheduler_driver = nova.scheduler.vmt_scheduler.VMTScheduler
vmturbo_rest_uri = <VMTurbo_IPAddress>
vmturbo_username = <VMTurbo_UserName>
vmturbo_password = <VMTurbo_Password>

After you restart the Nova scheduler, it can use the plugin to communicate with your Workload Optimization Manager instance.

Collecting Physical Machine Metrics

To collect full metrics from physical machines in your environment and display them in Workload Optimization Manager, the following actions must be taken:

- /etc/ceilometer/pipeline.yaml must be modified to match the following snippets:

```
- name: meter_snmp
  interval: 600
  resources:
    - [Compute Node FQDN]
    - [Compute Node FQDN]
    - [Compute Node FQDN]
  meters:
    - "hardware.cpu*"
    - "hardware.memory.used"
    - "hardware.disk.size.used"
  sinks:
    - meter_sink
- name: meter_snmp_rate
  interval: 600
  resources:
    - [Compute Node FQDN]
    - [Compute Node FQDN]
    - [Compute Node FQDN]
  meters:
    - "hardware.network*"
    - "hardware.system_stats*"
  sinks:
    - snmp_sink

- name: snmp_sink
  transformers:
    - name: "rate_of_change"
  parameters:
    source:
    map_from:
    name:
    "hardware\.\.(system_stats.io|network)\.(incoming|outgoing)\.(blocks|bytes)"
  unit: "(blocks|B)"
  target:
  map_to:
  name: "hardware.\1.\2.\3.rate"
```
After modifying this file, you will need to create a `snmpd.conf` file. For information about creating this file, contact Technical Support.

After these modifications are made, OpenStack will collect all available metrics for physical machines.

**Actions**

**Workload Optimization Manager** recommends actions for the cloud target supply chain as follows.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Virtual Machines</strong></td>
<td>• Provision additional resources (VMem, VCPU)</td>
</tr>
<tr>
<td></td>
<td>• Move Virtual Machine</td>
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<td>• Move Virtual Machine Storage</td>
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<tr>
<td></td>
<td>• Reconfigure Virtual Machine</td>
</tr>
<tr>
<td><strong>Physical Machines</strong></td>
<td>• Start Physical Machine</td>
</tr>
<tr>
<td></td>
<td>• Provision Physical Machine</td>
</tr>
<tr>
<td></td>
<td>• Suspend Physical Machine</td>
</tr>
<tr>
<td><strong>Consumer Virtual Datacenters</strong></td>
<td>• Resize Consumer vDC</td>
</tr>
<tr>
<td></td>
<td>• Provision Consumer vDC</td>
</tr>
</tbody>
</table>

**Monitored Resources**

**Workload Optimization Manager** monitors the following resources for the cloud target supply chain:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Virtual Machine</strong></td>
<td>• Virtual Memory (VMem)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the VMem allocated to the hosting VM</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td></td>
<td>• Virtual CPU (VCPU)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the VCPU allocated to the hosting VM</td>
</tr>
<tr>
<td></td>
<td>Measured in Megahertz (MHz)</td>
</tr>
<tr>
<td></td>
<td>• Virtual Storage (VStorage)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the virtual storage capacity allocated for the VM</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td></td>
<td>• Storage Access Operations Per Second (IOPS)</td>
</tr>
<tr>
<td></td>
<td>The utilization of IOPS allocated for the VStorage on the VM</td>
</tr>
<tr>
<td></td>
<td>Measured in IOPS</td>
</tr>
<tr>
<td></td>
<td>• Latency</td>
</tr>
<tr>
<td></td>
<td>The utilization of latency allocated for the VStorage on the VM</td>
</tr>
<tr>
<td></td>
<td>Measured in milliseconds (ms)</td>
</tr>
</tbody>
</table>
Physical Machine

- **Memory (Mem)**
  The utilization of the PM's memory reserved or in use
  Measured in Kilobytes (KB)

- **CPU**
  The utilization of the PM's CPU reserved or in use
  Measured in Megahertz (MHz)

- **IO**
  The utilization of the PM's IO adapters
  Measured in Kilobytes per second (KB/s)

- **Net**
  The utilization of data through the PM's network adapters
  Measured in Kilobytes per second (KB/s)

- **Swap**
  The utilization of the PM's swap space
  Measured in Kilobytes (KB)

- **Balloon**
  The utilization of shared memory among VMs running on the host. ESX-only
  Measured in Kilobytes (KB)

- **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)

**NOTE:** For datacenter entities, Workload Optimization Manager does not monitor resources directly from the datacenter, but from the physical machines in the datacenter.

Datacenter

- **Memory (Mem)**
  The utilization of the PM's memory reserved or in use
  Measured in Kilobytes (KB)

- **CPU**
  The utilization of the PM's CPU reserved or in use
  Measured in Megahertz (MHz)

- **IO**
  The utilization of the PM's IO adapters
  Measured in Kilobytes per second (KB/s)

- **Net**
  The utilization of data through the PM's network adapters
  Measured in Kilobytes per second (KB/s)

- **Swap**
  The utilization of the PM's swap space
  Measured in Kilobytes (KB)

- **Balloon**
  The utilization of shared memory among VMs running on the host. ESX-only
  Measured in Kilobytes (KB)

- **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)
Provider Virtual Datacenter

- **Memory (Mem)**
  The utilization of the Datacenter's memory reserved or in use
  Measured in Kilobytes (KB)

- **CPU**
  The utilization of the Datacenter's CPU reserved or in use
  Measured in Megahertz (MHz)

- **Storage**
  The utilization of the storage attached to the Provider vDC.
  Measured in Kilobytes (KB)

Consumer Virtual Datacenter

- **Memory (Mem)**
  The utilization of the Datacenter's memory reserved or in use
  Measured in Kilobytes (KB)

- **CPU**
  The utilization of the Datacenter's CPU reserved or in use
  Measured in Megahertz (MHz)

- **Storage**
  The utilization of the storage attached to the Consumer vDC.
  Measured in Kilobytes (KB)

**vCloud Director**

A vCloud Director environment has one or more vCloud Director servers (sometimes called cells) to build a multi-tenant private cloud by pooling resources managed by vCenter Servers. For typical installations, each vCloud Director cell manages one vCenter Server instance.

A Provider Virtual Datacenter combines the compute and memory resources from a single vCenter Server with the storage available to that vCenter Server into a single pool of resources to provide to an organization.

An Organization Virtual Datacenter uses the resources in a Provider Virtual Datacenter to present virtual compute and storage to the user.

**Prerequisites**

- vCloud Director account with System Administrator role
- vCenter service account with privileges to execute Workload Optimization Manager actions. For information about service accounts on vCenter Server, see Creating A Service User Account In vCenter on page 24

**Adding vCloud Director Targets**

**NOTE:** If any of the vCenter Servers that are connected to vCloud Director are already added as targets in Workload Optimization Manager, they must be deleted prior to adding vCloud Director.

A vCloud Director target must specify the address and user of a vCloud Director server and also a service account on the associated vCenter Server instance.

If the credentials for the vCenter Server service account are not valid, then the target will fail to validate in Workload Optimization Manager.
To add vCloud Director targets, select the **Cloud Management > vCloud Director** option on the Target Configuration page, and provide the following information:

- **Address**
  
  Host name or IP address of the vCloud Director Server.

- **Username**
  
  The username for an account on the vCloud Director server that has a System Administrator role.

- **Password**
  
  The password for the System Administrator account.

- **VC User Name (optional)**
  
  If you provide a value, the username for a service account on the vCenter Server that is managed by this vCloud Director.

  If you do not provide a value, Workload Optimization Manager will obtain the username from the vCloud Director server. Even if you do not provide a VC User Name value, you still must provide a VC Password.

- **VC Password**
  
  The password for the service account on the vCenter Server.

**Actions**

Workload Optimization Manager recommends actions for the cloud target supply chain as follows.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Machines</td>
<td>- Provision additional resources (VMem, VCPU)</td>
</tr>
<tr>
<td></td>
<td>- Move Virtual Machine</td>
</tr>
<tr>
<td></td>
<td>- Move Virtual Machine Storage</td>
</tr>
<tr>
<td></td>
<td>- Reconfigure Storage</td>
</tr>
<tr>
<td></td>
<td>- Reconfigure Virtual Machine</td>
</tr>
<tr>
<td>Physical Machines</td>
<td>- Start Physical Machine</td>
</tr>
<tr>
<td></td>
<td>- Provision Physical Machine</td>
</tr>
<tr>
<td></td>
<td>- Suspend Physical Machine</td>
</tr>
<tr>
<td>Consumer Virtual Datacenters</td>
<td>- Resize Consumer vDC</td>
</tr>
<tr>
<td></td>
<td>- Provision Consumer vDC</td>
</tr>
</tbody>
</table>
## Monitored Resources

Workload Optimization Manager monitors the following resources for the cloud target supply chain:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
</table>
| VirtualMachine   | - Virtual Memory (VMem)  
The utilization of the VMem allocated to the hosting VM  
Measured in Kilobytes (KB)  
- Virtual CPU (VCPU)  
The utilization of the VCPU allocated to the hosting VM  
Measured in Megahertz (MHz)  
- Virtual Storage (VStorage)  
The utilization of the virtual storage capacity allocated for the VM  
Measured in Kilobytes (KB)  
- Storage Access Operations Per Second (IOPS)  
The utilization of IOPS allocated for the VStorage on the VM  
Measured in IOPS  
- Latency  
The utilization of latency allocated for the VStorage on the VM  
Measured in milliseconds (ms) |
| Physical Machine | - Memory (Mem)  
The utilization of the PM’s memory reserved or in use  
Measured in Kilobytes (KB)  
- CPU  
The utilization of the PM’s CPU reserved or in use  
Measured in Megahertz (MHz)  
- IO  
The utilization of the PM’s IO adapters  
Measured in Kilobytes per second (KB/s)  
- Net  
The utilization of data through the PM’s network adapters  
Measured in Kilobytes per second (KB/s)  
- Swap  
The utilization of the PM’s swap space  
Measured in Kilobytes (KB)  
- Balloon  
The utilization of shared memory among VMs running on the host. ESX-only  
Measured in Kilobytes (KB)  
- 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) |
NOTE: For datacenter entities, Workload Optimization Manager does not monitor resources directly from the datacenter, but from the physical machines in the datacenter.

- **Memory (Mem)**
  The utilization of the PM's memory reserved or in use
  Measured in Kilobytes (KB)

- **CPU**
  The utilization of the PM's CPU reserved or in use
  Measured in Megahertz (MHz)

- **IO**
  The utilization of the PM's IO adapters
  Measured in Kilobytes per second (KB/s)

- **Net**
  The utilization of data through the PM's network adapters
  Measured in Kilobytes per second (KB/s)

- **Swap**
  The utilization of the PM's swap space
  Measured in Kilobytes (KB)

- **Balloon**
  The utilization of shared of memory among VMs running on the host. ESX-only
  Measured in Kilobytes (KB)

- **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)

- **Memory (Mem)**
  The utilization of the Datacenter's memory reserved or in use
  Measured in Kilobytes (KB)

- **CPU**
  The utilization of the Datacenter's CPU reserved or in use
  Measured in Megahertz (MHz)

- **Storage**
  The utilization of the storage attached to the Provider vDC.
  Measured in Kilobytes (KB)

- **Memory (Mem)**
  The utilization of the Datacenter's memory reserved or in use
  Measured in Kilobytes (KB)

- **CPU**
  The utilization of the Datacenter's CPU reserved or in use
  Measured in Megahertz (MHz)

- **Storage**
  The utilization of the storage attached to the Consumer vDC.
  Measured in Kilobytes (KB)
Virtual Machine Manager

In a VMM environment, the VMM management server processes commands and controls communications with the Hyper-V hosts. To manage VMM, you set the management server as a target. Workload Optimization Manager 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 Workload Optimization Manager access to the VMM management server, and also to all the associated Hyper-V machines.

Prerequisites

- Configure remote management on VMM management Hyper-V server. See Creating A Service User Account on page 16.
- 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 Workload Optimization Manager must be synchronized with each target VMM management server. The Workload Optimization Manager Installation Guide includes instructions for synchronizing the clock on the Workload Optimization Manager server.
- PowerShel 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 Workload Optimization Manager performance.

Adding VMM Targets

Workload Optimization Manager uses the address and credentials you provide to discover the VMM target. From the VMM target, Workload Optimization Manager 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.

NOTE: In Workload Optimization Manager 5.8 and above, Workload Optimization Manager will not display the underlying Hyper-V hosts in the Target Configuration page, only the VMM target that was added.

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 Workload Optimization Manager to communicate over HTTPS. For more information, see Secure Setup of WSMan on page 184.

Note that setting a secure connection for VMM does not also set secure connections for the underlying Hyper-V hosts. Any communications between Workload Optimization Manager 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)
  Workload Optimization Manager 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 Workload Optimization Manager uses to log into a Hyper-V host must satisfy certain requirements. For more information, see “Creating a Service User Account in Hyper-V” in the User Guide.

- Hosts in the VMM target that you would like to exclude from Workload Optimization Manager.
  Workload Optimization Manager will not discover or manage any hosts you enter in this field. These hosts do not participate in the market, and Workload Optimization Manager 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, Workload Optimization Manager 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, Workload Optimization Manager 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. Workload Optimization Manager 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”.

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### VMM SDK Probe Properties

Workload Optimization Manager offers the capability to adjust certain properties of the probe. In general, this tweaking will not be necessary. If adjustment is needed, the file can be found in the `/srv/tomcat/webapps/vmturbo/probe-jars/{probe}/resources` folder. This target has the following properties:

<table>
<thead>
<tr>
<th>Setting</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>maxEnvelopeSize</td>
<td>Maximum size of SOAP response envelope</td>
</tr>
<tr>
<td>timeout</td>
<td>Determines the timeout in milliseconds for both initial connection and discovery, and maximum period between data packets</td>
</tr>
<tr>
<td>executorThreadPoolSize</td>
<td>Size of the thread pool for Discovery process</td>
</tr>
<tr>
<td>hypervExecutorThreadPoolSize</td>
<td>Size of the thread pool for host discovery within the VMM target. One thread per cluster, and one per standalone host</td>
</tr>
<tr>
<td>vmmExecutorThreadPoolSize</td>
<td>Size of the thread pool used to execute VMM commands in parallel</td>
</tr>
<tr>
<td>connectorFactoryThreadPoolSize</td>
<td>Size of the thread pool used to create connection instances</td>
</tr>
<tr>
<td>vmmRequestChunkSize</td>
<td>Number of VMM commands issued in one chunk</td>
</tr>
<tr>
<td>shellRequestPollerInterval</td>
<td>Time in milliseconds to poll for completion of PowerShell commands</td>
</tr>
<tr>
<td>shellRequestTimeout</td>
<td>Time in milliseconds to retrieve result of PowerShell commands</td>
</tr>
<tr>
<td>conversionObjectsBatchSize</td>
<td>Maximum amount of internal objects that should be converted into EntityDTO in one batch</td>
</tr>
<tr>
<td>queriesThreadPoolCoreSize</td>
<td>Number of threads that will remain in the thread pool even if idle timeout is exceeded. This number should be lower or equal to queriesThreadPoolMaximumSize</td>
</tr>
<tr>
<td>queriesThreadPoolMaximumSize</td>
<td>Maximum number of threads that will be used by the thread pool</td>
</tr>
<tr>
<td>queriesThreadPoolIdleTimeout</td>
<td>Time in seconds before a thread will time out if number of active threads are above queriesThreadPoolCoreSize</td>
</tr>
<tr>
<td>hostThreadPoolCoreSize</td>
<td>Number of threads that will remain in the thread pool responsible for simultaneous discovery of host instances. This number should be lower or equal to hostThreadPoolMaximumSize</td>
</tr>
<tr>
<td>hostThreadPoolMaximumSize</td>
<td>Maximum number of threads that will be used by the thread pool responsible for simultaneous discovery of host instances</td>
</tr>
</tbody>
</table>
hostThreadPoolIdleTimeout | Time in seconds before a thread will time out if number of active threads are above hostThreadPoolCoreSize
clusterThreadPoolCoreSize | Number of threads that will remain in the thread pool for handling requests to Hyper-V targets. This number should be lower or equal to clusterThreadPoolMaximumSize
clusterThreadPoolMaximumSize | Maximum number of threads that will be used by the thread pool responsible for handling requests to Hyper-V hosts
clusterThreadPoolIdleTimeout | Time in seconds before a thread will time out if number of active threads are above clusterThreadPoolCoreSize
hypervCommonThreadPoolCoreSize | Number of threads that will remain in the thread pool responsible for miscellaneous SDK tasks
hypervCommonThreadPoolMaximumSize | Maximum number of threads that will be used by the thread pool responsible for miscellaneous SDK tasks. This number should be lower or equal to hypervCommonThreadPoolMaximumSize
hypervCommonThreadPoolIdleTimeout | Time in seconds before a thread will time out if number of active threads are above hypervCommonThreadPoolCoreSize
actionStepCheckSucceededTimeout | Time in milliseconds to wait before triggering the next step in an action chain
actionStepCheckAmount | Number of times to poll for an action is complete before failure
actionStepCheckTimeout | Time in milliseconds between action checks
requestsPerHost | Maximum number of simultaneous requests per host

**Actions**

Workload Optimization Manager recommends actions for the cloud target supply chain as follows.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
</tr>
</thead>
</table>
| Virtual Machines     | - Provision additional resources (VMem, VCPU)  
|                      | - Move Virtual Machine                      
|                      | - Move Virtual Machine Storage              
|                      | - Reconfigure Storage                        
|                      | - Reconfigure Virtual Machine                |
| Physical Machines    | - Start Physical Machine                     
|                      | - Provision Physical Machine                 
|                      | - Suspend Physical Machine                   |
Monitor Resources

Workload Optimization Manager monitors the following resources for the cloud target supply chain:

**Entity Type**

*VirtualMachine*

- Virtual Memory (VMem)
  - The utilization of the VMem allocated to the hosting VM
  - Measured in Kilobytes (KB)
- Virtual CPU (VCPU)
  - The utilization of the VCPU allocated to the hosting VM
  - Measured in Megahertz (MHz)
- Virtual Storage (VStorage)
  - The utilization of the virtual storage capacity allocated for the VM
  - Measured in Kilobytes (KB)
- Storage Access Operations Per Second (IOPS)
  - The utilization of IOPS allocated for the VStorage on the VM
  - Measured in IOPS
- Latency
  - The utilization of latency allocated for the VStorage on the VM
  - Measured in milliseconds (ms)

**Physical Machine**

- Memory (Mem)
  - The utilization of the PM's memory reserved or in use
  - Measured in Kilobytes (KB)
- CPU
  - The utilization of the PM's CPU reserved or in use
  - Measured in Megahertz (MHz)
- IO
  - The utilization of the PM's IO adapters
  - Measured in Kilobytes per second (KB/s)
- Net
  - The utilization of data through the PM's network adapters
  - Measured in Kilobytes per second (KB/s)
- Swap
  - The utilization of the PM's swap space
  - Measured in Kilobytes (KB)
- Balloon
  - The utilization of shared memory among VMs running on the host. ESX-only
  - Measured in Kilobytes (KB)
- 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)
NOTE: For datacenter entities, Workload Optimization Manager does not monitor resources directly from the datacenter, but from the physical machines in the datacenter.

- **Memory (Mem)**
  The utilization of the PM's memory reserved or in use
  Measured in Kilobytes (KB)

- **CPU**
  The utilization of the PM's CPU reserved or in use
  Measured in Megahertz (MHz)

- **IO**
  The utilization of the PM's IO adapters
  Measured in Kilobytes per second (KB/s)

- **Net**
  The utilization of data through the PM's network adapters
  Measured in Kilobytes per second (KB/s)

- **Swap**
  The utilization of the PM's swap space
  Measured in Kilobytes (KB)

- **Balloon**
  The utilization of shared of memory among VMs running on the host. ESX-only
  Measured in Kilobytes (KB)

- **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)

**Provider Virtual Datacenter**

- **Memory (Mem)**
  The utilization of the Datacenter's memory reserved or in use
  Measured in Kilobytes (KB)

- **CPU**
  The utilization of the Datacenter's CPU reserved or in use
  Measured in Megahertz (MHz)

- **Storage**
  The utilization of the storage attached to the Provider vDC.
  Measured in Kilobytes (KB)

**Consumer Virtual Datacenter**

- **Memory (Mem)**
  The utilization of the Datacenter's memory reserved or in use
  Measured in Kilobytes (KB)

- **CPU**
  The utilization of the Datacenter's CPU reserved or in use
  Measured in Megahertz (MHz)

- **Storage**
  The utilization of the storage attached to the Consumer vDC.
  Measured in Kilobytes (KB)
Public Cloud

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

On the public cloud, you can use Workload Optimization Manager to:

- Extend resource allocation across hybrid clouds
- Locate the most efficient workload placement within the hybrid environment, while assuring performance
- Perform elastic load balancing for application groups deployed to the public cloud

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

Supply Chain

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

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone</td>
<td></td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Start VM on the Zone" /></td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Suspend VM on the Zone" /></td>
</tr>
</tbody>
</table>

Monitored Resources

Workload Optimization Manager monitors the following public cloud infrastructure resources:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone</td>
<td>Memory (Mem)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the PM’s memory reserved or in use</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td></td>
<td>CPU</td>
</tr>
<tr>
<td></td>
<td>The utilization of the PM’s CPU reserved or in use</td>
</tr>
<tr>
<td></td>
<td>Measured in Megahertz (MHz)</td>
</tr>
<tr>
<td></td>
<td>IO</td>
</tr>
<tr>
<td></td>
<td>The utilization of the PM’s IO adapters</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes per second (KB/s)</td>
</tr>
<tr>
<td></td>
<td>Net</td>
</tr>
<tr>
<td></td>
<td>The utilization of data through the PM’s network adapters</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes per second (KB/s)</td>
</tr>
<tr>
<td></td>
<td>Swap</td>
</tr>
<tr>
<td></td>
<td>The utilization of the PM’s swap space</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td>Region</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Memory (Mem)</td>
<td>The utilization of the PM's memory reserved or in use</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td>CPU</td>
<td>The utilization of the PM's CPU reserved or in use</td>
</tr>
<tr>
<td></td>
<td>Measured in Megahertz (MHz)</td>
</tr>
<tr>
<td>IO</td>
<td>The utilization of the PM's IO adapters</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes per second (KB/s)</td>
</tr>
<tr>
<td>Net</td>
<td>The utilization of data through the PM's network adapters</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes per second (KB/s)</td>
</tr>
<tr>
<td>Swap</td>
<td>The utilization of the PM's swap space</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td>Balloon</td>
<td>The utilization of shared of memory among VMs running on the host. ESX-only</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td>CPU Ready</td>
<td>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</td>
</tr>
<tr>
<td></td>
<td>Measured in Megahertz (MHz)</td>
</tr>
</tbody>
</table>

**Amazon Web Services**

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

**Adding AWS Targets**

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

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

- **Address**

  You can leave this blank, or enter `aws.amazon.com`
Access Key
Provide the **Access Key** for the account you want to manage.

Secret Access Key
Provide the **Access Key Secret** for the account you want to manage.

IAM Role ARN
The Amazon Resource Name given to the IAM Role

Proxy Host
The IP of your Proxy Host

Proxy Port
The port required for the proxy above

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

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

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

Cost and Usage Report
In order for Workload Optimization Manager to display month-to-day spend, you must create a cost and usage report in AWS and store it in an S3 bucket.

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

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

The Workload Optimization Manager user account must have the following permissions.

For read access:
Use these permissions to gain insight into your environment, including utilization statistics and costs for workloads and services. Workload Optimization Manager can recommend actions, but this account cannot execute them.

- AmazonRDSReadOnlyAccess
- AmazonEC2ReadOnlyAccess
- AmazonS3ReadOnlyAccess
For write access (Action Execution):

Use these permissions to gain insight into your environment, and to automate actions based on Workload Optimization Manager analysis.

- AmazonRDSFullAccess
- AmazonEC2FullAccess
- AmazonS3ReadOnlyAccess

Actions

Workload Optimization Manager recommends actions for the cloud target supply chain as follows.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Machines (Cloud)</td>
<td>- Resize up to template (based on VMem / VCPU)&lt;br&gt;- Resize down to template (based on VMem / VCPU)&lt;br&gt;- Move Virtual Machine (intra-cloud)</td>
</tr>
<tr>
<td></td>
<td><strong>NOTE:</strong> This is a destructive move- data / applications are not preserved. This action also requires both a Workload Optimization Manager merge policy and the moved VM to be a linux VM with template configuration.</td>
</tr>
<tr>
<td>Consumer Virtual Datacenters</td>
<td>- Resize Consumer vDC&lt;br&gt;- Provision Consumer vDC</td>
</tr>
<tr>
<td>Zone</td>
<td>- Start VM on the Zone&lt;br&gt;- Suspend VM on the Zone</td>
</tr>
</tbody>
</table>

Monitored Resources

Workload Optimization Manager monitors the following resources for the cloud target supply chain:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>VirtualMachine</td>
<td>- Virtual Memory (VMem)&lt;br&gt;The utilization of the VMem allocated to the hosting VM Measured in Kilobytes (KB)&lt;br&gt;- Virtual CPU (VCPU)&lt;br&gt;The utilization of the VCPU allocated to the hosting VM Measured in Megahertz (MHz)&lt;br&gt;- Virtual Storage (VStorage)&lt;br&gt;The utilization of the virtual storage capacity allocated for the VM Measured in Kilobytes (KB)&lt;br&gt;- Storage Access Operations Per Second (IOPS)&lt;br&gt;The utilization of IOPS allocated for the VStorage on the VM Measured in IOPS&lt;br&gt;- Latency&lt;br&gt;The utilization of latency allocated for the VStorage on the VM Measured in milliseconds (ms)</td>
</tr>
</tbody>
</table>
**Datacenter**

**NOTE:** For datacenter entities, Workload Optimization Manager does not monitor resources directly from the datacenter, but from the physical machines in the datacenter.

- **Memory (Mem)**
  The utilization of the PM's memory reserved or in use
  Measured in Kilobytes (KB)

- **CPU**
  The utilization of the PM's CPU reserved or in use
  Measured in Megahertz (MHz)

- **IO**
  The utilization of the PM's IO adapters
  Measured in Kilobytes per second (KB/s)

- **Net**
  The utilization of data through the PM's network adapters
  Measured in Kilobytes per second (KB/s)

- **Swap**
  The utilization of the PM's swap space
  Measured in Kilobytes (KB)

- **Balloon**
  The utilization of shared of memory among VMs running on the host. ESX-only
  Measured in Kilobytes (KB)

- **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)

**Provider Virtual Datacenter**

- **Memory (Mem)**
  The utilization of the Datacenter's memory reserved or in use
  Measured in Kilobytes (KB)

- **CPU**
  The utilization of the Datacenter's CPU reserved or in use
  Measured in Megahertz (MHz)

- **Storage**
  The utilization of the storage attached to the Provider vDC.
  Measured in Kilobytes (KB)

**Consumer Virtual Datacenter**

- **Memory (Mem)**
  The utilization of the Datacenter's memory reserved or in use
  Measured in Kilobytes (KB)

- **CPU**
  The utilization of the Datacenter's CPU reserved or in use
  Measured in Megahertz (MHz)

- **Storage**
  The utilization of the storage attached to the Consumer vDC.
  Measured in Kilobytes (KB)
DPod

- Memory (Mem)
  The utilization of the DPod's memory reserved or in use
  Measured in Kilobytes (KB)

- CPU
  The utilization of the DPod's CPU reserved or in use
  Measured in Megahertz (MHz)

- Storage
  The utilization of the storage attached to the DPod
  Measured in Kilobytes (KB)

- 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)

IBM SoftLayer

IBM SoftLayer is an infrastructure platform for the public cloud. You gain access to this infrastructure through a subscription account. To specify a SoftLayer target, you provide the credentials for that account and Workload Optimization Manager discovers the resources available to you through that account.

Adding SoftLayer Targets

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

- Address
  You can leave this blank, or enter control.softlayer.com

- Username
  For this field, provide the user name for the account you want to manage.

- Password
  Provide the Authentication Key for the account you want to manage.

Actions

Workload Optimization Manager recommends actions for the cloud target supply chain as follows.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Machines</td>
<td>Provision additional resources (VMem, VCPU)</td>
</tr>
<tr>
<td></td>
<td>Move Virtual Machine</td>
</tr>
<tr>
<td></td>
<td>Move Virtual Machine Storage</td>
</tr>
<tr>
<td></td>
<td>Reconfigure Storage</td>
</tr>
<tr>
<td></td>
<td>Reconfigure Virtual Machine</td>
</tr>
<tr>
<td>Consumer Virtual Datacenters</td>
<td>Resize Consumer vDC</td>
</tr>
<tr>
<td></td>
<td>Provision Consumer vDC</td>
</tr>
</tbody>
</table>
### Zone
- Start VM on the Zone
- Suspend VM on the Zone

### Monitored Resources

Workload Optimization Manager monitors the following resources for the cloud target supply chain:

#### Entity Type

<table>
<thead>
<tr>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>VirtualMachine</td>
</tr>
<tr>
<td>Virtual Memory (VMem)</td>
</tr>
<tr>
<td>The utilization of the VMem allocated to the hosting VM</td>
</tr>
<tr>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td>Virtual CPU (VCPU)</td>
</tr>
<tr>
<td>The utilization of the VCPU allocated to the hosting VM</td>
</tr>
<tr>
<td>Measured in Megahertz (MHz)</td>
</tr>
<tr>
<td>Virtual Storage (VStorage)</td>
</tr>
<tr>
<td>The utilization of the virtual storage capacity allocated for the VM</td>
</tr>
<tr>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td>Storage Access Operations Per Second (IOPS)</td>
</tr>
<tr>
<td>The utilization of IOPS allocated for the VStorage on the VM</td>
</tr>
<tr>
<td>Measured in IOPS</td>
</tr>
<tr>
<td>Latency</td>
</tr>
<tr>
<td>The utilization of latency allocated for the VStorage on the VM</td>
</tr>
<tr>
<td>Measured in milliseconds (ms)</td>
</tr>
</tbody>
</table>

#### Datacenter

**NOTE:** For datacenter entities, Workload Optimization Manager does not monitor resources directly from the datacenter, but from the physical machines in the datacenter.

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

  **Provider Virtual Datacenter**

- **Memory (Mem)**
  The utilization of the Datacenter’s memory reserved or in use
  Measured in Kilobytes (KB)

- **CPU**
  The utilization of the Datacenter’s CPU reserved or in use
  Measured in Megahertz (MHz)

- **Storage**
  The utilization of the storage attached to the Provider vDC.
  Measured in Kilobytes (KB)

  **Consumer Virtual Datacenter**

- **Memory (Mem)**
  The utilization of the Datacenter’s memory reserved or in use
  Measured in Kilobytes (KB)

- **CPU**
  The utilization of the Datacenter’s CPU reserved or in use
  Measured in Megahertz (MHz)

- **Storage**
  The utilization of the storage attached to the Consumer vDC.
  Measured in Kilobytes (KB)

  **DPod**

- **Memory (Mem)**
  The utilization of the DPod’s memory reserved or in use
  Measured in Kilobytes (KB)

- **CPU**
  The utilization of the DPod’s CPU reserved or in use
  Measured in Megahertz (MHz)

- **Storage**
  The utilization of the storage attached to the DPod
  Measured in Kilobytes (KB)

- **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)

  **Zone**

- **Memory (Mem)**
  The utilization of the PM’s memory reserved or in use
  Measured in Kilobytes (KB)

- **CPU**
  The utilization of the PM’s CPU reserved or in use
  Measured in Megahertz (MHz)

- **IO**
  The utilization of the PM’s IO adapters
  Measured in Kilobytes per second (KB/s)
- **Net**
  The utilization of data through the PM's network adapters
  Measured in Kilobytes per second (KB/s)

- **Swap**
  The utilization of the PM's swap space
  Measured in Kilobytes (KB)

- **Balloon**
  The utilization of shared memory among VMs running on the host. ESX-only
  Measured in Kilobytes (KB)

- **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)

**Region**

- **Memory (Mem)**
  The utilization of the PM's memory reserved or in use
  Measured in Kilobytes (KB)

- **CPU**
  The utilization of the PM's CPU reserved or in use
  Measured in Megahertz (MHz)

- **IO**
  The utilization of the PM's IO adapters
  Measured in Kilobytes per second (KB/s)

- **Net**
  The utilization of data through the PM's network adapters
  Measured in Kilobytes per second (KB/s)

- **Swap**
  The utilization of the PM's swap space
  Measured in Kilobytes (KB)

- **Balloon**
  The utilization of shared memory among VMs running on the host. ESX-only
  Measured in Kilobytes (KB)

- **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)

**Microsoft Azure**

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

**Prerequisites**

- External access via Client/App ID

*NOTE:* Workload Optimization Manager will not discover Azure Classic virtual machines, as they do not utilize the Azure Resource Manager.
External Access via Client/App ID

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

To register a Web App with your account:

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

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

For more information, refer to your Microsoft Azure documentation.

Adding Azure Targets

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

- **Address**
  You can leave this blank, or enter management.core.windows.net

- **Subscription ID**
  The ID for your Azure subscription.

- **Tenant ID**
  The ID of the tenant you want to manage in your Azure subscription.

- **Client App ID**
  The Client/App ID of the Web App that gives Workload Optimization Manager access to resources in your Azure subscription.

- **Client Secret Key**
  The secret key for the Web App.

Actions

Workload Optimization Manager recommends actions for the cloud target supply chain as follows.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Machines (Cloud)</td>
<td>Resize up to template (based on VMem / VCPU)</td>
</tr>
<tr>
<td></td>
<td>Resize down to template (based on VMem / VCPU)</td>
</tr>
<tr>
<td></td>
<td>Move Virtual Machine (intra-cloud)</td>
</tr>
</tbody>
</table>
NOTE: This is a destructive move - data / applications are not preserved. This action also requires both a Workload Optimization Manager merge policy and the moved VM to be a Linux VM with template configuration.

Consumer Virtual Datacenters
- Resize Consumer vDC
- Provision Consumer vDC

Monitored Resources

Workload Optimization Manager monitors the following resources for the cloud target supply chain:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>VirtualMachine</td>
<td>- Virtual Memory (VMem)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the VMem allocated to the hosting VM</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td></td>
<td>- Virtual CPU (VCPU)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the VCPU allocated to the hosting VM</td>
</tr>
<tr>
<td></td>
<td>Measured in Megahertz (MHz)</td>
</tr>
<tr>
<td></td>
<td>- Virtual Storage (VStorage)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the virtual storage capacity allocated for the VM</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td></td>
<td>- Storage Access Operations Per Second (IOPS)</td>
</tr>
<tr>
<td></td>
<td>The utilization of IOPS allocated for the VStorage on the VM</td>
</tr>
<tr>
<td></td>
<td>Measured in IOPS</td>
</tr>
<tr>
<td></td>
<td>- Latency</td>
</tr>
<tr>
<td></td>
<td>The utilization of latency allocated for the VStorage on the VM</td>
</tr>
<tr>
<td></td>
<td>Measured in milliseconds (ms)</td>
</tr>
<tr>
<td>Datacenter</td>
<td>NOTE: For datacenter entities, Workload Optimization Manager does not monitor resources directly from the datacenter, but from the physical machines in the datacenter.</td>
</tr>
<tr>
<td></td>
<td>- Memory (Mem)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the PM's memory reserved or in use</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td></td>
<td>- CPU</td>
</tr>
<tr>
<td></td>
<td>The utilization of the PM's CPU reserved or in use</td>
</tr>
<tr>
<td></td>
<td>Measured in Megahertz (MHz)</td>
</tr>
<tr>
<td></td>
<td>- IO</td>
</tr>
<tr>
<td></td>
<td>The utilization of the PM's IO adapters</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes per second (KB/s)</td>
</tr>
<tr>
<td></td>
<td>- Net</td>
</tr>
<tr>
<td></td>
<td>The utilization of data through the PM's network adapters</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes per second (KB/s)</td>
</tr>
<tr>
<td></td>
<td>- Swap</td>
</tr>
<tr>
<td></td>
<td>The utilization of the PM's swap space</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
</tbody>
</table>
- **Balloon**
  The utilization of shared memory among VMs running on the host. ESX-only
  Measured in Kilobytes (KB)

- **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)

### Provider Virtual Datacenter
- **Memory (Mem)**
  The utilization of the Datacenter’s memory reserved or in use
  Measured in Kilobytes (KB)

- **CPU**
  The utilization of the Datacenter’s CPU reserved or in use
  Measured in Megahertz (MHz)

- **Storage**
  The utilization of the storage attached to the Provider vDC.
  Measured in Kilobytes (KB)

### Consumer Virtual Datacenter
- **Memory (Mem)**
  The utilization of the Datacenter’s memory reserved or in use
  Measured in Kilobytes (KB)

- **CPU**
  The utilization of the Datacenter’s CPU reserved or in use
  Measured in Megahertz (MHz)

- **Storage**
  The utilization of the storage attached to the Consumer vDC.
  Measured in Kilobytes (KB)

### DPod
- **Memory (Mem)**
  The utilization of the DPod’s memory reserved or in use
  Measured in Kilobytes (KB)

- **CPU**
  The utilization of the DPod’s CPU reserved or in use
  Measured in Megahertz (MHz)

- **Storage**
  The utilization of the storage attached to the DPod
  Measured in Kilobytes (KB)

- **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)
Storage Targets

Adding a storage Target enables Workload Optimization Manager to connect to your storage subsystem through an SMI-S provider API or through the controller’s native API. Workload Optimization Manager 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, Workload Optimization Manager 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 Workload Optimization Manager 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

<table>
<thead>
<tr>
<th>Storage</th>
<th>Volume</th>
<th>Volume (Regular, Thin, Meta)</th>
<th>LUN, Data Store, Volume</th>
<th>Volume</th>
<th>Virtual Volume</th>
<th>Volume</th>
<th>Container</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco Mapping</td>
<td>Dell Compellent</td>
<td>EMC VMAX</td>
<td>EMC VNX</td>
<td>EMC XtremlO</td>
<td>HPE 3Par</td>
<td>NetApp</td>
<td>Nutanix</td>
<td>Pure</td>
</tr>
<tr>
<td>Disk Array</td>
<td>Storage Type</td>
<td>Disk Group or Thin Pool</td>
<td>Raid Group, Storage Pool</td>
<td>XtremlO Cluster</td>
<td>CPG</td>
<td>Aggregate</td>
<td>Storage Pool</td>
<td>Shelf Array</td>
</tr>
<tr>
<td>Storage Controller</td>
<td>Storage Center</td>
<td>VMAX Array</td>
<td>Storage Processor</td>
<td>XtremlO Cluster</td>
<td>Controller</td>
<td>Controller / Filer</td>
<td>Controller VM</td>
<td>Controller</td>
</tr>
</tbody>
</table>

Actions

Workload Optimization Manager recommends actions for storage targets as follows.

**NOTE:** This is a general list of actions for storage managed by storage controllers. Specific actions Workload Optimization Manager 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, Workload Optimization Manager can automate a datastore move across disk arrays or storage controllers for NetApp in C mode, but not for other storage technologies. For another example, Workload Optimization Manager doesn’t recommend an action to provision a datastore on Nutanix because that platform includes datastores with each node – to increase storage capacity you would provision a Nutanix node.
You can see how actions differ per technology in each section that describes adding a specific type of Storage Manager target.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage</td>
<td>■ Start Storage</td>
</tr>
<tr>
<td></td>
<td>■ Provision Storage</td>
</tr>
<tr>
<td></td>
<td>■ Suspend Storage</td>
</tr>
<tr>
<td></td>
<td>■ Move (only with Storage Targets configured)</td>
</tr>
<tr>
<td></td>
<td>■ Resize (only with Storage Targets configured)</td>
</tr>
<tr>
<td>Disk Arrays</td>
<td>■ Provision Disk Array</td>
</tr>
<tr>
<td></td>
<td>■ Start Disk Array</td>
</tr>
<tr>
<td></td>
<td>■ Suspend Disk Array</td>
</tr>
<tr>
<td></td>
<td>■ Move Disk Array (for NetApp Cluster-Mode, only)</td>
</tr>
<tr>
<td></td>
<td>■ Move Virtual Machine</td>
</tr>
<tr>
<td></td>
<td>■ Move Datastore</td>
</tr>
<tr>
<td>Storage Controller</td>
<td>■ Provision Storage Controller (recommendation only)</td>
</tr>
</tbody>
</table>

**Monitored Resources**

Workload Optimization Manager monitors the following storage resources:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage</td>
<td>■ Storage Amount</td>
</tr>
<tr>
<td></td>
<td>The utilization of the datastore's capacity</td>
</tr>
<tr>
<td></td>
<td>Measured in Megabytes (MB)</td>
</tr>
<tr>
<td></td>
<td>■ Storage Provisioned</td>
</tr>
<tr>
<td></td>
<td>The utilization of the datastore's capacity, including overprovisioning.</td>
</tr>
<tr>
<td></td>
<td>Measured in Megabytes (MB)</td>
</tr>
<tr>
<td></td>
<td>■ Storage Access Operations Per Second (IOPS)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the storage access operations per second on the datastore</td>
</tr>
<tr>
<td></td>
<td>Measured in Operations per second</td>
</tr>
<tr>
<td></td>
<td>■ Latency</td>
</tr>
<tr>
<td></td>
<td>The utilization of latency on the datastore</td>
</tr>
<tr>
<td></td>
<td>Measured in Milliseconds (ms)</td>
</tr>
<tr>
<td>Disk Array</td>
<td>■ Storage Amount</td>
</tr>
<tr>
<td></td>
<td>The utilization of the Disk Array's capacity</td>
</tr>
<tr>
<td></td>
<td>Measured in Megabytes (MB)</td>
</tr>
<tr>
<td></td>
<td>■ Storage Provisioned</td>
</tr>
<tr>
<td></td>
<td>The utilization of the Disk Array's capacity, including overprovisioning.</td>
</tr>
<tr>
<td></td>
<td>Measured in Megabytes (MB)</td>
</tr>
<tr>
<td></td>
<td>■ Storage Access Operations Per Second (IOPS)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the storage access operations per second on the disk array</td>
</tr>
<tr>
<td></td>
<td>Measured in Operations per second</td>
</tr>
</tbody>
</table>
Latency
The utilization of latency on the disk array.
Measured in milliseconds (ms)

CPU
The utilization of the Storage Controller’s CPU in use
Measured in Megahertz (MHz)

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)

Dell Compellent

Workload Optimization Manager supports the management of Dell SC Series (Compellent) disk arrays and storage
controllers. Workload Optimization Manager connects through the Dell Enterprise Manager and performs management
as a client of the Enterprise Manager Data Collector.

The Dell Enterprise Manager is a management service that provides administration, management, and monitoring of
multiple Storage Centers — Typically installed on a Windows VM.

When you specify a Dell Compellent target, you provide the IP address of the Dell Enterprise Manager. Workload
Optimization Manager discovers the Compellent infrastructure through the SMI-S component which is typically installed
as part of the Enterprise Manager.

NOTE: Before adding the Dell Compellent target to Workload Optimization Manager, confirm that the Storage Centers
you want to manage show up in Dell Enterprise Manager (see “Storage Center Administration” in the Dell Compellent
Enterprise Manager Administrator’s Guide). The SMI-S user account must be able to access all of the Storage Centers.
If you add or remove Storage Centers later, Workload Optimization Manager will detect the changes during its next
discovery cycle.

Prerequisites

- Dell Enterprise Manager Data Collector Service 6.2 or higher
- Dell Compellent SMI-S Provider
- Storage Centers added to Dell Enterprise Manager

Setting Up the Dell Compellent SMI-S Provider

Your Dell Compellent storage environment must include an enabled Dell Compellent SMI-S Provider. Configure the
SMI-S Provider as described in the “SMI-S” section of the Dell Compellent Enterprise Manager Administrator’s Guide.
The guide provides detailed steps to:

- Open the required ports on the server hosting the Enterprise Manager Data Collector.
- Enable SMI-S for the Data Collector.
- Add a user for SMI-S.
- If using HTTPS, associate the SSL certificate with the SMI-S Provider.
Adding Dell Compellent Targets

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

- **Address**
  
  The name or IP address of the Dell Enterprise Manager.

  By default, Enterprise Manager provides SMI-S data over port 5988 (HTTP). If your installation uses a different port for SMI-S, include the port number in the Address field.

- **Username/Password**
  
  Credentials for the SMI-S user you added when setting up the SMI-S provider.

After validating the new target, Workload Optimization Manager discovers the connected storage entities. This table compares terms used in the Dell Enterprise Manager to those used in Workload Optimization Manager:

<table>
<thead>
<tr>
<th>Dell Name</th>
<th>Workload Optimization Manager Entity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage Center</td>
<td>Storage Controller</td>
</tr>
<tr>
<td>Storage Type</td>
<td>Disk Array</td>
</tr>
<tr>
<td>Volume</td>
<td>Storage</td>
</tr>
</tbody>
</table>

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 **Supply Chain** on page 65.

Supported Actions

Workload Optimization Manager supports the following actions for Dell Compellent entities:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Can Be Automated</th>
<th>Recommendations only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage</td>
<td></td>
<td>Move, Provision, Resize Up</td>
</tr>
<tr>
<td>Disk Array</td>
<td></td>
<td>Provision, Resize Up</td>
</tr>
<tr>
<td>Storage Controller</td>
<td></td>
<td>Provision</td>
</tr>
</tbody>
</table>

Monitored Resources

Workload Optimization Manager monitors the following storage resources:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage</td>
<td>Storage Amount</td>
</tr>
<tr>
<td></td>
<td>The utilization of the datastore's capacity</td>
</tr>
<tr>
<td></td>
<td>Measured in Megabytes (MB)</td>
</tr>
</tbody>
</table>
- **Storage Provisioned**
  The utilization of the datastore's capacity, including overprovisioning.
  Measured in Megabytes (MB)

- **Storage Access Operations Per Second (IOPS)**
  The utilization of the storage access operations per second on the datastore.
  Measured in Operations per second

- **Latency**
  The utilization of latency on the datastore.
  Measured in Milliseconds (ms)

**Disk Array**

- **Storage Amount**
  The utilization of the Disk Array's capacity.
  Measured in Megabytes (MB)

- **Storage Provisioned**
  The utilization of the Disk Array's capacity, including overprovisioning.
  Measured in Megabytes (MB)

- **Storage Access Operations Per Second (IOPS)**
  The utilization of the storage access operations per second on the disk array.
  Measured in Operations per second

- **Latency**
  The utilization of latency on the disk array.
  Measured in milliseconds (ms)

**Storage Controller**

- **CPU**
  The utilization of the Storage Controller's CPU in use.
  Measured in Megahertz (MHz)

- **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)

**VMAX**

Workload Optimization Manager supports management of VMAX2 and 3 Series storage arrays. The VMAX series is a family of enterprise storage arrays designed for SAN environments. Workload Optimization Manager 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, Workload Optimization Manager discovers all the added disk arrays.

Workload Optimization Manager 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 Workload Optimization Manager 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 hostname 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, Workload Optimization Manager discovers the connected storage entities. This table compares terms used in EMC VMAX to those used in Workload Optimization Manager:

<table>
<thead>
<tr>
<th>EMC VMAX Name</th>
<th>Workload Optimization Manager Entity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume (Regular, Thin, Meta)</td>
<td>Storage</td>
</tr>
<tr>
<td>Storage Resource Pool (VMAX3) / Thick Provisioned Pool (earlier)</td>
<td>Disk Array</td>
</tr>
<tr>
<td>Storage Group (VMAX3) / Thin Provisioned Pool (earlier)</td>
<td>Logical Pool</td>
</tr>
<tr>
<td>VMAX Array</td>
<td>Storage Controller</td>
</tr>
</tbody>
</table>

Supported Actions

For each discovered entity, Workload Optimization Manager can execute or recommend certain actions, as outlined below.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Can Be Automated</th>
<th>Recommendations only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage</td>
<td>Provision (Cloning), Delete</td>
<td>Resize (V-Volumes only)</td>
</tr>
<tr>
<td>Logical Pool</td>
<td></td>
<td>Resize</td>
</tr>
<tr>
<td>Disk Array</td>
<td></td>
<td>Provision</td>
</tr>
</tbody>
</table>

Monitored Resources

When calculating available storage, Workload Optimization Manager 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.
Workload Optimization Manager monitors the following storage resources:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Storage</strong></td>
<td>- Storage Amount&lt;br&gt;The utilization of the datastore's capacity&lt;br&gt;Measured in Megabytes (MB)&lt;br&gt;- Storage Provisioned&lt;br&gt;The utilization of the datastore's capacity, including overprovisioning.&lt;br&gt;Measured in Megabytes (MB)&lt;br&gt;- Storage Access Operations Per Second (IOPS)&lt;br&gt;The utilization of the storage access operations per second on the datastore&lt;br&gt;Measured in Operations per second&lt;br&gt;- Latency&lt;br&gt;The utilization of latency on the datastore&lt;br&gt;Measured in Milliseconds (ms)</td>
</tr>
<tr>
<td><strong>Logical Pool</strong></td>
<td>- Storage Amount&lt;br&gt;The utilization of the logical pool's capacity.&lt;br&gt;Measured in Megabytes (MB)&lt;br&gt;- Storage Provisioned&lt;br&gt;The utilization of the logical pool's capacity, including overprovisioning.&lt;br&gt;Measured in Megabytes (MB)&lt;br&gt;- Storage Access Operations Per Second (IOPS)&lt;br&gt;The utilization of the storage access operations per second on the logical pool.&lt;br&gt;Measured in Operations per second&lt;br&gt;- Latency&lt;br&gt;The utilization of latency on the logical pool.&lt;br&gt;Measured in milliseconds (ms)</td>
</tr>
<tr>
<td><strong>Disk Array</strong></td>
<td>- Storage Amount&lt;br&gt;The utilization of the Disk Array's capacity.&lt;br&gt;Measured in Megabytes (MB)&lt;br&gt;- Storage Provisioned&lt;br&gt;The utilization of the Disk Array's capacity, including overprovisioning.&lt;br&gt;Measured in Megabytes (MB)&lt;br&gt;- Storage Access Operations Per Second (IOPS)&lt;br&gt;The utilization of the storage access operations per second on the disk array.&lt;br&gt;Measured in Operations per second&lt;br&gt;- Latency&lt;br&gt;The utilization of latency on the disk array.&lt;br&gt;Measured in milliseconds (ms)</td>
</tr>
<tr>
<td><strong>Storage Controller</strong></td>
<td>- Storage Amount&lt;br&gt;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&lt;br&gt;Measured in Megabytes (MB)</td>
</tr>
</tbody>
</table>
EMC VNX

Workload Optimization Manager supports management of EMC VNX (not VNXe) file and block level storage systems, as well as unified VNX configurations. The requirements for specifying a VNX target differ, depending on the type of storage system you want to manage:

- **File level storage**
  Workload Optimization Manager connects to the VNX Control Station to discover and collect data from connected storage volumes.

- **Block level storage**
  Workload Optimization Manager uses the EMC SMI-S Provider to discover and collect data from block-level disk arrays and the controllers/storage processors in the VNX environment. A single SMI-S provider can communicate with multiple arrays.

- **Unified configuration**
  For unified (block and file) implementations, configure one VNX target for block and another VNX target for file.

**Prerequisites**

- For block level storage or unified configurations: EMC SMI-S Provider 4.6.2 (See below)
- For file level storage, VNX Control Station
- Firewall ports for the SMI-S provider
  On the system that hosts the SMI-S provider you may need to open the following ports:
  - UDP port 427
  - TCP ports 5988 and 5989
- A service account Workload Optimization Manager can use to connect to the target:
  - File level storage: An account with administrator privileges on the VNX Control Station (nasadmin).
  - Block level storage: An account with administrator privileges on the SMI-S provider host.

**EMC SMI-S Provider Setup Requirements**

**NOTE:** The SMI-S Provider is required for block level storage and unified configurations only. If you are using file level storage only, you do not need the SMI-S Provider.

1. Download EMC SMI-S Provider 4.6.2 from the EMC Support website.
2. Install the SMI-S Provider.
   Perform installation according to the installation instructions in the EMC SMI-S Provider Release Notes. When installing the provider:
   - In the Providers list, select the “Array Provider” (not the “Host Provider”).
   - If prompted to select which Stordaemon Services to install and start, select “EMC SE SYMAPI Server Daemon.”
3. Add storage resources to the SMI-S provider.
Use the “testsmiprovider” utility to add the disk arrays/pools you want to manage. Find instructions in the “Out-of-band discovery method” section of the EMC SMI-S Provider Release Notes.

The SMI-S Provider communicates over UDP port 427 and TCP ports 5988 and 5989. If a firewall is running on the server hosting the provider, these ports must be open. Also, the SMI-S Provider service must be running at all times.

**NOTE:** If you are running a Vblock environment or are using the Cisco UCS Converged Fabric, you may be using a Cisco SMI-S provider. Workload Optimization Manager requires the EMC SMI-S Provider. Since both providers use the same TCP port, install the EMC provider on its own system.

### Adding EMC VNX Targets

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

- **Address**
  - **File level storage:** The address of the primary VNX Control Station. You can get this from the EMC Unisphere management console.
  - **Block level storage:** The name or IP address of the server with the EMC SMI-S provider (see the section above for SMI-S Provider Setup Requirements).

- **Username/Password**
  - **File level storage:** Credentials for an administrator user on the primary VNX Control Station.
  - **Block level storage:** The name or IP address of the EMC SMI-S provider (see the section above for SMI-S Provider Setup Requirements).

**NOTE:** For unified configurations, configure one VNX target for block and another VNX target for file.

After validating the new target, Workload Optimization Manager discovers the connected storage entities. This table compares terms used in EMC VNX to those used in Workload Optimization Manager:

<table>
<thead>
<tr>
<th>VNX Name (CLARiiON / Celerra)</th>
<th>Workload Optimization Manager Entity</th>
</tr>
</thead>
<tbody>
<tr>
<td>LUN, Data Store / Volume</td>
<td>Storage</td>
</tr>
<tr>
<td>Raid Group, Storage Pool / Storage Pool</td>
<td>Disk Array</td>
</tr>
<tr>
<td>Storage Processor / Storage Processor</td>
<td>Storage Controller</td>
</tr>
</tbody>
</table>

### 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 **Supply Chain** on page 65.
Supported Actions

For each discovered entity, Workload Optimization Manager can execute or recommend certain actions, as outlined below.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Can Be Automated</th>
<th>Recommendations only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage</td>
<td>Move, Provision, Resize Up</td>
<td></td>
</tr>
<tr>
<td>Disk Array</td>
<td>Provision, Resize Up</td>
<td></td>
</tr>
<tr>
<td>Storage Controller</td>
<td>Provision</td>
<td></td>
</tr>
</tbody>
</table>

Monitored Resources

When calculating available storage, Workload Optimization Manager excludes disks devoted to the VNX 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.

Workload Optimization Manager monitors the following storage resources:

**Entity Type**

**Commodity**

**Storage**
- Storage Amount
  The utilization of the datastore's capacity
  Measured in Megabytes (MB)
- Storage Provisioned
  The utilization of the datastore's capacity, including overprovisioning.
  Measured in Megabytes (MB)
- Storage Access Operations Per Second (IOPS)
  The utilization of the storage access operations per second on the datastore
  Measured in Operations per second
- Latency
  The utilization of latency on the datastore
  Measured in Milliseconds (ms)

**Disk Array**
- Storage Amount
  The utilization of the Disk Array's capacity.
  Measured in Megabytes (MB)
- Storage Provisioned
  The utilization of the Disk Array's capacity, including overprovisioning.
  Measured in Megabytes (MB)
- Storage Access Operations Per Second (IOPS)
  The utilization of the storage access operations per second on the disk array
  Measured in Operations per second
- Latency
  The utilization of latency on the disk array.
  Measured in milliseconds (ms)

**Storage Controller**
- CPU
  The utilization of the Storage Controller's CPU in use
  Measured in Megahertz (MHz)
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)

EMC VPLEX

Workload Optimization Manager supports management of EMC VPLEX virtual storage systems in a local configuration, via the VPLEX API. Currently, Workload Optimization Manager does not support Metro or Geo configurations.

VPLEX is used to aggregate and refine data collected between connected Storage and Hypervisor targets. VPLEX supports one-to-one, one-to-many, and many-to-one relationships between virtual volumes and LUNs. Only one-to-one mapping between virtual volume and LUNs is supported by Workload Optimization Manager.

Prerequisites

- VPLEX Management Server
- Hypervisor target supported by Workload Optimization Manager
- Storage target supported by Workload Optimization Manager

NOTE: In order for Workload Optimization Manager to make use of the information provided by VPLEX, you must also add the hypervisor and storage layered under it as targets.

Adding EMC VPLEX Targets

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

- Address:
  The IP or Hostname of the VPLEX Management Server
- Username:
  The Username for the VPLEX Management Server
- Password:
  The Password for the VPLEX Management Server
- Port Number:
  The port number for the remote management connection. The default port number for the VPLEX Management server is 443
- Secure Connection:
  Select this option to use a secure connection (HTTPS)

NOTE: The default port (443) uses a secure connection.
Supported Actions
For this target, actions are generated and executed via the underlying storage targets. Workload Optimization Manager will use the enhanced visibility provided by VPLEX to make more intelligent storage decisions— for example, recommending storage vMotion between pools.

EMC XtremIO
EMC® XtremIO® is a flash-based (SSD) storage solution, designed to push data to applications at higher speeds. The system building blocks are SAN appliances called X-Bricks. A deployment is organized into clusters of X-Bricks, and the clusters are managed by the XtremIO Management Server (XMS).

Workload Optimization Manager connects to X-Bricks through the XMS. The XMS presents a unified view of each connected X-Brick cluster, rather than exposing the individual X-Bricks within each cluster. Within Workload Optimization Manager, each X-Brick cluster displays as a single storage controller with an associated disk array.

The relationship between Storage entities and individual X-Bricks within the cluster is not exposed through the XMS—Workload Optimization Manager cannot make recommendations to move datastores from one X-Brick to another. Additionally, the X-Brick has a fixed form factor—Workload Optimization Manager does not recommend resize actions for disk array or storage controller resources.

Workload Optimization Manager recognizes XtremIO arrays as flash storage and sets the IOPS capacity on discovered arrays accordingly.

Prerequisites
- A service user account on XMS 4.0 or higher—typically the default xmsadmin account

Workload Optimization Manager uses this account to connect to the XMS and execute commands through the XtremIO API.

Adding XtremIO Targets
For EMC XtremIO targets, select the Storage > EMC XtremIO option on the Target Configuration page and provide the following information:
- Address
  The name or IP address of the XtremIO Management Server (XMS).
- Username/Password
  Credentials for a user account on the XMS.

After validating the new target, Workload Optimization Manager discovers the connected storage entities. This table compares terms used in XTremIO to those used in Workload Optimization Manager:

<table>
<thead>
<tr>
<th>XTremIO Name</th>
<th>Workload Optimization Manager Entity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume</td>
<td>Storage</td>
</tr>
<tr>
<td>XTremIO Cluster</td>
<td>Disk Array</td>
</tr>
<tr>
<td>XTremIO Cluster</td>
<td>Storage Controller</td>
</tr>
</tbody>
</table>
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 Supply Chain on page 65.

Supported Actions

For each discovered entity, Workload Optimization Manager can execute or recommend certain actions, as outlined below.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Can Be Automated</th>
<th>Recommendations only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage</td>
<td></td>
<td>Provision, Resize Up</td>
</tr>
<tr>
<td>Disk Array</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage Controller</td>
<td></td>
<td>Provision</td>
</tr>
</tbody>
</table>

Monitored Resources

When calculating available storage, Workload Optimization Manager excludes disks devoted to the VNX operating system.

Workload Optimization Manager monitors the following storage resources:

**Entity Type**

**Commodity**

Storage

- **Storage Amount**
  - The utilization of the datastore's capacity
  - Measured in Megabytes (MB)
- **Storage Provisioned**
  - The utilization of the datastore's capacity, including overprovisioning.
  - Measured in Megabytes (MB)
- **Storage Access Operations Per Second (IOPS)**
  - The utilization of the storage access operations per second on the datastore
  - Measured in Operations per second
- **Latency**
  - The utilization of latency on the datastore
  - Measured in Milliseconds (ms)

Disk Array

- **Storage Amount**
  - The utilization of the Disk Array's capacity.
  - Measured in Megabytes (MB)
- **Storage Provisioned**
  - The utilization of the Disk Array's capacity, including overprovisioning.
  - Measured in Megabytes (MB)
- **Storage Access Operations Per Second (IOPS)**
  - The utilization of the storage access operations per second on the disk array
  - Measured in Operations per second
Latency
The utilization of latency on the disk array.
Measured in milliseconds (ms)

Storage Controller
CPU
The utilization of the Storage Controller’s CPU in use
Measured in Megahertz (MHz)

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)

HPE 3PAR
HPE 3PAR StoreServ systems use controller nodes to manage pools of storage resources and present a single storage system to consumers. Workload Optimization Manager communicates with the HPE 3PAR system via an SMI-S provider that is installed on the 3PAR controller node.

Prerequisites

- SMI-S Provider enabled and configured on the controller node
- A service account on the controller node that Workload Optimization Manager can use to connect to the SMI-S provider

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.
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, Workload Optimization Manager discovers the connected storage entities. This table compares terms used in HPE 3PAR to those used in Workload Optimization Manager:

<table>
<thead>
<tr>
<th>HPE 3PAR Name</th>
<th>Workload Optimization Manager Entity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Volume</td>
<td>Storage</td>
</tr>
<tr>
<td>CPG</td>
<td>Disk Array</td>
</tr>
<tr>
<td>Controller</td>
<td>Storage Controller</td>
</tr>
</tbody>
</table>

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 **Supply Chain** on page 65.

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, Workload Optimization Manager:

- Discovers each Common Provisioning Group (CPG) as a disk array
  
  In the Workload Optimization Manager user interface, these disk arrays do not host storage — They appear empty. Workload Optimization Manager will not recommend storage moves between these disk arrays, because such moves would conflict with AO block-level placement.

- Creates a single AO disk array that hosts all the datastores in an AO group

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

You can see the AO disk array in the Workload Optimization Manager user interface. The display name for this disk array:

- Begins with the string **AO_DiskArray**

- Includes the names of the discovered disk arrays (CPGs), separated by underscores
Supported Actions

For each discovered entity, Workload Optimization Manager can execute or recommend certain actions, as outlined below.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Can Be Automated</th>
<th>Recommendations only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage</td>
<td></td>
<td>Move, Provision, Resize Up</td>
</tr>
<tr>
<td>Disk Array</td>
<td></td>
<td>Resize Up</td>
</tr>
<tr>
<td>Storage Controller</td>
<td></td>
<td>Provision</td>
</tr>
</tbody>
</table>

Monitored Resources

Workload Optimization Manager monitors the following storage resources:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage</td>
<td>Storage Amount&lt;br&gt;The utilization of the datastore's capacity&lt;br&gt;Measured in Megabytes (MB)</td>
</tr>
<tr>
<td>Disk Array</td>
<td>Storage Amount&lt;br&gt;The utilization of the Disk Array's capacity.&lt;br&gt;Measured in Megabytes (MB)</td>
</tr>
<tr>
<td>Storage Controller</td>
<td>CPU&lt;br&gt;The utilization of the Storage Controller's CPU in use&lt;br&gt;Measured in Megahertz (MHz)</td>
</tr>
</tbody>
</table>
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)

HDS
Workload Optimization Manager supports management of HDS storage systems, via either the embedded SMI-S, or the shared SMI-S (Not recommended). If using the embedded SMI-S provider, each Storage System must be added to Workload Optimization Manager as a separate target.

Prerequisites

- SMI-S Provider
  Workload Optimization Manager recommends using the embedded SMI-S provider. Workload Optimization Manager also provides the ability to use the shared SMI-S Provider. To use the shared SMI-S provider, please contact Workload Optimization Manager support. The Hitachi Command Suite Administrator Guide.

- Tuning Manager
  The Tuning Manager is required for monitoring IOPs and Latency. For assistance in setting up the Tuning Manager, please see The HDS Tuning Manager User Guide.

Adding HDS Targets
To add HDS targets, select the Storage > HDS option on the Target Configuration page and provide the following information:

- SMI-S Address
  The IP or hostname of the SMI-S provider.

- SMI-S Username
  The Username for the SMI-S provider.

- SMI-S Password
  The Password for the SMI-S provider.

- SMI-S Secure connection
  If you are using HTTPS with the SMI-S Provider, select this.

- Shared SMI-S Provider
  If you are using the Shared SMI-S Provider (not recommended), select this.

- TnM Address
  The IP or hostname of the Tuning Manager.
- **TnM Username**
  The Username for the Tuning Manager.

- **TnM Password**
  The Password for the Tuning Manager.

- **TnM Secure connection**
  If you are using HTTPS with the Tuning Manager, select this.

**Entity Comparison**

After validating the new target, Workload Optimization Manager discovers the connected storage entities. This table compares terms used in HDS to those used in Workload Optimization Manager:

<table>
<thead>
<tr>
<th>HDS Name</th>
<th>Workload Optimization Manager Entity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume, Logical Device (LDEV), V-VOL</td>
<td>Storage</td>
</tr>
<tr>
<td>Parity Group</td>
<td>Disk Array</td>
</tr>
<tr>
<td>Dynamic Provisioning Pool</td>
<td>Logical Pool</td>
</tr>
<tr>
<td>Storage System</td>
<td>Storage Controller</td>
</tr>
</tbody>
</table>

**Supported Actions**

For each discovered entity, Workload Optimization Manager can execute or recommend certain actions, as outlined below.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Can Be Automated</th>
<th>Recommendations only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage</td>
<td></td>
<td>Provision, Suspend, Resize (V-Volumes only), Move</td>
</tr>
<tr>
<td>Logical Pool</td>
<td></td>
<td>Provision, Resize, Delete</td>
</tr>
<tr>
<td>Disk Array</td>
<td></td>
<td>Provision</td>
</tr>
<tr>
<td>Storage Controller</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Monitored Resources**

Workload Optimization Manager monitors the following storage resources:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
</table>
| Storage     | **Storage Amount**
  - The utilization of the datastore's capacity
  - Measured in Megabytes (MB)
  **Storage Provisioned**
  - The utilization of the datastore's capacity, including overprovisioning.
  - Measured in Megabytes (MB) |
Storage Access Operations Per Second (IOPS)
The utilization of the storage access operations per second on the datastore
Measured in Operations per second

Latency
The utilization of latency on the datastore
Measured in Milliseconds (ms)

Logical Pool

Storage Amount
The utilization of the logical pool's capacity.
Measured in Megabytes (MB)

Storage Provisioned
The utilization of the logical pool's capacity, including overprovisioning.
Measured in Megabytes (MB)

Storage Access Operations Per Second (IOPS)
The utilization of the storage access operations per second on the logical pool.
Measured in Operations per second

Latency
The utilization of latency on the logical pool.
Measured in milliseconds (ms)

Disk Array

Storage Amount
The utilization of the Disk Array's capacity.
Measured in Megabytes (MB)

Storage Provisioned
The utilization of the Disk Array's capacity, including overprovisioning.
Measured in Megabytes (MB)

Storage Access Operations Per Second (IOPS)
The utilization of the storage access operations per second on the disk array.
Measured in Operations per second

Latency
The utilization of latency on the disk array.
Measured in milliseconds (ms)

Storage Controller

CPU
The utilization of the Storage Controller's CPU in use
Measured in Megahertz (MHz)

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)

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. Workload Optimization Manager 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 Workload Optimization Manager can use to connect to the NetApp target

Enabling TLS

By default Workload Optimization Manager 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, 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 Cisco 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 Cisco 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, Workload Optimization Manager 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 Cisco -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 Cisco -application ontapi -authmethod password
  ```

  If you prefer not to grant full administrator rights, see Restricted Service Accounts In NetApp on page 86

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 Workload Optimization Manager to use.

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

<table>
<thead>
<tr>
<th>NetApp Name</th>
<th>Workload Optimization Manager Entity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume</td>
<td>Storage</td>
</tr>
<tr>
<td>Aggregate</td>
<td>Disk Array</td>
</tr>
<tr>
<td>Controller / Filer</td>
<td>Storage Controller</td>
</tr>
</tbody>
</table>

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 Supply Chain on page 65.

Supported Actions

For each discovered entity, Workload Optimization Manager can execute or recommend certain actions, as outlined below.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Can Be Automated</th>
<th>Recommendations only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage</td>
<td>Move (C-Mode only)</td>
<td>Move (7-Mode), Provision, Resize Up</td>
</tr>
<tr>
<td>Disk Array</td>
<td></td>
<td>Resize Up, Move (C-Mode only), Provision (C-Mode only)</td>
</tr>
<tr>
<td>Storage Controller</td>
<td></td>
<td>Provision</td>
</tr>
</tbody>
</table>

Note that for NetApp in C-Mode, Workload Optimization Manager 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

Workload Optimization Manager monitors the following storage resources:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage</td>
<td>■ Storage Amount</td>
</tr>
<tr>
<td></td>
<td>The utilization of the datastore’s capacity</td>
</tr>
<tr>
<td></td>
<td>Measured in Megabytes (MB)</td>
</tr>
<tr>
<td></td>
<td>■ Storage Provisioned</td>
</tr>
<tr>
<td></td>
<td>The utilization of the datastore’s capacity, including overprovisioning.</td>
</tr>
<tr>
<td></td>
<td>Measured in Megabytes (MB)</td>
</tr>
<tr>
<td></td>
<td>■ Storage Access Operations Per Second (IOPS)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the storage access operations per second on the datastore</td>
</tr>
<tr>
<td></td>
<td>Measured in Operations per second</td>
</tr>
</tbody>
</table>
Latency
The utilization of latency on the datastore
Measured in Milliseconds (ms)

Storage Amount
The utilization of the Disk Array's capacity.
Measured in Megabytes (MB)

Storage Provisioned
The utilization of the Disk Array's capacity, including overprovisioning.
Measured in Megabytes (MB)

Storage Access Operations Per Second (IOPS)
The utilization of the storage access operations per second on the disk array
Measured in Operations per second

Latency
The utilization of latency on the disk array.
Measured in milliseconds (ms)

CPU
The utilization of the Storage Controller's CPU in use
Measured in Megahertz (MHz)

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)

Restricted Service Accounts In NetApp

While Workload Optimization Manager 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:

   ```bash
   useradmin role add Cisco Role <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
Note that the last login capability (login-*) may be necessary for external users.

**Execution capabilities:**

- 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.
3. Create a group and assign the role.
   For example:
   ```bash
   useradmin add Cisco Group -r Cisco Role
   ```

4. Create a user that is a member of the group.
   For example:
   ```bash
   useradmin user add Cisco -g Cisco Group
   ```

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:
   ```bash
   - aggr-get-iter
   - igroup-get-iter
   - cluster-identity-get
   - lun-map-get-iter
   - net-interface-get-iter
   - storage-disk-get-iter
   - system-get-node-info-iter
   - volume-get-iter
   - vserver-get-iter
   - fcp-node-get-name
   - flash-device-get-iter
   - iscsi-node-get-name
   - options-list-info
   - qtree-list-iter
   - system-get-version
   - lun-get-iter
   - snapshot-get-iter
   ```
For example, to enable volume offline, execute the following:

```
security login role create -role Cisco Role -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 Cisco Role -username Cisco -application ontapi -authmethod password
security login create -role VMTurboRole -username VMTurbo -application ssh -authmethod password
```

**Nutanix**

Nutanix products provide hyperconverged platforms that include VM hosting and a distributed storage fabric. The platform presents storage in two tiers — Local HDD storage and server-attached flash (hot storage).

Nutanix environments include:

- One or more Nutanix appliances
  - An appliance contains up to four server nodes.

- Nutanix nodes
  - Servers that expose compute and storage resources. Each node provides local HDD and hot storage. Nodes combine to form a unified cluster that pools resources.

- Controller VMs
  - Each node includes a Controller VM that manages the node’s resources within the cluster pool. To minimize storage latency, the Controller VM keeps the most frequently accessed data in the hot storage.

Workload Optimization Manager supports management of Nutanix fabrics, where the supply chain treats a Nutanix Storage Pool as a disk array. Workload Optimization Manager recognizes Nutanix storage tiers when calculating placement of VMs and VStorage. In addition, Workload Optimization Manager can recommend actions to scale flash capacity up or down by adding more hosts to the cluster, or more flash drives to the hosts.

To specify a Nutanix target, provide the Cluster External IP address. This is a logical IP address that always connects to one of the active Controller VMs in the cluster. In this way, you can specify a Nutanix target without having to specify an explicit Controller VM.

**NOTE:** The Controller VM must remain pinned to its host machine — You must not move the Controller VM to a different host. If the Nutanix cluster uses the Nutanix Acropolis OS to manage VMs, Workload Optimization Manager automatically pins the Controller VMs. However, if you use vCenter Server or Hyper-V to manage VMs on the hosts, you must configure a group to pin the Controller VMs. For more information, see Pinning Nutanix Controller VMs in Generic Hypervisor Mode on page 93.
Prerequisites

- A service account with administrator rights on the Nutanix target

Finding the Cluster External IP Address

To set a Nutanix target, provide the Cluster External IP address for the given Nutanix cluster.

The Cluster External IP address is a logical IP that resolves to the cluster’s Prism Leader. If the Prism Leader fails, then the Cluster External IP address will resolve to the newly elected Prism Leader.

To find this IP address, open the Web Console (the Prism Element) on the cluster and navigate to the Cluster Details view. In this view you can see the Cluster External IP address. If there is no IP address specified, you can specify the address at this time. For more information, see the Nutanix documentation.

Operating Modes

A Nutanix node is a server that hosts VMs – In this sense the node functions as a hypervisor. A cluster of nodes can host VMs using the following Hypervisor technologies:

- Nutanix Acropolis
  The native Nutanix host platform, which combines software-defined storage with built-in virtualization.
- VMware ESXi
- Microsoft Hyper-V

Workload Optimization Manager divides Nutanix cluster management into two modes:

- Standalone Mode (Acropolis)
  In this mode you:
  - Enable standalone mode and restart the Workload Optimization Manager server
  - Specify the Nutanix Cluster External IP address as the target address – This adds the cluster as a Workload Optimization Manager target to manage both VM and storage resources

- Generic Hypervisor Mode (ESXi or Hyper-V)
  In this mode you:
  - Add each Hyper-V host or vCenter as a hypervisor target – This enables VM workload control for the respective hypervisor technologies
  - Specify the Nutanix Cluster External IP address as the target address – This adds the cluster as a Storage Controller target to enable Workload Optimization Manager storage control

**NOTE:** These operating modes are mutually exclusive for a Nutanix cluster. You cannot mix operating modes in the same cluster.

Enabling Standalone (Acropolis) Operating Mode

By default, Workload Optimization Manager supports the Generic Hypervisor operating mode. To enable management of Acropolis VMs, you must modify the Workload Optimization Manager targets configuration file and then restart the Workload Optimization Manager server, as outlined in Enabling Standalone (Acropolis) Operating Mode In Nutanix on page 93.
Controller VM Pinning

Each Nutanix node hosts a Controller VM that runs the Nutanix software and manages I/O for the hypervisor and all VMs running on the host. Each Controller VM must remain on its host node —The Controller VM must be pinned to that host, and must not be moved to any other host.

For more information about how to pin the Controller VM, see Pinning Nutanix Controller VMs in Generic Hypervisor Mode on page 93.

Adding Nutanix Targets

NOTE: This describes how to add a Nutanix cluster to Workload Optimization Manager as a target. The steps are the same no matter which operating mode you use (Standalone or Generic Hypervisor). Before you add the cluster as a target, you should know which operating mode you intend. If you want Standalone mode, then you will have to enable that operating mode after adding the cluster. If you want Generic Hypervisor mode, then you will have to add the hypervisors as targets after you have added the Nutanix cluster as a target. For more information, see Hypervisor Targets on page 5.

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

- Address
  The Cluster External IP address for the Nutanix cluster.

- Username/Password
  Credentials for an account on the Nutanix cluster.

After validating the new target, Workload Optimization Manager discovers the connected storage entities. This table compares terms used in Nutanix to those used in Workload Optimization Manager:

<table>
<thead>
<tr>
<th>Nutanix Name</th>
<th>Workload Optimization Manager Entity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Container</td>
<td>Storage</td>
</tr>
<tr>
<td>Storage Pool</td>
<td>Disk Array</td>
</tr>
<tr>
<td>Controller VM</td>
<td>Storage Controller</td>
</tr>
</tbody>
</table>

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 Supply Chain on page 65.

Supported Actions

For each discovered entity, Workload Optimization Manager can execute or recommend certain actions, as outlined below.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Can Be Automated</th>
<th>Recommendations only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Datastore (&quot;Storage&quot;)</td>
<td></td>
<td>Provision, Resize Up</td>
</tr>
<tr>
<td>Disk Array</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage Controller</td>
<td></td>
<td>Provision</td>
</tr>
</tbody>
</table>
Monitored Resources

Workload Optimization Manager monitors the following storage resources:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Storage</strong></td>
<td>- <strong>Storage Amount</strong>&lt;br&gt;The utilization of the datastore's capacity&lt;br&gt;Measured in Megabytes (MB)&lt;br&gt;- <strong>Storage Provisioned</strong>&lt;br&gt;The utilization of the datastore's capacity, including overprovisioning.&lt;br&gt;Measured in Megabytes (MB)&lt;br&gt;- <strong>Storage Access Operations Per Second (IOPS)</strong>&lt;br&gt;The utilization of the storage access operations per second on the datastore&lt;br&gt;Measured in Operations per second&lt;br&gt;- <strong>Latency</strong>&lt;br&gt;The utilization of latency on the datastore&lt;br&gt;Measured in Milliseconds (ms)</td>
</tr>
<tr>
<td><strong>Disk Array</strong></td>
<td>- <strong>Storage Amount</strong>&lt;br&gt;The utilization of the Disk Array's capacity.&lt;br&gt;Measured in Megabytes (MB)&lt;br&gt;- <strong>Storage Provisioned</strong>&lt;br&gt;The utilization of the Disk Array's capacity, including overprovisioning.&lt;br&gt;Measured in Megabytes (MB)&lt;br&gt;- <strong>Storage Access Operations Per Second (IOPS)</strong>&lt;br&gt;The utilization of the storage access operations per second on the disk array&lt;br&gt;Measured in Operations per second&lt;br&gt;- <strong>Latency</strong>&lt;br&gt;The utilization of latency on the disk array.&lt;br&gt;Measured in milliseconds (ms)</td>
</tr>
<tr>
<td><strong>Storage Controller</strong></td>
<td>- <strong>CPU</strong>&lt;br&gt;The utilization of the Storage Controller's CPU in use&lt;br&gt;Measured in Megahertz (MHz)&lt;br&gt;- <strong>Storage Amount</strong>&lt;br&gt;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&lt;br&gt;Measured in Megabytes (MB)</td>
</tr>
</tbody>
</table>
Enabling Standalone (Acropolis) Operating Mode In Nutanix

**NOTE:** Standalone and Generic modes are mutually exclusive for a Nutanix cluster. You cannot mix operating modes in the same cluster.

To enable Acropolis management for a cluster:

1. Add the Nutanix cluster as a target.
   
   Add the cluster as a target using the Cluster External IP address. Be sure you have added the target, and that Workload Optimization Manager has validated the target. Keep a note of the IP address you used.

2. Open a secure session on the Workload Optimization Manager server.
   
   `ssh root@<server_ip_address>`
   
   The default password is `vmturbo`.

3. Navigate to the configuration directory.
   
   Change directory to `/srv/tomcat/data/config`.

4. Back up the config file.
   
   Create a backup of `disc.config.topology`.

5. Locate the target entry for the cluster you added.
   
   Open `disc.config.topology` in a text editor.
   
   In this file, search the `<targets>` section for the `nutanix:NutanixTarget` entry that has the IP address you supplied for the Nutanix cluster.
   
   For example, assume you added a Nutanix cluster with the IP address, 10.10.64.88. Then you would search for the following entry in the config file:
   
   ```xml
   <targets xsi:type="nutanix:NutanixTarget" uuid="_pRSdsFheEeWgpfmffIwmXw" name="VMTTarget_10.10.64.88" displayName="10.10.64.88" nameOrAddress="10.10.64.88" timeout="30000" template="_2kieMIMcEeCC5PhGZd6dJj" ... </targets>
   ```

6. Modify the entry's TEMPLATE attribute.
   
   Note the template attribute. In the example above, the value is `_2kieMIMcEeCC5PhGZd6dJj`.
   
   Change the last character in the `template` attribute from `j` to `i`. Following the example, the config file entry would now be:
   
   ```xml
   <targets xsi:type="nutanix:NutanixTarget" uuid="_pRSdsFheEeWgpfmffIwmXw" name="VMTTarget_10.10.64.88" displayName="10.10.64.88" nameOrAddress="10.10.64.88" timeout="30000" template="_2kieMIMcEeCC5PhGZd6dJi" ... </targets>
   ```

7. Save your changes to the configuration file.

8. Restart Workload Optimization Manager.

Pinning Nutanix Controller VMs in Generic Hypervisor Mode

Each Nutanix node hosts a Controller VM that runs the Nutanix software and manages I/O for the hypervisor and all VMs running on the host. Each Controller VM must remain on its host node — The Controller VM must be pinned to that host, and must not be moved to any other host.
For a cluster in Standalone mode (running Acropolis hypervisors), Workload Optimization Manager recognizes the Controller VMs, and never recommends move actions for them.

For a cluster in Generic Hypervisor mode (using vCenter or Hyper-V hypervisors), you must use Workload Optimization Manager policies to pin the Controller VMs to their respective nodes. To do this, you will create a dynamic group of Nutanix Controller VMs, and then disable move actions for all members of this group.

To pin the Controller VMs:

1. Create a group of Controller VMs.

   In Workload Optimization Manager you can create dynamic groups based on VM name — All VMs with matching names automatically belong to the group. Nutanix uses the following naming convention for Control VMs:

   \text{NTNX-<SerialNumber>-A-CVM}, \text{where} \ <\text{SerialNumber}> \text{is the serial number of the Controller VM.}

   - Create a new group

     In Workload Optimization Manager go to the \text{Policy > Group Management} view and create a new group that groups VM entities by criteria.

   - Add a filter to match the VM names

     Add a filter that matches names by the regular expression, \text{NTNX.*CVM}. This regular expression will match the Nutanix Controller VMs.

2. Disable moves for all VMs in this group.

   - In Workload Optimization Manager go to the \text{Policy > Action > VM view}

   - Set the scope to the group you made

     In the \text{Scope} column, expand \text{My Groups} and select the group you just made.

   - Disable moves for this group

     In the \text{Parameter} column under \text{Action Mode Settings}, set the value to \text{Disabled}. This will override the global action mode.

   - Save the action mode settings

     Be sure to click \text{Apply Settings Change}.

## Pure Storage

Workload Optimization Manager 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, Workload Optimization Manager uses the setting made for SSD Disks in the Policy View.

Because of the improved performance of Pure Storage arrays, Workload Optimization Manager intelligently moves more demanding workloads to these datastores. Workload Optimization Manager analysis is also able to incorporate Pure Storage de-duplication and compression when recommending actions.
Prerequisites

- A service account Workload Optimization Manager 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 Workload Optimization Manager can use to connect to the FlashArray.

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

<table>
<thead>
<tr>
<th>Pure Name</th>
<th>Workload Optimization Manager Entity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume</td>
<td>Storage</td>
</tr>
<tr>
<td>Shelf Array</td>
<td>Disk Array</td>
</tr>
<tr>
<td>Controller</td>
<td>Storage Controller</td>
</tr>
</tbody>
</table>

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 Supply Chain on page 65.

Supported Actions

For each discovered entity, Workload Optimization Manager can execute or recommend certain actions, as outlined below.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Can Be Automated</th>
<th>Recommendations only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage</td>
<td></td>
<td>Resize Up</td>
</tr>
<tr>
<td>Disk Array</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage Controller</td>
<td></td>
<td>Provision</td>
</tr>
</tbody>
</table>

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

Workload Optimization Manager monitors the following storage resources:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage</td>
<td></td>
</tr>
</tbody>
</table>
|             | - Storage Amount  
The utilization of the datastore's capacity  
Measured in Megabytes (MB) |
|             | - Storage Provisioned  
The utilization of the datastore's capacity, including overprovisioning.  
Measured in Megabytes (MB) |
|             | - Storage Access Operations Per Second (IOPS)  
The utilization of the storage access operations per second on the datastore  
Measured in Operations per second |
|             | - Latency  
The utilization of latency on the datastore  
Measured in Milliseconds (ms) |
| Disk Array  |           |
|             | - Storage Amount  
The utilization of the Disk Array's capacity.  
Measured in Megabytes (MB) |
|             | - Storage Provisioned  
The utilization of the Disk Array's capacity, including overprovisioning.  
Measured in Megabytes (MB) |
|             | - Storage Access Operations Per Second (IOPS)  
The utilization of the storage access operations per second on the disk array  
Measured in Operations per second |
|             | - Latency  
The utilization of latency on the disk array.  
Measured in milliseconds (ms) |
| Storage Controller |           |
|             | - CPU  
The utilization of the Storage Controller's CPU in use  
Measured in Megahertz (MHz) |
|             | - 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) |
Guest OS Process Targets

This version of Workload Optimization Manager supports the following Guest OS Process targets:

- SNMP (Simple Network Management Protocol)
- WMI (Windows Management Instrumentation)
- Docker

**NOTE:** Starting with version 5.8, Workload Optimization Manager offers Target Configuration for WMI, SNMP, and Docker targets. This method deprecates discovery via application policies. To avoid duplication of any legacy targets, you must remove them from the Policy view before adding them via Target Configuration.

Do not discover the same targets though both Policy view and Target Configuration. Doing so will cause entity duplication and may adversely affect your environment.

Supply Chain

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

Actions

Workload Optimization Manager recommends actions for the Guest OS Process supply chain as follows.

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

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applications</td>
<td>Without discovered Guest OS Processes, Workload Optimization Manager doesn’t perform actions on applications. Instead, it performs resize actions on the host VMs. If host utilization is high enough on the physical machine running the application VM, Workload Optimization Manager may also recommend provisioning a new host. For specific applications, see the individual application entry.</td>
</tr>
<tr>
<td>Virtual Machines</td>
<td>- Provision additional resources (VMem, VCPU)</td>
</tr>
<tr>
<td></td>
<td>- Move Virtual Machine</td>
</tr>
<tr>
<td></td>
<td>- Move Virtual Machine Storage</td>
</tr>
<tr>
<td></td>
<td>- Reconfigure Storage</td>
</tr>
<tr>
<td></td>
<td>- Reconfigure Virtual Machine</td>
</tr>
</tbody>
</table>
Monitored Resources

Workload Optimization Manager monitors the following resources for the Guest OS Process supply chain:

**Entity Type** | **Commodity**
--- | ---
WMI/SNMP Application | ▪ Virtual Memory (VMem)
 | The utilization of the VMem allocated to the hosting VM
 | Measured in Kilobytes (KB)
▪ Virtual CPU (VCPU)
 | The utilization of the VCPU allocated to the hosting VM
 | Measured in Megahertz (MHz)
VirtualMachine | ▪ Virtual Memory (VMem)
 | The utilization of the VMem allocated to the hosting VM
 | Measured in Kilobytes (KB)
▪ Virtual CPU (VCPU)
 | The utilization of the VCPU allocated to the hosting VM
 | Measured in Megahertz (MHz)
▪ Virtual Storage (VStorage)
 | The utilization of the virtual storage capacity allocated for the VM
 | Measured in Kilobytes (KB)
▪ Storage Access Operations Per Second (IOPS)
 | The utilization of IOPS allocated for the VStorage on the VM
 | Measured in IOPS
▪ Latency
 | The utilization of latency allocated for the VStorage on the VM
 | Measured in milliseconds (ms)

Docker Containers

Workload Optimization Manager will discover Docker application containers running on VMs in your entire environment, or a portion of your environment, based on scope.

Prerequisites for Docker Containers

▪ Underlying VM host targets added to Workload Optimization Manager (for discovery)
▪ Docker remote API (Docker REST service) v1.20+ enabled/configured on target VMs

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

Adding Docker Targets

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

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

- **Port**
  
  The Port number Workload Optimization Manager will use to connect to the Virtual Machine hosting the application.

- **Secure Connection**
  
  Workload Optimization Manager will use SSL to connect to the target.

- **Scope**
  
  Workload Optimization Manager will search for Docker containers on the VMs found within the set scope. This scope can be set to the entire environment, single or multiple clusters, or particular physical machines. Select this option and choose the scope for discovery.

**Supported Actions**

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

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Docker Container</td>
<td>Resize Container</td>
</tr>
<tr>
<td></td>
<td>Recommend Only</td>
</tr>
</tbody>
</table>

**Virtual Machines**

- Provision additional resources (VMem, VCPU)
- Move Virtual Machine
- Move Virtual Machine Storage
- Reconfigure Storage
- Reconfigure Virtual Machine

**Monitored Resources**

Workload Optimization Manager monitors the following resources for the container supply chain:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Docker Container</td>
<td>Virtual Memory (VMem)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the VMem allocated to the hosting VM Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td></td>
<td>Virtual CPU (VCPU)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the VCPU allocated to the hosting VM Measured in Megahertz (MHz)</td>
</tr>
</tbody>
</table>
VirtualMachine

- Virtual Memory (VMem)
  The utilization of the VMem allocated to the hosting VM
  Measured in Kilobytes (KB)
- Virtual CPU (VCPU)
  The utilization of the VCPU allocated to the hosting VM
  Measured in Megahertz (MHz)
- Virtual Storage (VStorage)
  The utilization of the virtual storage capacity allocated for the VM
  Measured in Kilobytes (KB)
- Storage Access Operations Per Second (IOPS)
  The utilization of IOPS allocated for the VStorage on the VM
  Measured in IOPS
- Latency
  The utilization of latency allocated for the VStorage on the VM
  Measured in milliseconds (ms)

SNMP

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

Prerequisites

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

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


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

Adding SNMP Targets

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

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

- **Community**
  The SNMP v2c community string Workload Optimization Manager will use to connect to the application

- **Port number**
  The Port number Workload Optimization Manager will use to connect to the Virtual Machine hosting the application
Scope

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

Workload Optimization Manager recommends that a single scope contain no more than 500 virtual machines. Multiple targets should be used for environments exceeding this limit.

SNMP Probe Properties

Workload Optimization Manager offers the capability to adjust certain properties of the probe. In general, this tweaking will not be necessary. If adjustment is needed, the file can be found in the /srv/tomcat/webapps/vmturbo/probe-jars/{probe}/resources folder. This target has the following properties:

<table>
<thead>
<tr>
<th>Setting</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>connectorTimeoutMillis</td>
<td>Maximum time to wait for a response from a single request</td>
</tr>
<tr>
<td>snmpConnectorRetries</td>
<td>Number of attempts the SNMP connector will make to connect</td>
</tr>
</tbody>
</table>

Supported Actions

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

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applications</td>
<td>Without discovered Guest OS Processes, Workload Optimization Manager doesn’t perform actions on applications. Instead, it performs resize actions on the host VMs. If host utilization is high enough on the physical machine running the application VM, Workload Optimization Manager may also recommend provisioning a new host. For specific applications, see the individual application entry.</td>
</tr>
<tr>
<td>Virtual Machines</td>
<td>- Provision additional resources (VMem, VCPU)</td>
</tr>
<tr>
<td></td>
<td>- Move Virtual Machine</td>
</tr>
<tr>
<td></td>
<td>- Move Virtual Machine Storage</td>
</tr>
<tr>
<td></td>
<td>- Reconfigure Storage</td>
</tr>
<tr>
<td></td>
<td>- Reconfigure Virtual Machine</td>
</tr>
</tbody>
</table>
Monitored Resources

Workload Optimization Manager monitors the following resources for the application supply chain:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
</table>
| WMI/SNMP Application | ■ Virtual Memory (VMem)  
The utilization of the VMem allocated to the hosting VM  
Measured in Kilobytes (KB)  
■ Virtual CPU (VCPU)  
The utilization of the VCPU allocated to the hosting VM  
Measured in Megahertz (MHz)  |
| VirtualMachine       | ■ Virtual Memory (VMem)  
The utilization of the VMem allocated to the hosting VM  
Measured in Kilobytes (KB)  
■ Virtual CPU (VCPU)  
The utilization of the VCPU allocated to the hosting VM  
Measured in Megahertz (MHz)  
■ Virtual Storage (VStorage)  
The utilization of the virtual storage capacity allocated for the VM  
Measured in Kilobytes (KB)  
■ Storage Access Operations Per Second (IOPS)  
The utilization of IOPS allocated for the VStorage on the VM  
Measured in IOPS  
■ Latency  
The utilization of latency allocated for the VStorage on the VM  
Measured in milliseconds (ms) |

Enabling SNMP

Workload Optimization Manager requires that SNMP is enabled and configured in order to discover Guest Processes. While these steps will change slightly between OS versions, the general instructions are below:

1. Obtain and install the SNMP server package for your version of Linux. This is commonly called `net-snmp` in most package managers. Also install the `net-snmp-utils` package if it is available.

2. Configure the SNMP daemon by editing `/etc/snmp/snmpd.conf` or running `snmpconf -i` at the command line in order to verify that:
   - SNMPv2c is enabled
   - A read-only community name has been set. This community name will be used by Workload Optimization Manager to communicate with the VM

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

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

4. Start the SNMP daemon process
Sample snmp.conf Files

Provided below are two sample snmp.conf files that will aid in making the necessary changes.

Long form, VACM:

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

Short form, older syntax:

rocommunity MyCommunity default system

Verify SNMP Setup

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

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

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

WMI

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

Prerequisites

- Underlying VM host targets added to Workload Optimization Manager (for discovery)
- WMI Enabled on target VMs. For assistance in enabling WMI, see "Enabling WMI" in the User Guide.

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


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

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

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

- **Username**
  The username Workload Optimization Manager will use to connect to the Virtual Machine hosting the application

- **Password**
  The password Workload Optimization Manager will use to connect to the Virtual Machine hosting the application

- **Secure Connection**
  When selected, Workload Optimization Manager will connect using SSL

- **Domain Name:**
  The Active Directory domain used by Workload Optimization Manager in conjunction with the Username for authentication. Leave blank for local accounts.

- **Scope:**
  Workload Optimization Manager will search for WMI applications on the VMs found within the set scope. This scope can be set to the entire environment, single or multiple clusters, or particular physical machines. Select this option and choose the scope for application discovery.

  Workload Optimization Manager recommends that a single scope contain no more than 500 virtual machines. Multiple targets should be used for environments exceeding this limit.

WMI Probe Properties

Workload Optimization Manager offers the capability to adjust certain properties of the probe. In general, this tweaking will not be necessary. If adjustment is needed, the file can be found in the `/srv/tomcat/webapps/vmturbo/probe-jars/{probe}/resources` folder. This target has the following properties:

<table>
<thead>
<tr>
<th>Setting</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>connectorTimeoutMillis</td>
<td>Maximum time to wait for a response from a single request</td>
</tr>
<tr>
<td>slaCapacity</td>
<td>Capacity for the SLA commodity</td>
</tr>
<tr>
<td>transactionCapacity</td>
<td>Capacity for the Transaction commodity</td>
</tr>
</tbody>
</table>
Supported Actions
For each discovered entity within the application supply chain, Workload Optimization Manager can execute or recommend certain actions, as outlined below.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applications</td>
<td>Without discovered Guest OS Processes, Workload Optimization Manager doesn’t perform actions on applications. Instead, it performs resize actions on the host VMs. If host utilization is high enough on the physical machine running the application VM, Workload Optimization Manager may also recommend provisioning a new host. For specific applications, see the individual application entry.</td>
</tr>
<tr>
<td>Virtual Machines</td>
<td>- Provision additional resources (VMem, VCPU)</td>
</tr>
<tr>
<td></td>
<td>- Move Virtual Machine</td>
</tr>
<tr>
<td></td>
<td>- Move Virtual Machine Storage</td>
</tr>
<tr>
<td></td>
<td>- Reconfigure Storage</td>
</tr>
<tr>
<td></td>
<td>- Reconfigure Virtual Machine</td>
</tr>
</tbody>
</table>

Monitored Resources
Workload Optimization Manager monitors the following resources for the container supply chain:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
</table>
| WMI/SNMP Application | - Virtual Memory (VMem)  
The utilization of the VMem allocated to the hosting VM  
Measured in Kilobytes (KB)  
- Virtual CPU (VCPU)  
The utilization of the VCPU allocated to the hosting VM  
Measured in Megahertz (MHz) |
| Virtual Machine    | - Virtual Memory (VMem)  
The utilization of the VMem allocated to the hosting VM  
Measured in Kilobytes (KB)  
- Virtual CPU (VCPU)  
The utilization of the VCPU allocated to the hosting VM  
Measured in Megahertz (MHz)  
- Virtual Storage (VStorage)  
The utilization of the virtual storage capacity allocated for the VM  
Measured in Kilobytes (KB)  
- Storage Access Operations Per Second (IOPS)  
The utilization of IOPS allocated for the VStorage on the VM  
Measured in IOPS  
- Latency  
The utilization of latency allocated for the VStorage on the VM  
Measured in milliseconds (ms) |
Enabling WMI

To enable Workload Optimization Manager discovery of Windows-based Guest Processes, you must configure and enable WMI.

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

1. Open an elevated PowerShell prompt on the virtual machine(s) to be discovered as a WMI Target.
2. Enable the WS-Management protocol and set the default configuration for remote management.
   
   ```
   winrm quickconfig
   ```
3. Enable the WinRM Negotiate authentication scheme.
   
   This policy is enabled by default. To enable this policy if it is disabled, execute
   ```
   winrm set winrm/config/service/auth '@{Negotiate="true"}';
   ```
4. Set the WinRM AllowUnencrypted property to true.
   
   This property must be set on both the server and the client. Note that setting this value to true does not mean that WMI passes sensitive data in an unencrypted form. It will send only the content of the SOAP messages as plain text:
   ```
   winrm set winrm/config/service '@{AllowUnencrypted="true"}';
   winrm set winrm/config/client '@{AllowUnencrypted="true"}';
   ```
5. Restart the Remote Registry service.

After restarting the Remote Registry service, Workload Optimization Manager will discover the WMI targets.
Application Server Targets

This version of Workload Optimization Manager supports the following application servers as targets:

- IBM WebSphere
- Oracle WebLogic
- JBoss
- Apache Tomcat
- Generic JVM

With the exception of Apache Tomcat and Generic JVM, these target types support domains of application servers that are controlled by management servers. For such managed domains you can add the management server as a target, and Workload Optimization Manager will discover the managed application servers. You can also add an individual application server as a target, or you can add all matching targets within a given scope.

To add any of these servers as a target, you specify:

- The IP address of the VM hosting the management server
  You can optionally specify the IP address of an individual application server.
- The port that the target server listens on
- Administrator credentials for the target server instance

Supply Chain

Application Server targets add Application entities to the supply chain. The inventory groups applications by server type – You can navigate to each individual application server to see specific details.

Resource Monitoring

To manage application servers, Workload Optimization Manager monitors the resources that affect application performance, as listed in the following table. Note that because WebLogic performs its own tuning of thread pools, Workload Optimization Manager does not monitor threads for WebLogic application servers.

<table>
<thead>
<tr>
<th>Monitored Resource</th>
<th>WebSphere</th>
<th>WebLogic</th>
<th>JBoss</th>
<th>Tomcat</th>
<th>JVM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heap</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Garbage Collection Time</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Threads</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Transactions</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Response Time</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
In addition to monitoring these resources and recommending associated actions, Workload Optimization Manager:

- Monitors garbage collection in the application memory space, and uses that information when recommending actions for heap resizes.
- Discovers JDBC connection pools and through these pools can discover relationships between an application server and a given database server. As a result, Workload Optimization Manager sees the JDBC connection pool as a consumer of database connections, and can recommend resize actions for that connection pool.

### Application Server Scaling Policy

After you specify an application server target, Workload Optimization Manager discovers the resource utilization for that server, and recommends appropriate actions. These actions will follow one of the two following scaling policies:

- **Provision**
  Scaling by Provision enables horizontal scaling, where the environment adjusts to increased demand by provisioning new application servers.

- **Resize**
  Scaling by Resize enables vertical scaling, where the environment adjusts to increased demand by resizing the application server, or the VM that hosts the application server.

These scaling policies are mutually exclusive – the affected application servers can scale by Provisioning or by Resizing, but not both. For example, Workload Optimization Manager can recommend resize actions, but if you have set the Scaling Policy to Provision, Workload Optimization Manager will only recommend Provision and Suspend actions.

You set the Scaling Policy in the Policy view – Workload Optimization Manager policies support scope, so you can select specific groups of application servers to set their Scaling Policies as you like. For more information, see "Application Server Actions" in the User Guide.

### Actions

Workload Optimization Manager recommends actions for the application supply chain as follows.

**NOTE:** This is a general list of actions for entities discovered for applications. See specific actions for each target on that targets page.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Applications</td>
<td>Workload Optimization Manager does not recommend actions to perform on the virtual application itself, but it does recommend actions to perform on the VMs that host bound applications. For example, assume a virtual application that manages three SQL databases. If a surge in requests degrades performance across all three databases, then Workload Optimization Manager can start a new VM to</td>
</tr>
</tbody>
</table>
run another instance of the database application, and bind it to the virtual application. On the other hand, if SQL requests drop off so that the load balancer only forwards requests to two of the databases, Workload Optimization Manager can suspend the dormant database and unbind it from the virtual application.

Virtual Applications will only be discovered if there is a load balancer configured.

Applications

Without discovered Guest OS Processes, Workload Optimization Manager doesn’t perform actions on applications. Instead, it performs resize actions on the host VMs. If host utilization is high enough on the physical machine running the application VM, Workload Optimization Manager may also recommend provisioning a new host.

For specific applications, see the individual application entry.

Virtual Machines

- Provision additional resources (VMem, VCPU)
- Move Virtual Machine
- Move Virtual Machine Storage
- Reconfigure Storage
- Reconfigure Virtual Machine

Monitored Resources

Workload Optimization Manager monitors the following resources for the application server supply chain:

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

**Entity Type** | **Commodity**
--- | ---
Virtual Applications | Transactions
The utilization of the allocated transactions per second for the given virtual application
Measured in transactions per second

Application | Virtual Memory (VMem)
The utilization of the VMem allocated to the hosting VM
Measured in Kilobytes (KB)
| Virtual CPU (VCPU)
The utilization of the VCPU allocated to the hosting VM
Measured in Megahertz (MHz)
| Transactions
The utilization of the allocated transactions per second for the given virtual application
Measured in transactions per second
| Heap
The utilization of the application server’s heap
Measured in Kilobytes (KB)
Response Time
The utilization of the server’s allocated response time
Measured in Milliseconds (ms)

Threads
The utilization of the server’s thread capacity
Measured in Threads

DBMem
The utilization of the database’s memory capacity. Only applicable to database servers
Measured in Kilobytes (KB)

Connection
The utilization of the connection capacity. Only applicable to database servers
Measured in Connections

TransactionLog
The utilization of the server’s capacity for storage devoted to transaction logs
Measured in Kilobytes (KB)

Garbage Collection
The of server uptime spent garbage collecting
Measured in of uptime (%)

Virtual Memory (VMem)
The utilization of the VMem allocated to the hosting VM
Measured in Kilobytes (KB)

Virtual CPU (VCPU)
The utilization of the VCPU allocated to the hosting VM
Measured in Megahertz (MHz)

Virtual Storage (VStorage)
The utilization of the virtual storage capacity allocated for the VM
Measured in Kilobytes (KB)

Storage Access Operations Per Second (IOPS)
The utilization of IOPS allocated for the VStorage on the VM
Measured in IOPS

Latency
The utilization of latency allocated for the VStorage on the VM
Measured in milliseconds (ms)

JBoss
Workload Optimization Manager supports connecting to JBoss targets running in these operation modes:

Managed Domain
A collection of JBoss servers in a domain, with a single Domain Controller process acting as the central management control point. In this case, the VM that hosts the Domain Controller will be the target. You configure a Domain Controller via the domain-controller entry in the host.xml file on the JBoss machine.

Standalone
A single JBoss server – The VM that hosts the server is the target.
Prerequisites

- The target VM is properly configured as Domain Controller or standalone, depending on the operations mode
- Discovered infrastructure
  
  Workload Optimization Manager discovers JBoss servers that are running on VMs or containers. The hosting VM or container must already be in your Workload Optimization Manager inventory.
  
  To set the target for a server running on a VM, you must have first discovered the hosting VM through a hypervisor target. To set the target for a server running in a container, you must have configured container discovery for JBoss applications.
  
  - For information about container targets, see Application Container Targets on page 156
  
  - For information about hypervisor targets, see Hypervisor Targets on page 5

- To monitor Threads (utilization of thread pool capacity), threads must be configured for the JBoss server

  Workload Optimization Manager monitors the Threads resource in application servers to track utilization of thread pool capacity. To monitor threads in JBoss, each JBoss server must define a thread pool in its configuration files.
  
  To specify thread pools, see your JBoss documentation.

Adding a JBoss Target

You can add an individual JBoss server as a target, or you can add all matching targets within a given scope.

To add a server as a target, specify:

- **Address:** The name or IP address of the VM hosting the JBoss server
  
  If you are adding a Domain Controller, give the IP address of the VM that hosts the Domain Controller. For a standalone JBoss server, give the address of the VM that hosts the JBoss server.

- **Scope (optional):** A cluster or group of VMs that host JBoss servers or Domain Controllers
  
  If you set target scope, Workload Optimization Manager scans each VM within that group or cluster and tries to connect to a JBoss server over the specified port. Workload Optimization Manager adds any JBoss servers it finds as targets.

- **Port Number:** The port that connects to the JBoss server
  
  The default port for HTTP access is 9990.

- **Username/Password:** Valid administrator credentials for the JBoss server or Domain Controller

Application Names

Workload Optimization Manager displays discovered JBoss servers in the user interface. These names indicate whether they’re standalone or in a managed domain.

The name is divided into three sections:

- **IP Address**
- **Domain Controller name or “STANDALONE”**
- **The server name**
Actions

Workload Optimization Manager recommends actions for the application supply chain as follows.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Applications</td>
<td>Workload Optimization Manager does not recommend actions to perform on the virtual application itself, but it does recommend actions to perform on the VMs that host bound applications. For example, assume a virtual application that manages three SQL databases. If a surge in requests degrades performance across all three databases, then Workload Optimization Manager can start a new VM to run another instance of the database application, and bind it to the virtual application. On the other hand, if SQL requests drop off so that the load balancer only forwards requests to two of the databases, Workload Optimization Manager can suspend the dormant database and unbind it from the virtual application. Virtual Applications will only be discovered if there is a load balancer configured.</td>
</tr>
<tr>
<td>JBoss</td>
<td>Resize Heap</td>
</tr>
<tr>
<td></td>
<td>This action can only be executed by Workload Optimization Manager when running in a domain controller. Standalone applications will see only a recommendation.</td>
</tr>
<tr>
<td></td>
<td>Resize Thread Pool</td>
</tr>
<tr>
<td></td>
<td>Recommendation only.</td>
</tr>
<tr>
<td></td>
<td>Resize Connection Capacity</td>
</tr>
<tr>
<td></td>
<td>Recommendation only.</td>
</tr>
<tr>
<td></td>
<td>Suspend VM</td>
</tr>
<tr>
<td></td>
<td>This action can only be executed by a VM hosted in a vCenter environment. Applications running on other hypervisors will see only a recommendation.</td>
</tr>
<tr>
<td></td>
<td>Provision VM</td>
</tr>
<tr>
<td></td>
<td>This action can only be executed by a VM hosted in a vCenter environment. Applications running on other hypervisors will see only a recommendation.</td>
</tr>
<tr>
<td>Virtual Machines</td>
<td>Provision additional resources (VMem, VCPU)</td>
</tr>
<tr>
<td></td>
<td>Move Virtual Machine</td>
</tr>
<tr>
<td></td>
<td>Move Virtual Machine Storage</td>
</tr>
<tr>
<td></td>
<td>Reconfigure Storage</td>
</tr>
<tr>
<td></td>
<td>Reconfigure Virtual Machine</td>
</tr>
</tbody>
</table>

Monitored Resources

Workload Optimization Manager monitors the following resources for the application server supply chain:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Applications</td>
<td>Transactions</td>
</tr>
<tr>
<td></td>
<td>The utilization of the allocated transactions per second for the given virtual application</td>
</tr>
<tr>
<td></td>
<td>Measured in transactions per second</td>
</tr>
</tbody>
</table>
Application

- **Virtual Memory (VMem)**
  The utilization of the VMem allocated to the hosting VM
  Measured in Kilobytes (KB)

- **Virtual CPU (VCPU)**
  The utilization of the VCPU allocated to the hosting VM
  Measured in Megahertz (MHz)

- **Transactions**
  The utilization of the allocated transactions per second for the given virtual application
  Measured in transactions per second

- **Heap**
  The utilization of the application server’s heap
  Measured in Kilobytes (KB)

- **Response Time**
  The utilization of the server’s allocated response time
  Measured in Milliseconds (ms)

- **Threads**
  The utilization of the server’s thread capacity
  Measured in Threads

- **DBMem**
  The utilization of the database’s memory capacity. Only applicable to database servers
  Measured in Kilobytes (KB)

- **Connection**
  The utilization of the connection capacity. Only applicable to database servers
  Measured in Connections

- **TransactionLog**
  The utilization of the server’s capacity for storage devoted to transaction logs
  Measured in Kilobytes (KB)

- **Garbage Collection**
  The of server uptime spent garbage collecting
  Measured in of uptime (%)

VirtualMachine

- **Virtual Memory (VMem)**
  The utilization of the VMem allocated to the hosting VM
  Measured in Kilobytes (KB)

- **Virtual CPU (VCPU)**
  The utilization of the VCPU allocated to the hosting VM
  Measured in Megahertz (MHz)

- **Virtual Storage (VStorage)**
  The utilization of the virtual storage capacity allocated for the VM
  Measured in Kilobytes (KB)

- **Storage Access Operations Per Second (IOPS)**
  The utilization of IOPS allocated for the VStorage on the VM
  Measured in IOPS

- **Latency**
  The utilization of latency allocated for the VStorage on the VM
  Measured in milliseconds (ms)
Apache Tomcat

Workload Optimization Manager supports connecting to individual Tomcat targets. Workload Optimization Manager connects to the Tomcat process as a remote client via remote JMX access. Target configuration includes the port used by the JMX/RMI registry.

Prerequisites

- A valid service user account on the Tomcat server
  - If Tomcat security is enabled, this must be a Tomcat JMX user with a readonly role.
- Tomcat should run on JDK version 7 or 8
- For VMware environments, VMware Tools must be installed on the VM that hosts the Tomcat
  - This ensures that the VM hosting the Tomcat can get its IP address
- Remote JMX access is enabled through a port that is opened to the firewall
- Discovered infrastructure
  - Workload Optimization Manager discovers Tomcat servers that are running on VMs or containers. The hosting VM or container must already be in your Workload Optimization Manager inventory.
  - To set the target for a server running on a VM, you must have first discovered the hosting VM through a Hypervisor target. To set the target for a server running in a container, you must have configured container discovery for Tomcat applications.
    - For information about container targets, see Application Container Targets on page 156
    - For information about hypervisor targets, see Hypervisor Targets on page 5

Configuring JMX Remote Access

Workload Optimization Manager monitors and controls the Tomcat server via JMX Remote access. You must configure a JMX Remote port.

Note that to work with a firewall you should also set the RMI Server port – If you don’t set an RMI port, then JMX sets an arbitrary ephemeral port, and you can’t guarantee that the port will be open to your firewall.

There are two ways to set JMX Remote port on Linux platforms:

- Ports specified as system properties
  - You can set the port via the system property, com.sun.management.jmxremote.port. For example:

    ```
    com.sun.management.jmxremote.port=8050
    ```

  - A common way to set this property is to declare it in the CATALINA_OPTS system variable – You can set this in the setenv.sh script. For example:

    ```
    CATALINA_OPTS="$CATALINA_OPTS
    -Dcom.sun.management.jmxremote
    -Dcom.sun.management.jmxremote.port=8050"
    export CATALINA_OPTS
    ```
Note that this sets the JMX Remote port, but it does not set the RMI Server port — Tomcat startup will specify an ephemeral port for the RMI server.

- Ports specified in a JMX Remote Lifecycle Listener

  This listener component fixes the ports used by the JMX/RMI Server. When you configure the listener, you specify both the JMX Remote port and the RMI Server port. This is the preferred method when working with a firewall. For more information, see the Apache Tomcat documentation.

On Windows, the typical installation is with Tomcat as a service. There are two ways to set the JMX Remote port:

- Via setenv.bat

  Add the property to the CATALINA_OPTS environment variable:
  
  ```
  set "CATALINA_OPTS=%CATALINA_OPTS% -Dcom.sun.management.jmxremote.port=8050"
  ```

- Use the Tomcat configuration utility (tomcat7w or tomcat8w)

  Set the port with the following command:
  
  ```
  -Dcom.sun.management.jmxremote.port=8050"
  ```

To discover the JMX port that is set to an already running Tomcat, you can look in the following locations:

- For Linux platforms, look in the configuration files — Either:
  
  - setenv.sh — Assuming you configured the port by adding it to the CATALINA_OPTS environment variable
  - $CATALINA_HOME/conf/server.xml — Assuming you configured a JMX Remote Lifecycle Listener in this file

- For Windows platforms, look in:
  
  - setenv.bat — Assuming you configured the port by adding it to the CATALINA_OPTS environment variable
  - The Windows registry — Assuming you installed Tomcat as a Windows service using the Tomcat Configuration utility

Adding a Tomcat Target

You can add an individual Tomcat server as a target, or you can add all matching servers within a given scope.

To add a server as a target, specify:

- **Target Name:** Name displayed in the Workload Optimization Manager UI
- **Username:** Username of an account with the Admin role
- **Password:** Password of an account with the Admin role
- **Scope:** A cluster or group of VMs that host Tomcat servers

If you set target scope, Workload Optimization Manager scans each VM within that group or cluster and tries to connect to a Tomcat server over the specified port. Workload Optimization Manager adds any Tomcat servers it finds as targets.

- **Port Number:** The JMX Remote port
## Actions

Workload Optimization Manager recommends actions for the application supply chain as follows.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Applications</td>
<td>Workload Optimization Manager does not recommend actions to perform on the virtual application itself, but it does recommend actions to perform on the VMs that host bound applications. For example, assume a virtual application that manages three SQL databases. If a surge in requests degrades performance across all three databases, then Workload Optimization Manager can start a new VM to run another instance of the database application, and bind it to the virtual application. On the other hand, if SQL requests drop off so that the load balancer only forwards requests to two of the databases, Workload Optimization Manager can suspend the dormant database and unbind it from the virtual application. Virtual Applications will only be discovered if there is a load balancer configured.</td>
</tr>
<tr>
<td>Tomcat</td>
<td>Resize Heap Recommendation only.</td>
</tr>
<tr>
<td></td>
<td>Resize Thread Pool Recommendation only.</td>
</tr>
<tr>
<td></td>
<td>Resize Connection Capacity Recommendation only.</td>
</tr>
<tr>
<td></td>
<td>Suspend VM This action can only be executed by a VM hosted in a vCenter environment. Applications running on other hypervisors will see only a recommendation.</td>
</tr>
<tr>
<td></td>
<td>Provision VM This action can only be executed by a VM hosted in a vCenter environment. Applications running on other hypervisors will see only a recommendation.</td>
</tr>
<tr>
<td>Virtual Machines</td>
<td>Provision additional resources (VMem, VCPU)</td>
</tr>
<tr>
<td></td>
<td>Move Virtual Machine</td>
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<td>Move Virtual Machine Storage</td>
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<tr>
<td></td>
<td>Reconfigure Storage</td>
</tr>
<tr>
<td></td>
<td>Reconfigure Virtual Machine</td>
</tr>
</tbody>
</table>

## Monitored Resources

Workload Optimization Manager monitors the following resources for the application server supply chain:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Applications</td>
<td>Transactions The utilization of the allocated transactions per second for the given virtual application Measured in transactions per second</td>
</tr>
</tbody>
</table>
Application

- **Virtual Memory (VMem)**
  The utilization of the VMem allocated to the hosting VM
  Measured in Kilobytes (KB)

- **Virtual CPU (VCPU)**
  The utilization of the VCPU allocated to the hosting VM
  Measured in Megahertz (MHz)

- **Transactions**
  The utilization of the allocated transactions per second for the given virtual application
  Measured in transactions per second

- **Heap**
  The utilization of the application server’s heap
  Measured in Kilobytes (KB)

- **Response Time**
  The utilization of the server’s allocated response time
  Measured in Milliseconds (ms)

- **Threads**
  The utilization of the server’s thread capacity
  Measured in Threads

- **DBMem**
  The utilization of the database’s memory capacity. Only applicable to database servers
  Measured in Kilobytes (KB)

- **Connection**
  The utilization of the connection capacity. Only applicable to database servers
  Measured in Connections

- **TransactionLog**
  The utilization of the server’s capacity for storage devoted to transaction logs
  Measured in Kilobytes (KB)

- **Garbage Collection**
  The use of server uptime spent garbage collecting
  Measured in percent of uptime (%)

VirtualMachine

- **Virtual Memory (VMem)**
  The utilization of the VMem allocated to the hosting VM
  Measured in Kilobytes (KB)

- **Virtual CPU (VCPU)**
  The utilization of the VCPU allocated to the hosting VM
  Measured in Megahertz (MHz)

- **Virtual Storage (VStorage)**
  The utilization of the virtual storage capacity allocated for the VM
  Measured in Kilobytes (KB)

- **Storage Access Operations Per Second (IOPS)**
  The utilization of IOPS allocated for the VStorage on the VM
  Measured in IOPS

- **Latency**
  The utilization of latency allocated for the VStorage on the VM
  Measured in milliseconds (ms)
JVM Application

Workload Optimization Manager supports connecting to individual JVM Applications as targets. Workload Optimization Manager connects to the JVM process as a remote client via remote JMX access. Target configuration includes the port used by the JMX/RMI registry.

Prerequisites

- A valid user account on the JVM application
  - If JMX security is enabled this must be a JMX user with a `readonly` role
- The application should run on JDK version 7 or 8
- For VMware environments, VMware Tools must be installed on the VM that hosts the application
  - This ensures that the VM hosting the application can get the application’s IP address
- Remote JMX access is enabled through a port that is opened to the firewall
- Discovered infrastructure

Workload Optimization Manager discovers JVM applications that are running on VMs or containers. The hosting VM or container must already be in your Workload Optimization Manager inventory.

To set the target for a server running on a VM, you must have first discovered the hosting VM through a Hypervisor target. To set the target for a server running in a container, you must have configured container discovery for JVM applications.

- For information about container targets, see Application Container Targets on page 156
- For information about hypervisor targets, see Hypervisor Targets on page 5

Configuring JMX Remote Access

Workload Optimization Manager monitors and controls the JVM application via JMX Remote access. You must configure a JMX Remote port.

Note that to work with a firewall you should also set the RMI Server port – If you don’t set an RMI port, then JMX sets an arbitrary `ephemeral port`, and you can’t guarantee that the port will be open to your firewall.

To set the JMX Remote port, pass in the port at the command line when you start your application. For example, to set the port to 8090, start your application with the following options:

```
-Dcom.sun.management.jmxremote -Dcom.sun.management.jmxremote.port=8090
```

Adding a JVM Target

You can add an individual JVM application as a target, or you can add all matching applications within a given scope.

To add an application as a target, specify:

- **Address**: The name or IP address of the VM hosting the JVM application
Scope (optional): a Workload Optimization Manager group of VMs that host JVM applications

If you set target scope, Workload Optimization Manager scans each VM within that group or cluster and tries to connect to a JVM application over the specified port. Workload Optimization Manager adds any applications it finds as targets.

Port Number: The JMX Remote port

Username/Password: Credentials for a user account with an Admin role

The credentials you provide must match the credentials you specify for JMX login configuration when you start up the application.

If you disable authentication on the application, then you must still provide arbitrary values for Username and Password. To disable JMX authentication, use the following flags in the command line as you start the application:

-Dcom.sun.management.jmxremote.authenticate=false
-Dcom.sun.management.jmxremote.ssl=false

Multiple JVM Targets On Single VM

Note that you can specify targets with different ports, but that run on the same VM (use the same IP address). You can also specify targets via the same scope, but with different ports – This is another way to assign applications running on the same VM to different ports. To do this:

To do this, add the targets in two separate steps. For example, assume you want to add two JVM application targets, and they both run on the VM at 10.10.123.45. One application is on port 123, and the other application is on port 456. To specify these two targets:

Specify the first target with the following parameters:
- Scope/Address: 10.10.123.45
- Port number: 123
- Username: AppUser
- Password: *********

Then click ADD to create an entry in the Pending Targets list.

Specify the second target with the following parameters:
- Scope/Address: 10.10.123.45
- Port number: 456
- Username: AppUser
- Password: *********

Then click ADD to create an entry in the Pending Targets list.

Click Apply to add these pending targets to Workload Optimization Manager and begin validation and discovery.
Actions

Workload Optimization Manager recommends actions for the application supply chain as follows.

**Entity Type** | **Action**
--- | ---
Virtual Applications | Workload Optimization Manager does not recommend actions to perform on the virtual application itself, but it does recommend actions to perform on the VMs that host bound applications. For example, assume a virtual application that manages three SQL databases. If a surge in requests degrades performance across all three databases, then Workload Optimization Manager can start a new VM to run another instance of the database application, and bind it to the virtual application. On the other hand, if SQL requests drop off so that the load balancer only forwards requests to two of the databases, Workload Optimization Manager can suspend the dormant database and unbind it from the virtual application.

Virtual Applications will only be discovered if there is a load balancer configured.

JVM

- Resize Heap  
  Recommendation only.
- Resize Thread Pool  
  Recommendation only.
- Resize Connection Capacity  
  Recommendation only.
- Suspend VM  
  This action can only be executed by a VM hosted in a vCenter environment. Applications running on other hypervisors will see only a recommendation.

Virtual Machines

- Provision additional resources (VMem, VCPU)
- Move Virtual Machine
- Move Virtual Machine Storage
- Reconfigure Storage
- Reconfigure Virtual Machine

Monitored Resources

Workload Optimization Manager monitors the following resources for the application server supply chain:

**Entity Type** | **Commodity**
--- | ---
Virtual Applications | Transactions  
  The utilization of the allocated transactions per second for the given virtual application  
  Measured in transactions per second
JVM Application

- **Heap**
  The utilization of the application server’s heap
  Measured in Kilobytes (KB)

- **Garbage Collection**
  The of server uptime spent garbage collecting
  Measured in of uptime (%)

VirtualMachine

- **Virtual Memory (VMem)**
  The utilization of the VMem allocated to the hosting VM
  Measured in Kilobytes (KB)

- **Virtual CPU (VCPU)**
  The utilization of the VCPU allocated to the hosting VM
  Measured in Megahertz (MHz)

- **Virtual Storage (VStorage)**
  The utilization of the virtual storage capacity allocated for the VM
  Measured in Kilobytes (KB)

- **Storage Access Operations Per Second (IOPS)**
  The utilization of IOPS allocated for the VStorage on the VM
  Measured in IOPS

- **Latency**
  The utilization of latency allocated for the VStorage on the VM
  Measured in milliseconds (ms)

Oracle WebLogic

The typical WebLogic deployment is a managed domain with one Administration Server that provides a single point of entry for administration and management of the domain. The domain can include other WebLogic Servers which are the Managed Servers. You set the WebLogic Administration Server as a Workload Optimization Manager target.

For a standalone WebLogic deployment, the single server acts as its own Administration Server — You can set the standalone server as a Workload Optimization Manager target.

WebLogic deployments can include clusters to distribute workload across multiple WebLogic servers. Workload Optimization Manager recommended actions respect the cluster architecture. For example, if you have enabled horizontal scaling for your WebLogic servers, then Workload Optimization Manager can recommend provisioning new servers for a given cluster.

Prerequisites

- A service user account with an Admin role.

  To execute actions the service account must have an Admin role. For read-only monitoring and analysis, you can set the target with a more restricted role, but then you will have to execute all recommended actions manually, through the WebLogic interface.

- Weblogic requires both the local and remote ends of the connection be resolvable by DNS. The Workload Optimization Manager IP address must be resolvable by your local DNS server.

- Discovered infrastructure

  Workload Optimization Manager discovers WebLogic servers that are running on VMs or containers. The hosting VM or container must already be in your Workload Optimization Manager inventory.
To set the target for a server running on a VM, you must have first discovered the hosting VM through a Hypervisor target. To set the target for a server running in a container, you must have configured container discovery for WebLogic applications.

- For information about container targets, see Application Container Targets on page 156
- For information about hypervisor targets, see Hypervisor Targets on page 5

Finding the T3 Listen Port

To configure a WebLogic target, you need to know the port that the server listens on for administrative communications. Launch the WebLogic Administration Console:

- Navigate to Domain Structure and display the domain you’re interested in
- Navigate to Environment > Servers and select the Domain Administration Server you’re setting as a target

The console displays configuration information for the server, including the T3 listen port.

Adding a WebLogic Target

You can add an individual WebLogic server as a target, or you can add all matching targets within a given scope.

To add a server as a target, specify:

- **Address:** The name or IP address of the VM hosting the WebLogic server
- **Scope (optional):** A cluster or group of VMs that host WebLogic servers
  
  If you set target scope, Workload Optimization Manager scans each VM within that group or cluster and tries to connect to a WebLogic server over the specified port. Workload Optimization Manager adds any WebLogic servers it finds as targets.

- **Port Number:** The T3 listen port that’s configured on the WebLogic server
  
  The default port for HTTP access is 9990.

- **Username/Password:** Credentials for a wluser account with an Admin role

Actions

Workload Optimization Manager recommends actions for the application supply chain as follows.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Applications</td>
<td>Workload Optimization Manager does not recommend actions to perform on the virtual application itself, but it does recommend actions to perform on the VMs that host bound applications. For example, assume a virtual application that manages three SQL databases. If a surge in requests degrades performance across all three databases, then Workload Optimization Manager can start a new VM to run another instance of the database application, and bind it to the virtual application. On the other hand, if SQL requests drop off so that the load balancer only forwards requests to two of the databases, Workload Optimization Manager can suspend the dormant database and unbind it from the virtual application. Virtual Applications will only be discovered if there is a load balancer configured.</td>
</tr>
</tbody>
</table>
WebLogic

- Resize Heap
  This action can only be executed by Workload Optimization Manager when running in a domain controller. Standalone applications will see only a recommendation.
- Resize Thread Pool
  Recommendation only.
- Resize Connection Capacity
  Recommendation only.
- Suspend VM
  This action can only be executed by a VM hosted in a vCenter environment. Applications running on other hypervisors will see only a recommendation.
- Provision VM
  This action can only be executed by a VM hosted in a vCenter environment. Applications running on other hypervisors will see only a recommendation.

Virtual Machines

- Provision additional resources (VMem, VCPU)
- Move Virtual Machine
- Move Virtual Machine Storage
- Reconfigure Storage
- Reconfigure Virtual Machine

Monitored Resources

Workload Optimization Manager monitors the following resources for the application server supply chain:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
</table>
| Virtual Applications | Transactions
  The utilization of the allocated transactions per second for the given virtual application
  Measured in transactions per second |
|                      | Virtual Memory (VMem)
  The utilization of the VMem allocated to the hosting VM
  Measured in Kilobytes (KB) |
|                      | Virtual CPU (VCPU)
  The utilization of the VCPU allocated to the hosting VM
  Measured in Megahertz (MHz) |
|                      | Transactions
  The utilization of the allocated transactions per second for the given virtual application
  Measured in transactions per second |
|                      | Heap
  The utilization of the application server’s heap
  Measured in Kilobytes (KB) |
|                      | Response Time
  The utilization of the server’s allocated response time
  Measured in Milliseconds (ms) |
- **Threads**
  The utilization of the server’s thread capacity
  Measured in Threads

- **DBMem**
  The utilization of the database’s memory capacity. Only applicable to database servers
  Measured in Kilobytes (KB)

- **Connection**
  The utilization of the connection capacity. Only applicable to database servers
  Measured in Connections

- **TransactionLog**
  The utilization of the server’s capacity for storage devoted to transaction logs
  Measured in Kilobytes (KB)

- **Garbage Collection**
  The of server uptime spent garbage collecting
  Measured in of uptime (%)

- **VirtualMemory (VMem)**
  The utilization of the VMem allocated to the hosting VM
  Measured in Kilobytes (KB)

- **Virtual CPU (VCPU)**
  The utilization of the VCPU allocated to the hosting VM
  Measured in Megahertz (MHz)

- **Virtual Storage (VStorage)**
  The utilization of the virtual storage capacity allocated for the VM
  Measured in Kilobytes (KB)

- **Storage Access Operations Per Second (IOPS)**
  The utilization of IOPS allocated for the VStorage on the VM
  Measured in IOPS

- **Latency**
  The utilization of latency allocated for the VStorage on the VM
  Measured in milliseconds (ms)

### IBM WebSphere

The typical WebSphere deployment is a cell of WebSphere servers, controlled by a Deployment Manager. A cell makes up a managed domain that incorporates multiple VMS that host managed application servers. The Deployment Manager is a WebSphere instance that provides a single point of entry for the managed domain.

To configure the WebSphere installation, you can use the WebSphere Integrated Solutions Console. This is a client that exposes configuration settings including the SOAP port and the PMI settings.

To manage the servers in an installation, WebSphere uses the Performance Monitoring Infrastructure (PMI). Each WebSphere server runs a PMI service that collects performance data from the various application server components. Workload Optimization Manager uses PMI for monitoring and control of the WebSphere installation.
Prerequisites

- The PMI service set to monitor at the Basic level or greater
- A service user account with an Administrator role

To execute actions the service account must have an Administrator role. For read-only monitoring and analysis, you can set the target with a more restricted role (Monitor), but then you will have to execute all recommended actions manually, through the WebSphere interface.

- Discovered infrastructure

Workload Optimization Manager discovers WebSphere servers that are running on VMs or containers. The hosting VM or container must already be in your Workload Optimization Manager inventory.

To set the target for a server running on a VM, you must have first discovered the hosting VM through a Hypervisor target. To set the target for a server running in a container, you must have configured container discovery for WebSphere applications.

- For information about hypervisor targets, see Application Container Targets on page 156
- For information about container targets, see Hypervisor Targets on page 5

Finding the SOAP Connector Address

To configure a WebSphere target, you need to know the port that the server listens on for administrative communications. Launch the WebSphere Administration Console:

- Navigate to System Administration > Deployment Manager
- Under Additional Properties, click Ports

The entry for SOAP_CONNECTOR_ADDRESS gives the currently set port number.

Adding a WebSphere Target

You can add an individual WebLogic server as a target, or you can add all matching targets within a given scope.

To add a server as a target, specify:

- **Target Name:** Name displayed in the Workload Optimization Manager UI
- **Username:** Username of a wsuser account with the Admin role
- **Password:** Password of a wsuser account with the Admin role
- **Scope:** A cluster or group of VMs that host WebSphere servers

Workload Optimization Manager will scan each VM within that group or cluster and try to connect to a WebSphere server over the specified port. Workload Optimization Manager adds any WebSphere servers it finds as targets.

- **Port Number:** Port used by the SOAP_CONNECTOR_ADDRESS
## Actions

Workload Optimization Manager recommends actions for the application supply chain as follows.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
</tr>
</thead>
</table>
| Virtual Applications | Workload Optimization Manager does not recommend actions to perform on the virtual application itself, but it does recommend actions to perform on the VMs that host bound applications. For example, assume a virtual application that manages three SQL databases. If a surge in requests degrades performance across all three databases, then Workload Optimization Manager can start a new VM to run another instance of the database application, and bind it to the virtual application. On the other hand, if SQL requests drop off so that the load balancer only forwards requests to two of the databases, Workload Optimization Manager can suspend the dormant database and unbind it from the virtual application. 
|                   | Virtual Applications will only be discovered if there is a load balancer configured. |
| WebSphere         | - Resize Heap
|                   |  This action can only be executed by Workload Optimization Manager when running in a domain controller. Standalone applications will see only a recommendation. |
|                   | - Resize Thread Pool
|                   |  Recommendation only. |
|                   | - Resize Connection Capacity
|                   |  Recommendation only. |
|                   | - Suspend VM
|                   |  This action can only be executed by a VM hosted in a vCenter environment. Applications running on other hypervisors will see only a recommendation. |
|                   | - Provision VM
|                   |  This action can only be executed by a VM hosted in a vCenter environment. Applications running on other hypervisors will see only a recommendation. |

<table>
<thead>
<tr>
<th>Virtual Machines</th>
<th>Provision additional resources (VMem, VCPU)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Move Virtual Machine</td>
</tr>
<tr>
<td></td>
<td>Move Virtual Machine Storage</td>
</tr>
<tr>
<td></td>
<td>Reconfigure Storage</td>
</tr>
<tr>
<td></td>
<td>Reconfigure Virtual Machine</td>
</tr>
</tbody>
</table>

## Monitored Resources

Workload Optimization Manager monitors the following resources for the application server supply chain:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
</table>
| Virtual Applications | Transactions
|                  |  The utilization of the allocated transactions per second for the given virtual application |
|                  |  Measured in transactions per second                                      |
Application

- **Virtual Memory (VMem)**
  The utilization of the VMem allocated to the hosting VM
  Measured in Kilobytes (KB)
- **Virtual CPU (VCPU)**
  The utilization of the VCPU allocated to the hosting VM
  Measured in Megahertz (MHz)
- **Transactions**
  The utilization of the allocated transactions per second for the given virtual application
  Measured in transactions per second
- **Heap**
  The utilization of the application server’s heap
  Measured in Kilobytes (KB)
- **Response Time**
  The utilization of the server’s allocated response time
  Measured in Milliseconds (ms)
- **Threads**
  The utilization of the server’s thread capacity
  Measured in Threads
- **DBMem**
  The utilization of the database’s memory capacity. Only applicable to database servers
  Measured in Kilobytes (KB)
- **Connection**
  The utilization of the connection capacity. Only applicable to database servers
  Measured in Connections
- **TransactionLog**
  The utilization of the server’s capacity for storage devoted to transaction logs
  Measured in Kilobytes (KB)
- **Garbage Collection**
  The of server uptime spent garbage collecting
  Measured in of uptime (%)

VirtualMachine

- **Virtual Memory (VMem)**
  The utilization of the VMem allocated to the hosting VM
  Measured in Kilobytes (KB)
- **Virtual CPU (VCPU)**
  The utilization of the VCPU allocated to the hosting VM
  Measured in Megahertz (MHz)
- **Virtual Storage (VStorage)**
  The utilization of the virtual storage capacity allocated for the VM
  Measured in Kilobytes (KB)
- **Storage Access Operations Per Second (IOPS)**
  The utilization of IOPS allocated for the VStorage on the VM
  Measured in IOPS
- **Latency**
  The utilization of latency allocated for the VStorage on the VM
  Measured in milliseconds (ms)
Database Server Targets

This version of Workload Optimization Manager supports the following database servers as targets:

- Oracle 11g R2 and 12c
- Microsoft SQL Server 2008 R2, 2012, and 2014
- MySQL 5.5.26 and higher, and all 5.6 releases

You can add an individual database server as a target, or you can add all matching targets within a given group or cluster.

If you set target scope, Workload Optimization Manager scans each VM within that group or cluster and tries to connect to a database server over the specified port. Workload Optimization Manager adds any database servers it finds as targets.

Supply Chain

Database targets add Application entities to the supply chain. The inventory groups applications by database type – You can navigate to each individual database to see specific details.

Actions

Workload Optimization Manager recommends actions for the database supply chain as follows.

**NOTE:** This is a general list of actions for entities discovered for databases. You can see how actions differ per technology in each section that describes adding a specific type of database target.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Applications</td>
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</tr>
</tbody>
</table>
Database Applications
- Resize Database Memory
  Recommendation only.
- Resize Transactions
  Recommendation only.
- Resize Connections
  Recommendation only.

Virtual Machines
- Provision additional resources (VMem, VCPU)
- Move Virtual Machine
- Move Virtual Machine Storage
- Reconfigure Storage
- Reconfigure Virtual Machine

Monitored Resources

Workload Optimization Manager monitors the following resources for the database supply chain:

NOTE: This is a general list of commodities for entities discovered for databases. You can see how actions differ per technology in each section that describes adding a specific type of database target.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
</table>
| Virtual Applications | - Transactions
  The utilization of the allocated transactions per second for the given virtual application
  Measured in transactions per second |
| Database Applications| - DBMem
  The memory utilized by the database, as a fraction of the memory capacity that is allocated to the database. Note that this resource is more accurate than the VMem resource on the hosting VM. With this resource, Workload Optimization Manager can drive resize and move actions based on the memory consumed by the database, not the memory consumed by the VM
- Virtual Memory (VMem)
  The utilization of the VMem allocated to the hosting VM
  Measured in Kilobytes (KB)
- Virtual CPU (VCPU)
  The utilization of the VCPU allocated to the hosting VM
  Measured in Megahertz (MHz)
- Transactions
  The utilization of the allocated transactions per second for the given virtual application
  Measured in transactions per second
- Heap
  The utilization of the application server’s heap
  Measured in Kilobytes (KB)
- Response Time
  The utilization of the server’s allocated response time
  Measured in Milliseconds (ms)
Threads
The utilization of the server’s thread capacity
Measured in Threads

DBMem
The utilization of the database’s memory capacity. Only applicable to database servers
Measured in Kilobytes (KB)

Connection
The utilization of the connection capacity. Only applicable to database servers
Measured in Connections

TransactionLog
The utilization of the server’s capacity for storage devoted to transaction logs
Measured in Kilobytes (KB)

Garbage Collection
The of server uptime spent garbage collecting
Measured in of uptime (%)

VirtualMachine
Virtual Memory (VMem)
The utilization of the VMem allocated to the hosting VM
Measured in Kilobytes (KB)

Virtual CPU (VCPU)
The utilization of the VCPU allocated to the hosting VM
Measured in Megahertz (MHz)

Virtual Storage (VStorage)
The utilization of the virtual storage capacity allocated for the VM
Measured in Kilobytes (KB)

Storage Access Operations Per Second (IOPS)
The utilization of IOPS allocated for the VStorage on the VM
Measured in IOPS

Latency
The utilization of latency allocated for the VStorage on the VM
Measured in milliseconds (ms)

MySQL
To manage a MySQL databases, Workload Optimization Manager can connect:
- To an individual database server
- To all the database servers within a group or cluster

This version of Workload Optimization Manager supports MySQL 5.5.26 and higher, and all 5.6 releases.

Prerequisites
- Target is properly configured as Domain Controller or standalone, depending on the operations mode
- User Permissions are enabled on the MySQL Server. See Enabling User Permissions on MySQL Server on page 133
Adding a MySQL Database Target

You can add an individual database server as a target, or you can add all matching targets within a given scope.

To add a database server as a target, you specify:

- **Address:** The name or IP address of the VM hosting the database server

- **Scope (optional):** A cluster or group of VMs that host MySQL servers
  
  If you set target scope, Workload Optimization Manager scans each VM within that group or cluster and tries to connect to a MySQL database server over the specified port. Workload Optimization Manager adds any database servers it finds as targets.

- **Port Number:** The port that connects to the MySQL browser
  
  You must open the firewall on the MySQL server to allow access through this port.

- **Username/Password:** Valid client credentials for the database service
  
  For Workload Optimization Manager to execute actions, the account must have administrator privileges. Also, you must have enabled user permissions to this user account, including remote access from the Workload Optimization Manager server.

Actions

Workload Optimization Manager recommends actions for the application supply chain as follows.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
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</thead>
<tbody>
<tr>
<td>Virtual Applications</td>
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</tr>
<tr>
<td>Database Applications</td>
<td>Resize Database Memory Recommendation only.</td>
</tr>
<tr>
<td></td>
<td>Resize Transactions Recommendation only.</td>
</tr>
<tr>
<td></td>
<td>Resize Connections Recommendation only.</td>
</tr>
<tr>
<td>Virtual Machines</td>
<td>Provision additional resources (VMem, VCPU)</td>
</tr>
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</tbody>
</table>
Monitored Resources

Workload Optimization Manager monitors the following resources for the application server supply chain:

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<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Applications</td>
<td>■ Transactions&lt;br&gt;The utilization of the allocated transactions per second for the given virtual application&lt;br&gt;Measured in transactions per second</td>
</tr>
<tr>
<td></td>
<td>■ DBMem&lt;br&gt;The memory utilized by the database, as a fraction of the memory capacity that is allocated to the database. Note that this resource is more accurate than the VMem resource on the hosting VM. With this resource, Workload Optimization Manager can drive resize and move actions based on the memory consumed by the database, not the memory consumed by the VM</td>
</tr>
<tr>
<td></td>
<td>■ Virtual Memory (VMem)&lt;br&gt;The utilization of the VMem allocated to the hosting VM&lt;br&gt;Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td></td>
<td>■ Virtual CPU (VCPU)&lt;br&gt;The utilization of the VCPU allocated to the hosting VM&lt;br&gt;Measured in Megahertz (MHz)</td>
</tr>
<tr>
<td></td>
<td>■ Transactions&lt;br&gt;The utilization of the allocated transactions per second for the given virtual application&lt;br&gt;Measured in transactions per second</td>
</tr>
<tr>
<td></td>
<td>■ Heap&lt;br&gt;The utilization of the application server’s heap&lt;br&gt;Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td></td>
<td>■ Response Time&lt;br&gt;The utilization of the server’s allocated response time&lt;br&gt;Measured in Milliseconds (ms)</td>
</tr>
<tr>
<td></td>
<td>■ Threads&lt;br&gt;The utilization of the server’s thread capacity&lt;br&gt;Measured in Threads</td>
</tr>
<tr>
<td></td>
<td>■ DBMem&lt;br&gt;The utilization of the database’s memory capacity. Only applicable to database servers&lt;br&gt;Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td></td>
<td>■ Connection&lt;br&gt;The utilization of the connection capacity. Only applicable to database servers&lt;br&gt;Measured in Connections</td>
</tr>
<tr>
<td></td>
<td>■ TransactionLog&lt;br&gt;The utilization of the server’s capacity for storage devoted to transaction logs&lt;br&gt;Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td></td>
<td>■ Garbage Collection&lt;br&gt;The percentage of server uptime spent garbage collecting&lt;br&gt;Measured in percentage (%)</td>
</tr>
</tbody>
</table>
VirtualMachine

- **Virtual Memory (VMem)**
  The utilization of the VMem allocated to the hosting VM
  Measured in Kilobytes (KB)

- **Virtual CPU (VCPU)**
  The utilization of the VCPU allocated to the hosting VM
  Measured in Megahertz (MHz)

- **Virtual Storage (VStorage)**
  The utilization of the virtual storage capacity allocated for the VM
  Measured in Kilobytes (KB)

- **Storage Access Operations Per Second (IOPS)**
  The utilization of IOPS allocated for the VStorage on the VM
  Measured in IOPS

- **Latency**
  The utilization of latency allocated for the VStorage on the VM
  Measured in milliseconds (ms)

---

Enabling User Permissions on MySQL Server

Follow the following steps in order to enable appropriate user permissions on a MySQL Server.

1. **Edit the MySQL server’s configuration file.**

   You must edit the `.cnf` file on the MySQL server to grant user permissions. Open a secure shell session on the server and edit the file. Depending on the platform your MySQL is running on, you’ll find the file at different locations:

   - **Debian Linux:**
     `/etc/mysql/my.cnf`
   - **Red Hat Linux (Fedora or Centos):**
     `/etc/my.cnf`
   - **FreeBSD Linux:**
     You must create the file at `/var/db/mysql/my.cnf`

   Open the file in an editor and find the section, `[mysqld]`. Then make the following changes:

   - Comment out the line:
     ```
     skip-networking
     ```
     Commenting out this line enables remote connections over TCP/Is.

   - Add the line
     ```
     bind-address=<MySQL_IP_Address>
     ```
     For example, if your MySQL server has the address, 123.45.66.77, then the section of the `.cnf` file should appear as follows:

     ```
     [mysqld]
     user = mysql
     pid-file = /var/run/mysqld/mysqld.pid
     ```
socket          = /var/run/mysqld/mysqld.sock
port            = 3306
basedir         = /usr
datadir         = /var/lib/mysql
tmpdir          = /tmp
language        = /usr/share/mysql/English
bind-address    = 123.45.66.77 # skip-networking
....

When you are done, save the .conf file.

2. Give your Workload Optimization Manager server remote access to the database.

   Execute the following command to log into to the MySQL server:

   ```
   $mysql -u root -p mysql
   ```

   Then execute the following command:

   Assume a user named USER_NAME with a password PWD_STRING. Then assume that your Workload Optimization Manager has an IP address of 10.10.123.45. The following command grants privileges to that Workload Optimization Manager, if it connects with the specified user account:

   ```
   GRANT SELECT ON performance_schema.* TO 'USER_NAME'@'10.10.123.45'
   IDENTIFIED BY 'PWD_STRING';
   GRANT PROCESS ON *.* TO 'USER_NAME'@'10.10.123.45' IDENTIFIED BY 'PWD_STRING';
   FLUSH PRIVILEGES;
   ```

   When you’re finished, log out of MySQL.

Oracle

To connect to an Oracle database, you will:

- Add a Dynamic Performance view to the Oracle database
- Configure a service account on the database that Workload Optimization Manager can use to log on
- Find the Service Name (SID) and port for the database

This version of Workload Optimization Manager supports Oracle versions 11g R2 and 12c

Prerequisites

- User permissions that grant access to Workload Optimization Manager through a specific user account. See Creating a Service User Account in Oracle on page 138.
- Dynamic Performance View (V$) must be enabled. See "Adding a Dynamic Performance View", below.
- Access through the firewall to the MySQL database port that you specify for the Workload Optimization Manager target connection
Adding a Dynamic Performance View

In order to collect data from the Oracle database, Workload Optimization Manager uses the Dynamic Performance View (referred to as $\text{V}$). $\text{V}$ is not enabled by default, and users must run a script to build the tables and views that are necessary to enable $\text{V}$. In some environments only the DBA has privileges to run this script.

To enable $\text{V}$:

- Open a secure shell session (ssh) on the database host as a system user or a user with the `sysdba` role.
- In the shell session enter the following commands:

```
sqlplus /nolog
connect /as sysdba
@?/rdbms/admin/catalog.sql
```

Adding an Oracle Database to Workload Optimization Manager

You can add an individual database server as a target, or you can add all matching targets within a given scope.

To add a database server as a target, you specify:

- **Address**: The name or IP address of the VM hosting the database server
- **Scope (optional)**: A cluster or group of VMs that host Oracle database servers

If you set target scope, Workload Optimization Manager scans each VM within that group or cluster and tries to connect to an Oracle database server over the specified port. Workload Optimization Manager adds any database servers it finds as targets.

- **Port Number**: The port that connects to database SID

You must open the firewall on the database server to allow access through this port. For further information, see "Finding the Service Name (SID) and Port", below.

- **Service**: The SID for the database that you are connecting to
- **Username/Password**: Valid client credentials for the database server

For Workload Optimization Manager to execute actions, the account must have administrator privileges. Also, you must have enabled user permissions to this user account, including remote access from the Workload Optimization Manager server.

Finding the Service Name (SID) and Port

To specify a target, you must provide the SID and port that you want to connect to. To find the SID for your database:

- Open a secure shell session (ssh) on the database host as a system user or a user with the `sysdba` role
- In the shell session, enter the command, `lsnrctl status`

Find the line that has the string `PROTOCOL=tcp` and note the port number.
In the shell session enter the following commands:

```sql
sqlplus /nolog
connect /as sysdba
SELECT SYS_CONTEXT('userenv', 'db_name') FROM dual;
```

Note the SID that displays as a result of these commands.

**Actions**

Workload Optimization Manager recommends actions for the application supply chain as follows.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
</tr>
</thead>
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<tr>
<td>Virtual Applications</td>
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</tr>
</tbody>
</table>
| Database Applications | - Resize Database Memory  
Recommendation only.  
- Resize Transactions  
Recommendation only.  
- Resize Connections  
Recommendation only. |
| Virtual Machines      | - Provision additional resources (VMem, VCPU)  
- Move Virtual Machine  
- Move Virtual Machine Storage  
- Reconfigure Storage  
- Reconfigure Virtual Machine |

**Monitored Resources**

Workload Optimization Manager monitors the following resources for the application server supply chain:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
</table>
| Virtual Applications  | Transactions  
The utilization of the allocated transactions per second for the given virtual application  
Measured in transactions per second |
Database Applications

- **DBMem**
The memory utilized by the database, as a portion of the memory capacity that is allocated to the database. Note that this resource is more accurate than the VMem resource on the hosting VM. With this resource, Workload Optimization Manager can drive resize and move actions based on the memory consumed by the database, not the memory consumed by the VM.

- **Virtual Memory (VMem)**
The utilization of the VMem allocated to the hosting VM
  Measured in Kilobytes (KB)

- **Virtual CPU (VCPU)**
The utilization of the VCPU allocated to the hosting VM
  Measured in Megahertz (MHz)

- **Transactions**
The utilization of the allocated transactions per second for the given virtual application
  Measured in transactions per second

- **Heap**
The utilization of the application server’s heap
  Measured in Kilobytes (KB)

- **Response Time**
The utilization of the server’s allocated response time
  Measured in Milliseconds (ms)

- **Threads**
The utilization of the server’s thread capacity
  Measured in Threads

- **DBMem**
The utilization of the database’s memory capacity. Only applicable to database servers
  Measured in Kilobytes (KB)

- **Connection**
The utilization of the connection capacity. Only applicable to database servers
  Measured in Connections

- **TransactionLog**
The utilization of the server’s capacity for storage devoted to transaction logs
  Measured in Kilobytes (KB)

- **Garbage Collection**
The of server uptime spent garbage collecting
  Measured in of uptime (%)

VirtualMachine

- **Virtual Memory (VMem)**
The utilization of the VMem allocated to the hosting VM
  Measured in Kilobytes (KB)

- **Virtual CPU (VCPU)**
The utilization of the VCPU allocated to the hosting VM
  Measured in Megahertz (MHz)

- **Virtual Storage (VStorage)**
The utilization of the virtual storage capacity allocated for the VM
  Measured in Kilobytes (KB)
Creating a Service User Account in Oracle

To collect data from the Oracle database, Workload Optimization Manager requires a service account that has privileges to access the V$ Dynamic Performance view. To create this account:

- Open a secure shell session (ssh) on the database host as a system user or a user with the sysdba role
- In the shell session enter the following commands:
  
  sqlplus /nolog
  connect /as sysdba
  
  CREATE USER My_Username IDENTIFIED BY My_Password container=all;
  GRANT CONNECT TO My_Username container=all;
  GRANT sysdba TO My_Username container=all;

  This creates a user account named My_Username with full privileges to access the V$ Dynamic Performance view.

**NOTE:** The above example uses a fictitious username. To comply with Oracle 12C norms, the username should include a prefix of c##.

Some enterprises don’t allow accounts with sysdba access. Cisco recommends using sysdba, according to the Oracle documentation. However, you can work with your Oracle DBA staff to provide read access to the following views, which are the ones that Workload Optimization Manager needs:

- V$INSTANCE
- V$LOG
- V$LOGFILE
- V$PARAMETER
- V$PGASTAT
- V$RESOURCE_LIMIT
- V$SGASTAT
- V$SYS_TIME_MODEL
- V$SYSMETRIC
- V$SYSSTAT
SQL Server

When connecting to a SQL Server database, you provide a “service” name. This is the name of the actual database, so the target is the database itself, and not a service on the database.

This version of Workload Optimization Manager supports Microsoft SQL Server 2008 R2, 2012, and 2014.

Prerequisites

- A user account with SQL permissions on the database
- The following services must be running, and set to enabled:
  - Net.Tcp Listener Adapter
  - Net.Tcp Port Sharing Service
- TC/IP is enabled on the port that you set for the Workload Optimization Manager specification

Creating a Service User Account

The user account that Workload Optimization Manager uses for its service login must include the following:

- The account must exist in the Security folder within the SQL Server Object Explorer, with the following properties:
  - Enable SQL Server Authentication
  - Disable Enforce password policy
- The account’s security properties must include:
  - Permission to connect to the database through SQL
  - Permission to view the server state

Adding a SQL Server Database to Workload Optimization Manager

You can add an individual database server as a target, or you can add all matching targets within a given scope.

To add a database server as a target, you specify:

- Target ID
  The display name that will be used to identify the target in the Target List. This is for display in the UI only; it does not need to match any internal name.
- Username
  The username Workload Optimization Manager will use to connect to the Virtual Machine hosting the database
- Password
  The password Workload Optimization Manager will use to connect to the Virtual Machine hosting the database
- Secure Connection
  When selected, Workload Optimization Manager will connect using SSL
Domain Name:
The Active Directory domain used by Workload Optimization Manager in conjunction with the Username for authentication. Leave blank for local accounts.

Scope:
Workload Optimization Manager will search for SQL Servers on the VMs found within the set scope. This scope can be set to the entire environment, single or multiple clusters, or particular physical machines. Select this option and choose the scope for application discovery.

Actions
Workload Optimization Manager recommends actions for the application supply chain as follows.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Applications</td>
<td>Workload Optimization Manager does not recommend actions to perform on the virtual application itself, but it does recommend actions to perform on the VMs that host bound applications. For example, assume a virtual application that manages three SQL databases. If a surge in requests degrades performance across all three databases, then Workload Optimization Manager can start a new VM to run another instance of the database application, and bind it to the virtual application. On the other hand, if SQL requests drop off so that the load balancer only forwards requests to two of the databases, Workload Optimization Manager can suspend the dormant database and unbind it from the virtual application. Virtual Applications will only be discovered if there is a load balancer configured.</td>
</tr>
<tr>
<td>Applications</td>
<td>Without discovered Guest OS Processes, Workload Optimization Manager doesn’t perform actions on applications. Instead, it performs resize actions on the host VMs. If host utilization is high enough on the physical machine running the application VM, Workload Optimization Manager may also recommend provisioning a new host. For specific applications, see the individual application entry.</td>
</tr>
</tbody>
</table>
| Virtual Machines | ▪ Provision additional resources (VMem, VCPU)  
▪ Move Virtual Machine  
▪ Move Virtual Machine Storage  
▪ Reconfigure Storage  
▪ Reconfigure Virtual Machine |
## Monitored Resources

Workload Optimization Manager monitors the following resources for the application server supply chain:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Virtual Applications</strong></td>
<td></td>
</tr>
<tr>
<td>Transactions</td>
<td>The utilization of the allocated transactions per second for the given virtual application</td>
</tr>
<tr>
<td></td>
<td>Measured in transactions per second</td>
</tr>
<tr>
<td>DBMem</td>
<td>The memory utilized by the database, as a of the memory capacity that is allocated to the database. Note that this resource is more accurate than the VMem resource on the hosting VM. With this resource, Workload Optimization Manager can drive resize and move actions based on the memory consumed by the database, not the memory consumed by the VM</td>
</tr>
<tr>
<td>Virtual Memory (VMem)</td>
<td>The utilization of the VMem allocated to the hosting VM</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td>Virtual CPU (VCPU)</td>
<td>The utilization of the VCPU allocated to the hosting VM</td>
</tr>
<tr>
<td></td>
<td>Measured in Megahertz (MHz)</td>
</tr>
<tr>
<td>Transactions</td>
<td>The utilization of the allocated transactions per second for the given virtual application</td>
</tr>
<tr>
<td></td>
<td>Measured in transactions per second</td>
</tr>
<tr>
<td>Heap</td>
<td>The utilization of the application server’s heap</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td>Response Time</td>
<td>The utilization of the server’s allocated response time</td>
</tr>
<tr>
<td></td>
<td>Measured in Milliseconds (ms)</td>
</tr>
<tr>
<td>Threads</td>
<td>The utilization of the server’s thread capacity</td>
</tr>
<tr>
<td></td>
<td>Measured in Threads</td>
</tr>
<tr>
<td>DBMem</td>
<td>The utilization of the database’s memory capacity. Only applicable to database servers</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td>Connection</td>
<td>The utilization of the connection capacity. Only applicable to database servers</td>
</tr>
<tr>
<td></td>
<td>Measured in Connections</td>
</tr>
<tr>
<td>TransactionLog</td>
<td>The utilization of the server’s capacity for storage devoted to transaction logs</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td>Garbage Collection</td>
<td>The of server uptime spent garbage collecting</td>
</tr>
<tr>
<td></td>
<td>Measured in of uptime (%)</td>
</tr>
</tbody>
</table>
Virtual Machine

- Virtual Memory (VMem)
The utilization of the VMem allocated to the hosting VM
Measured in Kilobytes (KB)

- Virtual CPU (VCPU)
The utilization of the VCPU allocated to the hosting VM
Measured in Megahertz (MHz)

- Virtual Storage (VStorage)
The utilization of the virtual storage capacity allocated for the VM
Measured in Kilobytes (KB)

- Storage Access Operations Per Second (IOPS)
The utilization of IOPS allocated for the VStorage on the VM
Measured in IOPS

- Latency
The utilization of latency allocated for the VStorage on the VM
Measured in milliseconds (ms)
Windows® Application Targets

This version of Workload Optimization Manager supports adding Microsoft® Exchange® servers as targets. With the Application Control Module, Workload Optimization Manager can monitor the application server resources and recommend actions to scale server capacity horizontally (provision new servers) or vertically (resize existing servers).

You can add an individual Exchange server as a target, or you can add all matching targets within a given scope.

Prerequisites

- Configure remote management on each Exchange server. See Creating A Service User Account on page 16.
- Port access
  
  WinRM uses ports 5985 and 5986 for standard and secure communications, respectively. The firewall on your VMM server must open these ports.

Supply Chain

Exchange Server targets add Application entities to the supply chain. The inventory groups applications by server type – You can navigate to each individual application server to see specific details.

Application Server Scaling Policy

After you specify an application server target, Workload Optimization Manager discovers the resource utilization for that server, and recommends appropriate actions. These actions will follow one of the two following scaling policies:

- Provision
  
  Scaling by Provision enables horizontal scaling, where the environment adjusts to increased demand by provisioning new application servers.

- Resize
  
  Scaling by Resize enables vertical scaling, where the environment adjusts to increased demand by resizing the application server, or the VM that hosts the application server.

These scaling policies are mutually exclusive — the affected application servers can scale by Provisioning or by Resizing, but not both. For example, Workload Optimization Manager can recommend resize actions, but if you have set the Scaling Policy to Provision, Workload Optimization Manager will only recommend Provision and Suspend actions.

You set the Scaling Policy in the Policy view – Workload Optimization Manager policies support scope, so you can select specific groups of application servers to set their Scaling Policies as you like. For more information, see "Application Server Actions" in the User Guide.
Adding Microsoft Exchange Server Targets

Once you’ve enabled remote management, you can add your Exchange servers as targets. To add an Exchange Server target, select the [Windows Application > MS Exchange] option on the Target Configuration page and provide the following information:

- **Host**
  The host name of the Exchange server.
  Note that you can enter an IP address for the host, but you must first configure an SPN on the host. Cisco recommends that you use the host name in this field.

- **Scope (optional)**
  A cluster or group of VMs that host Exchange servers
  If you set target scope, Workload Optimization Manager scans each VM within that group or cluster and tries to connect to an Exchange server over the specified port. Workload Optimization Manager adds any servers it finds as targets.

- **Port number**
  The port number for the remote management connection. The default HTTP port is 5985; the default HTTPS port is 5986.

- **Username**
  The domain\username of an Active Directory account that Workload Optimization Manager can use to connect to the Exchange server.

- **Password**
  Password for account used.

Actions

Workload Optimization Manager recommends actions for the application supply chain as follows.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Applications</td>
<td>Workload Optimization Manager does not recommend actions to perform on the virtual application itself, but it does recommend actions to perform on the VMs that host bound applications. For example, assume a virtual application that manages three SQL databases. If a surge in requests degrades performance across all three databases, then Workload Optimization Manager can start a new VM to run another instance of the database application, and bind it to the virtual application. On the other hand, if SQL requests drop off so that the load balancer only forwards requests to two of the databases, Workload Optimization Manager can suspend the dormant database and unbind it from the virtual application. Virtual Applications will only be discovered if there is a load balancer configured.</td>
</tr>
<tr>
<td>Applications</td>
<td>Without discovered Guest OS Processes, Workload Optimization Manager doesn’t perform actions on applications. Instead, it performs resize actions on the host</td>
</tr>
</tbody>
</table>

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VMs. If host utilization is high enough on the physical machine running the application VM, Workload Optimization Manager may also recommend provisioning a new host.

For specific applications, see the individual application entry.

**Virtual Machines**
- Provision additional resources (VMem, VCPU)
- Move Virtual Machine
- Move Virtual Machine Storage
- Reconfigure Storage
- Reconfigure Virtual Machine

**Monitored Resources**

Workload Optimization Manager monitors the following resources for the application server supply chain:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
</table>
| Virtual Apps  | Transactions
The utilization of the allocated transactions per second for the given virtual application
Measured in transactions per second |
|               | Virtual Memory (VMem)
The utilization of the VMem allocated to the hosting VM
Measured in Kilobytes (KB) |
|               | Virtual CPU (VCPU)
The utilization of the VCPU allocated to the hosting VM
Measured in Megahertz (MHz) |
|               | Transactions
The utilization of the allocated transactions per second for the given virtual application
Measured in transactions per second |
|               | Heap
The utilization of the application server’s heap
Measured in Kilobytes (KB) |
|               | Response Time
The utilization of the server’s allocated response time
Measured in Milliseconds (ms) |
|               | Threads
The utilization of the server’s thread capacity
Measured in Threads |
|               | DBMem
The utilization of the database’s memory capacity. Only applicable to database servers
Measured in Kilobytes (KB) |
|               | Connection
The utilization of the connection capacity. Only applicable to database servers
Measured in Connections |
- **TransactionLog**  
  The utilization of the server's capacity for storage devoted to transaction logs  
  Measured in Kilobytes (KB)

- **Garbage Collection**  
  The of server uptime spent garbage collecting  
  Measured in of uptime (%)

---

**VirtualMachine**

- **Virtual Memory (VMem)**  
  The utilization of the VMem allocated to the hosting VM  
  Measured in Kilobytes (KB)

- **Virtual CPU (VCPU)**  
  The utilization of the VCPU allocated to the hosting VM  
  Measured in Megahertz (MHz)

- **Virtual Storage (VStorage)**  
  The utilization of the virtual storage capacity allocated for the VM  
  Measured in Kilobytes (KB)

- **Storage Access Operations Per Second (IOPS)**  
  The utilization of IOPS allocated for the VStorage on the VM  
  Measured in IOPS

- **Latency**  
  The utilization of latency allocated for the VStorage on the VM  
  Measured in milliseconds (ms)
Network Flow Targets

With Network Targets, Workload Optimization Manager can calculate costs associated with network proximity when managing workload placement. For example, two VMs that show a lot of network traffic between each other should be placed close together. They would see the best network performance if they were placed on the same physical host, and latency would increase as traffic has to hop more switches to pass data between them. With a Network Target added, Workload Optimization Manager can include the benefits of localizing network traffic in its analysis.

For network analysis, Workload Optimization Manager groups entities into two types of group:

- **VPods**
  Sets of consumers that communicate frequently with each other over the network – for example, VMs that run processes for the same distributed application.

- **DPods**
  Sets of closely connected providers (providers underneath the same switch) – For example a storage controller, its datastores, and the hosts that consume the storage resources. A unified fabric chassis can also make up a DPod, as can the providers under a switch in an Arista network.

In this scheme, DPods provide network flow to VPods, and VPods provide this flow to their constituent consumers. For example, as Workload Optimization Manager calculates the placement of a VM on a host or datastore, it considers the cost of the network flow so that VMs can reside closer together if that will lower the overall cost of their placement.

There are four levels of cost for network flow:

- **Zero**
  The consumers use the same provider – For example VMs that reside on the same host. Such consumers have infinite net throughput capacity.

- **Low**
  The consumers reside within the same DPod. Net throughput capacity for these consumers is determined by the capacity of the providers on the DPod.

- **Medium**
  The consumers communicate across DPods (communicate through multiple switches). Throughput capacity is the capacity of the uplink, divided by the number of providers sharing it.

- **High**
  The consumers communicate across the cloud.

Workload Optimization Manager takes these costs into account when making workload placement decisions.
License Requirements

- Network targets are available in the Premier Edition of Workload Optimization Manager
- To discover DPods via storage controllers, a storage target
- To discover DPods via UCS fabrics, a fabric target

Supply Chain

Network targets add VPod and DPod entities to the Supply Chain.

Actions

Workload Optimization Manager recommends actions for the network target supply chain as follows.

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

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>VPod</td>
<td>Move VPod across DPod</td>
</tr>
<tr>
<td></td>
<td>Move VM across VPods</td>
</tr>
<tr>
<td>DPod</td>
<td>Provision new DPod</td>
</tr>
</tbody>
</table>

Monitored Resources

Workload Optimization Manager monitors the following resources for the network supply chain:

NOTE: This is a general list of commodities for entities discovered for network targets. You can see how actions differ per technology in each section that describes adding a specific type of network target.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>VPod</td>
<td>Memory (Mem)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the VPod's memory reserved or in use</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td></td>
<td>CPU</td>
</tr>
<tr>
<td></td>
<td>The utilization of the VPod's CPU reserved or in use</td>
</tr>
<tr>
<td></td>
<td>Measured in Megahertz (MHz)</td>
</tr>
<tr>
<td></td>
<td>Storage</td>
</tr>
<tr>
<td></td>
<td>The utilization of the storage attached to the VPod</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td></td>
<td>Flow</td>
</tr>
<tr>
<td></td>
<td>The utilization of the network flow capacity utilized by the VPod. This is divided into Flow1 (Low Cost) and Flow2 (Medium Cost) utilization</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes per second (KB/s)</td>
</tr>
</tbody>
</table>
DPod

- **Memory (Mem)**
  The utilization of the DPod's memory reserved or in use
  Measured in Kilobytes (KB)

- **CPU**
  The utilization of the DPod's CPU reserved or in use
  Measured in Megahertz (MHz)

- **Storage**
  The utilization of the storage attached to the DPod
  Measured in Kilobytes (KB)

- **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)

Arista

To monitor an Arista network, choose a single Top-Of-Rack switch from the network you want to monitor and add it as a Workload Optimization Manager target. Workload Optimization Manager can discover the rest of the network through that single switch. As a result of discovery, Workload Optimization Manager builds one DPod per switch.

Note: An Arista target only discovers DPods from the Arista switches. To include VPods in your network analysis, you must also add flow connectors. For more information, see NetFlow on page 152 or sFlow on page 154.

Prerequisites

- The Arista Command eAPI must be enabled for HTTPS communication (see the Arista documentation for details)
- A service account Workload Optimization Manager can use to connect to Arista. This account must be able to connect to the Arista eAPI.

Adding Arista Targets to Workload Optimization Manager

To add an Arista target, select the **Network > Arista** option on the Target Configuration page and provide the following information:

- **Address**: The IP address of the top-of-rack switch
- **Username/Password**: The credentials of an account Workload Optimization Manager can use to connect to the Arista switch.

Actions

Workload Optimization Manager recommends actions for the network target supply chain as follows.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>DPod</td>
<td>Provision new DPod</td>
</tr>
</tbody>
</table>
Monitored Resources

Workload Optimization Manager monitors the following resources for the network supply chain:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>DPod</td>
<td>- Memory (Mem)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the DPod’s memory reserved or in use</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td></td>
<td>- CPU</td>
</tr>
<tr>
<td></td>
<td>The utilization of the DPod’s CPU reserved or in use</td>
</tr>
<tr>
<td></td>
<td>Measured in Megahertz (MHz)</td>
</tr>
<tr>
<td></td>
<td>- Storage</td>
</tr>
<tr>
<td></td>
<td>The utilization of the storage attached to the DPod</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td></td>
<td>- Flow</td>
</tr>
<tr>
<td></td>
<td>The utilization of the network flow capacity utilized by the DPod.</td>
</tr>
<tr>
<td></td>
<td>This is divided into Flow1 (Low Cost) and Flow2 (Medium Cost) utilization</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes per second (KB/s)</td>
</tr>
</tbody>
</table>

Cisco APIC

Workload Optimization Manager uses TCAM (Ternary Content-Addressable Memory) table utilization to make network-aware VM placement decisions under top-of-rack APIC (Application Policy Infrastructure Controller) switches in such a way that the tables remain balanced. To monitor a network using Cisco APIC, add it as a Workload Optimization Manager target. Workload Optimization Manager will discover the TCAM utilization of the underlying infrastructure.

**NOTE:** Adding a Cisco APIC target will not cause any service entities to appear in the market. Instead, Workload Optimization Manager represents TCAM utilization using a commodity that Physical Machines under the APIC sell to the associated VMs.

Prerequisites

- A service account Workload Optimization Manager can use to connect to Cisco APIC. Unlike most other targets, this account can be read-only as Workload Optimization Manager does not make action recommendations directly through the Cisco APIC.
Adding Cisco APIC Targets to Workload Optimization Manager

To add a Cisco APIC target, select the **Network > Cisco APIC** option on the Target Configuration page and provide the following information:

- **Address**: The IP address of the Cisco APIC.
- **Username/Password**: The credentials of an account Workload Optimization Manager can use to connect to the Cisco APIC.

**Actions**

The commodity that represents TCAM utilization assists in driving actions in the market, in conjunction with other factors such as resource usage, etc.

**Tetration**

Workload Optimization Manager can connect to Cisco Tetration to gather information about east-west traffic between VMs, hosts, and storage. Using this information, Workload Optimization Manager can build VPods to manage performance related to network traffic. With these VPods, Workload Optimization Manager can reduce network latency through enhanced Flow analysis, and keep VMs close together on the network if they communicate frequently with each other.

To get the most benefit from the information that Tetration provides, you must also add any hypervisor target(s) that correspond to the VMs using Tetration. For example, if the VMs to be monitored are residing in a vCenter environment, add that vCenter as a hypervisor target.

**Prerequisites**

- A Cisco Tetration data collector
- An API key with the `flow_inventory_query` permission that Workload Optimization Manager can use to connect to the data collector

**Adding Tetration Targets to Workload Optimization Manager**

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

- **Address**: The IP address of the Tetration server
- **Username**: The API key that Workload Optimization Manager will use to connect to the Tetration server.
- **Password**: The API secret for the API key Workload Optimization Manager will use to connect to the Tetration server.

**Actions**

Workload Optimization Manager recommends actions for the network target supply chain as follows:
### Entity Type Action

**VPod**
- Move VPod across DPod
- Move VM across VPods

### Monitored Resources

*Workload Optimization Manager* monitors the following resources for the network supply chain:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>VPod</td>
<td><strong>Memory (Mem)</strong></td>
</tr>
<tr>
<td></td>
<td>The utilization of the VPod's memory reserved or in use</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td>VPod</td>
<td><strong>CPU</strong></td>
</tr>
<tr>
<td></td>
<td>The utilization of the VPod's CPU reserved or in use</td>
</tr>
<tr>
<td></td>
<td>Measured in Megahertz (MHz)</td>
</tr>
<tr>
<td>VPod</td>
<td><strong>Storage</strong></td>
</tr>
<tr>
<td></td>
<td>The utilization of the storage attached to the VPod</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td>VPod</td>
<td><strong>Flow</strong></td>
</tr>
<tr>
<td></td>
<td>The utilization of the network flow capacity utilized by the VPod. This is divided into Flow1 (Low Cost) and Flow2 (Medium Cost) utilization</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes per second (KB/s)</td>
</tr>
</tbody>
</table>

### NetFlow

*Workload Optimization Manager* can connect to NetFlow data collectors to gather information about traffic between VMs, hosts, and storage. Using this information, *Workload Optimization Manager* can build VPods and make recommendations that reduce network latency.

**NOTE:** The NetFlow target builds VPods and includes them in *Workload Optimization Manager* analysis. To get the most benefit from the Network Control Module, you should also build DPods. To do this, you must add targets for Arista networks, storage controllers, or fabrics.

For information about adding these targets, see:

- *Arista* on page 149
- *Storage Targets* on page 65
- *Fabric Targets* on page 163

### Prerequisites

- A NetFlow data collector
- A service account *Workload Optimization Manager* can use to connect to the NetFlow data collector

The service account *Workload Optimization Manager* uses must have permission to remotely SSH into the data collector and run NFDUMP.
NetFlow Data Collector Requirements

The NetFlow data collector that you use must include NFDUMP tools, and the `nfcapd` service (NetFlow capture daemon) must be running on the NetFlow system.

Workload Optimization Manager uses `nfdump` to import the NetFlow data from the collector.

Cisco provides a NetFlow data collector OVA with NFDUMP preconfigured.

To verify that the data collector is capturing data, open a secure shell on the collector’s host, log in using the service account that you specify for the Workload Optimization Manager target, and execute the following command:

```
nfdump -R /var/netflow
```

vSphere Distributed Switch Requirements

If you are collecting NetFlow data from a vSphere Distributed Switch (vDS):

- The vDS must be configured to point to the NetFlow data collector
- NetFlow Monitoring must be enabled on the distributed port group associated with each vDS

For information about these configuration steps, refer to your vSphere documentation.

Adding NetFlow Targets to Operations Manager

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

- **Address**: The IP address of the Netflow data collector
- **Username/Password**: The credentials of an account Workload Optimization Manager can use to connect to the data collector.

Actions

Workload Optimization Manager recommends actions for the network target supply chain as follows.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>VPod</td>
<td>Move VPod across DPod</td>
</tr>
<tr>
<td></td>
<td>Move VM across VPods</td>
</tr>
</tbody>
</table>

Monitored Resources

Workload Optimization Manager monitors the following resources for the network supply chain:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>VPod</td>
<td>Memory (Mem)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the VPod’s memory reserved or in use</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
</tbody>
</table>
CPU
The utilization of the VPod's CPU reserved or in use
Measured in Megahertz (MHz)

Storage
The utilization of the storage attached to the VPod
Measured in Kilobytes (KB)

Flow
The utilization of the network flow capacity utilized by the VPod. This is divided into Flow1 (Low Cost) and Flow2 (Medium Cost) utilization
Measured in Kilobytes per second (KB/s)

sFlow
Workload Optimization Manager can connect to SFlow data collectors to gather information about traffic between VMs, hosts, and storage. Using this information, Workload Optimization Manager can build VPods and make recommendations that reduce network latency.

NOTE: The sFlow target builds VPods and includes them in Workload Optimization Manager analysis. To get the most benefit from the Network Control Module, you should also build DPods. To do this, you must add targets for Arista networks, storage controllers, or fabrics.

For information about adding these targets, see:
- Arista on page 149
- Storage Targets on page 65
- Fabric Targets on page 163

Prerequisites
- An sFlow data collector

You must have an sFlow data collector running on your network. Make sure the `sflow-rt` service is running. Workload Optimization Manager connects to the data collector through its REST API on port 8008. Credentials are not typically required to access the SFlow API. If you require a secure connection, contact Cisco Technical Support for assistance.

Cisco provides an OVA with a preconfigured sFlow-RT data collector.

Adding sFlow Targets to Operations Manager

To add a NetFlow target, select the Network > sFlow option on the Target Configuration page and provide the following information:

- **Address:** The IP address of the sFlow data collector
- **Username/Password:** The credentials of an account Workload Optimization Manager can use to connect to the data collector.
### Actions

Workload Optimization Manager recommends actions for the network target supply chain as follows.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>VPod</td>
<td>• Move VPod across DPod</td>
</tr>
<tr>
<td></td>
<td>• Move VM across VPods</td>
</tr>
</tbody>
</table>

### Monitored Resources

Workload Optimization Manager monitors the following resources for the network supply chain:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>VPod</td>
<td>• Memory (Mem)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the VPod's memory reserved or in use</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td></td>
<td>• CPU</td>
</tr>
<tr>
<td></td>
<td>The utilization of the VPod's CPU reserved or in use</td>
</tr>
<tr>
<td></td>
<td>Measured in Megahertz (MHz)</td>
</tr>
<tr>
<td></td>
<td>• Storage</td>
</tr>
<tr>
<td></td>
<td>The utilization of the storage attached to the VPod</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td></td>
<td>• Flow</td>
</tr>
<tr>
<td></td>
<td>The utilization of the network flow capacity utilized by the VPod. This is divided into Flow1 (Low Cost) and Flow2 (Medium Cost) utilization</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes per second (KB/s)</td>
</tr>
</tbody>
</table>
Application Container Targets

If you are running the Cloud Native Edition of Workload Optimization Manager, it will discover application containers in your environment, recommend resize actions, and display discovered containers in the Inventory view. This release of Workload Optimization Manager supports Docker containers.

To use this functionality, you must specify a container target. These targets are found under the "Application Server" target type in the Target Configuration section of the Admin tab.

Supply Chain

Workload Optimization Manager adds Container objects to the inventory. A container object hosts an application.

Actions

Workload Optimization Manager recommends actions for the container supply chain as follows.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Docker Container</td>
<td>Resize Container</td>
</tr>
<tr>
<td></td>
<td>Recommend Only</td>
</tr>
<tr>
<td>Virtual Machines</td>
<td>Provision additional resources (VMem, VCPU)</td>
</tr>
<tr>
<td></td>
<td>Move Virtual Machine</td>
</tr>
<tr>
<td></td>
<td>Move Virtual Machine Storage</td>
</tr>
<tr>
<td></td>
<td>Reconfigure Storage</td>
</tr>
<tr>
<td></td>
<td>Reconfigure Virtual Machine</td>
</tr>
</tbody>
</table>

Monitored Resources

Workload Optimization Manager monitors the following resources for the container supply chain:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>ContainerPod</td>
<td>VMem</td>
</tr>
<tr>
<td></td>
<td>The of memory capacity the container utilizes</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td></td>
<td>VCPU</td>
</tr>
<tr>
<td></td>
<td>The of CPU capacity the container utilizes</td>
</tr>
<tr>
<td></td>
<td>Measured in Megahertz (Mhz)</td>
</tr>
</tbody>
</table>
VirtualMemory

- Virtual Memory (VMem)
  The utilization of the VMem allocated to the hosting VM
  Measured in Kilobytes (KB)
- Virtual CPU (VCPU)
  The utilization of the VCPU allocated to the hosting VM
  Measured in Megahertz (MHz)
- Virtual Storage (VStorage)
  The utilization of the virtual storage capacity allocated for the VM
  Measured in Kilobytes (KB)
- Storage Access Operations Per Second (IOPS)
  The utilization of IOPS allocated for the VStorage on the VM
  Measured in IOPS
- Latency
  The utilization of latency allocated for the VStorage on the VM
  Measured in milliseconds (ms)

Setting Up Application Containers Managed By Kubernetes

Workload Optimization Manager will discover application containers running across all pods in a Kubernetes cluster.

Prerequisites

- Workload Optimization Manager 5.9+ installation
- Running Kubernetes 1.4+ cluster

Adding Kubernetes Targets

In order to add this target, you must create a Kubeturbo configuration file with your Workload Optimization Manager credentials and a custom pod definition that will be used by Kubelet to create a mirror pod running the Kubeturbo service.

For more information, contact your technical support representative.

NOTE: You must install Kubeturbo on each cluster you want Workload Optimization Manager to discover.

Supported Actions

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

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kubernetes ContainerPod</td>
<td>Horizontal Scale Up</td>
</tr>
<tr>
<td></td>
<td>Horizontal Scale Down</td>
</tr>
<tr>
<td></td>
<td>Provision Additional Resources (VMem, VCPU) Recommend Only</td>
</tr>
<tr>
<td></td>
<td>Move Pod across VM</td>
</tr>
</tbody>
</table>
Monitored Resources

Workload Optimization Manager monitors the following resources for the container supply chain:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>ContainerPod</td>
<td>• VMem</td>
</tr>
<tr>
<td></td>
<td>• The memory capacity the container utilizes</td>
</tr>
<tr>
<td></td>
<td>• Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td></td>
<td>• VCPU</td>
</tr>
<tr>
<td></td>
<td>• The CPU capacity the container utilizes</td>
</tr>
<tr>
<td></td>
<td>• Measured in Megahertz (Mhz)</td>
</tr>
</tbody>
</table>
PaaS Manager Targets

Platform as a Service (PaaS) is a management model to deliver applications over the internet. A PaaS provider delivers hardware and software tools as a service, and customers use the service to build and deploy applications.

Workload Optimization Manager supports the CloudFoundry platform. For targets, you can specify PaaS implementations that use the CloudFoundry SDK v.2. Cisco has tested implementations of HPE Stackato, but Workload Optimization Manager should support other implementations on v.2, such as Pivotal.

Identifying the CloudFoundry API Endpoint

To specify a target, you attach to a CloudFoundry API endpoint. The following steps describe how to identify the endpoint in HPE Stackato:

- Open the Management Console
- Navigate to Admin > Cluster Management
- Find the entry for API Endpoint — That shows the IP address you need for the Workload Optimization Manager target

Adding CloudFoundry Targets

To add CloudFoundry targets, select the PaaS > CloudFoundry option on the Target Configuration page and provide the following information:

- Address
  The address of the API endpoint.
- Username/Password
  Credentials for an account on the endpoint with administrator privileges.

Actions

Workload Optimization Manager recommends actions for the PaaS supply chain as follows.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applications</td>
<td>Without discovered Guest OS Processes, Workload Optimization Manager doesn’t perform actions on applications. Instead, it performs resize actions on the host VMs. If host utilization is high enough on the physical machine running the application VM, Workload Optimization Manager may also recommend provisioning a new host. For specific applications, see the individual application entry.</td>
</tr>
</tbody>
</table>
Virtual Machines
- Provision additional resources (VMem, VCPU)
- Move Virtual Machine
- Move Virtual Machine Storage
- Reconfigure Storage
- Reconfigure Virtual Machine

Physical Machines
- Start Physical Machine
- Provision Physical Machine
- Suspend Physical Machine

Storage
- Start Storage
- Provision Storage
- Suspend Storage
- Move (only with Storage Targets configured)
- Resize (only with Storage Targets configured)

Monitored Resources

Workload Optimization Manager monitors the following resources for the PaaS supply chain:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application</td>
<td></td>
</tr>
<tr>
<td>Virtual Memory (VMem)</td>
<td>The utilization of the VMem allocated to the hosting VM Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td>Virtual CPU (VCPU)</td>
<td>The utilization of the VCPU allocated to the hosting VM Measured in Megahertz (MHz)</td>
</tr>
<tr>
<td>Transactions</td>
<td>The utilization of the allocated transactions per second for the given virtual application Measured in transactions per second</td>
</tr>
<tr>
<td>Heap</td>
<td>The utilization of the application server’s heap Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td>Response Time</td>
<td>The utilization of the server’s allocated response time Measured in Milliseconds (ms)</td>
</tr>
<tr>
<td>Threads</td>
<td>The utilization of the server’s thread capacity Measured in Threads</td>
</tr>
<tr>
<td>DBMem</td>
<td>The utilization of the database’s memory capacity. Only applicable to database servers Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td>Connection</td>
<td>The utilization of the connection capacity. Only applicable to database servers Measured in Connections</td>
</tr>
<tr>
<td>Parameter</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>VirtualMachine</strong></td>
<td></td>
</tr>
<tr>
<td>TransactionLog</td>
<td>The utilization of the server’s capacity for storage devoted to transaction logs</td>
</tr>
<tr>
<td>Garbage Collection</td>
<td>The of server uptime spent garbage collecting</td>
</tr>
<tr>
<td>Virtual Memory (VMem)</td>
<td>The utilization of the VMem allocated to the hosting VM</td>
</tr>
<tr>
<td>Virtual CPU (VCPU)</td>
<td>The utilization of the VCPU allocated to the hosting VM</td>
</tr>
<tr>
<td>Virtual Storage (VStorage)</td>
<td>The utilization of the virtual storage capacity allocated for the VM</td>
</tr>
<tr>
<td>Storage Access Operations Per Second (IOPS)</td>
<td>The utilization of IOPS allocated for the VStorage on the VM</td>
</tr>
<tr>
<td>Latency</td>
<td>The utilization of latency allocated for the VStorage on the VM</td>
</tr>
<tr>
<td><strong>Physical Machine</strong></td>
<td></td>
</tr>
<tr>
<td>Memory (Mem)</td>
<td>The utilization of the PM’s memory reserved or in use</td>
</tr>
<tr>
<td>CPU</td>
<td>The utilization of the PM’s CPU reserved or in use</td>
</tr>
<tr>
<td>IO</td>
<td>The utilization of the PM's IO adapters</td>
</tr>
<tr>
<td>Net</td>
<td>The utilization of data through the PM's network adapters</td>
</tr>
<tr>
<td>Swap</td>
<td>The utilization of the PM's swap space</td>
</tr>
<tr>
<td>Balloon</td>
<td>The utilization of shared memory among VMs running on the host. ESX-only</td>
</tr>
<tr>
<td>CPU Ready</td>
<td>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</td>
</tr>
</tbody>
</table>
Storage

- **Storage Amount**
  The utilization of the datastore's capacity
  Measured in Megabytes (MB)

- **Storage Provisioned**
  The utilization of the datastore's capacity, including overprovisioning.
  Measured in Megabytes (MB)

- **Storage Access Operations Per Second (IOPS)**
  The utilization of the storage access operations per second on the datastore
  Measured in Operations per second

- **Latency**
  The utilization of latency on the datastore
  Measured in Milliseconds (ms)
Fabric Targets

A fabric target is a service that unites compute, network and storage access into a cohesive system. When you connect Workload Optimization Manager 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, Workload Optimization Manager 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, Workload Optimization Manager 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. The Domain serves as the bottom-level pool of network resource, supplying the Fabric Interconnect.

Supported Fabric Targets

Workload Optimization Manager supports the following fabric targets:

- Cisco UCS
- Cisco UCS Central
- HPE OneView

Monitored Resources

Workload Optimization Manager monitors the following resources for the fabric supply chain:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>VirtualMachine</td>
<td>Virtual Memory (VMem)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the VMem allocated to the hosting VM</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td></td>
<td>Virtual CPU (VCPU)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the VCPU allocated to the hosting VM</td>
</tr>
<tr>
<td></td>
<td>Measured in Megahertz (MHz)</td>
</tr>
</tbody>
</table>
- **Virtual Storage (VStorage)**
  The utilization of the virtual storage capacity allocated for the VM
  Measured in Kilobytes (KB)
- **Storage Access Operations Per Second (IOPS)**
  The utilization of IOPS allocated for the VStorage on the VM
  Measured in IOPS
- **Latency**
  The utilization of latency allocated for the VStorage on the VM
  Measured in milliseconds (ms)

**Blade**

- **Net**
  The utilization of data through the Blade's network adapters
  Measured in Kilobytes per second (KB/s)
- **Treated as a Physical Machine of the underlying Hypervisor (see below)**
  CPU, Mem, etc.

**Physical Machine**

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

**I/O Module**

- **NetThroughput**
  Rate of message delivery over a port
  Measured in Megabits per second (Mb/s)

**Fabric Interconnect**

- **NetThroughput**
  Rate of message delivery over a port
  Measured in Mb/s
- **PortChannel**
  Amalgamation of ports with a shared net throughput and utilization
  Measured in Mb/s
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 Workload Optimization Manager enables automation at the hardware level, including automated provisioning of hosts.

Prerequisites

- A service account Workload Optimization Manager 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.

  Workload Optimization Manager 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 Workload Optimization Manager will use to connect to UCS Manager.

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

  NOTE: When providing a username, if the account is managed by an Authentication Domain, you must include the domain in all capital letters. For example, MY_AUTHENTICATION_DOMAIN\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

Workload Optimization Manager recommends actions for the various entities of the UCS Fabric Network as follows:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Machines</td>
<td>- Provision additional resources (VMem, VCPU)</td>
</tr>
<tr>
<td></td>
<td>- Move Virtual Machine</td>
</tr>
<tr>
<td></td>
<td>- Move Virtual Machine Storage</td>
</tr>
<tr>
<td></td>
<td>- Reconfigure Storage</td>
</tr>
<tr>
<td></td>
<td>- Reconfigure Virtual Machine</td>
</tr>
<tr>
<td>Physical Machines</td>
<td>- Start Physical Machine</td>
</tr>
<tr>
<td></td>
<td>- Provision Physical Machine</td>
</tr>
<tr>
<td></td>
<td>- Suspend Physical Machine</td>
</tr>
<tr>
<td>Chassis</td>
<td>- Provision New Chassis</td>
</tr>
<tr>
<td>Fabric Interconnect</td>
<td>- Add Port to Port Channel</td>
</tr>
<tr>
<td></td>
<td>- Remove Port from Port Channel</td>
</tr>
<tr>
<td></td>
<td>- Add Port</td>
</tr>
<tr>
<td>DPod</td>
<td>- Provision new DPod</td>
</tr>
</tbody>
</table>

Monitored Resources

Workload Optimization Manager monitors the following commodities of the UCS target:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Machine</td>
<td>- Virtual Memory (VMem)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the VMem allocated to the hosting VM</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td></td>
<td>- Virtual CPU (VCPU)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the VCPU allocated to the hosting VM</td>
</tr>
<tr>
<td></td>
<td>Measured in Megahertz (MHz)</td>
</tr>
<tr>
<td></td>
<td>- Virtual Storage (VStorage)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the virtual storage capacity allocated for the VM</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td></td>
<td>- Storage Access Operations Per Second (IOPS)</td>
</tr>
<tr>
<td></td>
<td>The utilization of IOPS allocated for the VStorage on the VM</td>
</tr>
<tr>
<td></td>
<td>Measured in IOPS</td>
</tr>
<tr>
<td></td>
<td>- Latency</td>
</tr>
<tr>
<td></td>
<td>The utilization of latency allocated for the VStorage on the VM</td>
</tr>
<tr>
<td></td>
<td>Measured in milliseconds (ms)</td>
</tr>
</tbody>
</table>
Physical Machine

- Memory (Mem)
  The utilization of the PM’s memory reserved or in use
  Measured in Kilobytes (KB)

- CPU
  The utilization of the PM’s CPU reserved or in use
  Measured in Megahertz (MHz)

- IO
  The utilization of the PM’s IO adapters
  Measured in Kilobytes per second (KB/s)

- Net
  The utilization of data through the PM’s network adapters
  Measured in Kilobytes per second (KB/s)

- Swap
  The utilization of the PM’s swap space
  Measured in Kilobytes (KB)

- Balloon
  The utilization of shared memory among VMs running on the host. ESX-only
  Measured in Kilobytes (KB)

- 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)

Chassis

- Space
  Representation of the physical number of Rack-Mounts available
  Measured in Rack-slots

- Power
  Electricity being consumed by the Chassis
  Measured in Watts (W)

- Temperature
  Temperature of the internals of the Chassis
  Measured in degrees Celsius (C)

I/O Module

- NetThroughput
  Rate of message delivery over a port
  Measured in Megabits per second (Mb/s)

Fabric Interconnect

- NetThroughput
  Rate of message delivery over a port
  Measured in Mb/s

- PortChannel
  Amalgamation of ports with a shared net throughput and utilization
  Measured in Mb/s
**Cisco UCS Central**

Cisco UCS Central aggregates multiple Cisco Unified Computing System targets onto a single point of management. Managing compute resources on a network fabric of this magnitude enables automation at the hardware level, including automated provisioning of hosts on any of the underlying UCS Manager instances.

Workload Optimization Manager does not discover entities through the UCS Central target. Instead, all entities are identified from the UCS Manager instances associated to the UCS Central Software, and discovered through the UCS Managers.

**Prerequisites**

- A service account Workload Optimization Manager can use to connect to UCS Central Software

**Adding UCS Central Targets**

To add a UCS Central target, select the **Fabric** category and choose UCS Central. Then provide the following information:

- **Address:** The IP address of the Virtual Machine running the UCS Central OVA.

  This gives access to the UCS Central Software that resides on the Virtual Machine.

  Workload Optimization Manager 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 Workload Optimization Manager will use to connect to UCS Central.

  The Authentication Domain or local username must be identical on UCS Central and each connected UCS Manager instance for Workload Optimization Manager to discover the instances.

**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.

After you add a UCS Central target, Workload Optimization Manager will discover all the associated UCS Manager targets that are part of the UCS Central instance.
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

Workload Optimization Manager recommends actions for the various UCS Manager instances of the UCS Central Fabric Network as follows:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fabric Interconnect</td>
<td>• Add Port to Port Channel</td>
</tr>
<tr>
<td></td>
<td>Overutilization of Ports in Port Channel</td>
</tr>
<tr>
<td></td>
<td>• Remove Port from Port Channel</td>
</tr>
<tr>
<td></td>
<td>Underutilization of Ports in Port Channel</td>
</tr>
<tr>
<td></td>
<td>• Add Port</td>
</tr>
<tr>
<td></td>
<td>Overutilization of Ports not in Port Channels</td>
</tr>
<tr>
<td>Blade</td>
<td>• Provision Blade</td>
</tr>
<tr>
<td></td>
<td>Overutilization of currently available Blades</td>
</tr>
<tr>
<td></td>
<td>Available powered-down Blade without associated host profile</td>
</tr>
<tr>
<td></td>
<td>• Start Blade</td>
</tr>
<tr>
<td></td>
<td>Overutilization of currently available blades</td>
</tr>
<tr>
<td></td>
<td>Available powered-down Blade with associated host profile</td>
</tr>
<tr>
<td></td>
<td>• Suspend Blade</td>
</tr>
<tr>
<td></td>
<td>Underutilization of currently available Blades</td>
</tr>
</tbody>
</table>

**NOTE:** Workload Optimization Manager will also recommend adding a port to the I/O Module via an "Add Port to Port Channel" recommendation from the Fabric Interconnect, with the Port Channel name of "fex" (Fabric EXtender). Workload Optimization Manager will never resize down the I/O module Port Channel.

Monitored Resources

Workload Optimization Manager monitors the following commodities of each underlying UCS Manager instance:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>VirtualMachine</td>
<td>• Virtual Memory (VMem)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the VMem allocated to the hosting VM</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td></td>
<td>• Virtual CPU (VCPU)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the VCPU allocated to the hosting VM</td>
</tr>
<tr>
<td></td>
<td>Measured in Megahertz (MHz)</td>
</tr>
<tr>
<td></td>
<td>• Virtual Storage (VStorage)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the virtual storage capacity allocated for the VM</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
</tbody>
</table>
Storage Access Operations Per Second (IOPS)
The utilization of IOPS allocated for the VStorage on the VM
Measured in IOPS

Latency
The utilization of latency allocated for the VStorage on the VM
Measured in milliseconds (ms)

Blade

Net
The utilization of data through the Blade's network adapters
Measured in Kilobytes per second (KB/s)
Treated as a Physical Machine of the underlying Hypervisor (see below)
CPU, Mem, etc.

Physical Machine

Memory (Mem)
The utilization of the PM's memory reserved or in use
Measured in Kilobytes (KB)

CPU
The utilization of the PM's CPU reserved or in use
Measured in Megahertz (MHz)

IO
The utilization of the PM's IO adapters
Measured in Kilobytes per second (KB/s)

Net
The utilization of data through the PM's network adapters
Measured in Kilobytes per second (KB/s)

Swap
The utilization of the PM's swap space
Measured in Kilobytes (KB)

Balloon
The utilization of shared memory among VMs running on the host. ESX-only
Measured in Kilobytes (KB)

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)

Chassis

Space
Representation of the physical number of Rack-Mounts available
Measured in Rack-slots

Power
Electricity being consumed by the Chassis
Measured in Watts (W)

Temperature
Temperature of the internals of the Chassis
Measured in degrees Celsius (C)

I/O Module

NetThroughput
Rate of message delivery over a port
Measured in Megabits per second (Mb/s)
Fabric Interconnect

- **NetThroughput**
  Rate of message delivery over a port
  Measured in Mb/s

- **PortChannel**
  Amalgamation of ports with a shared net throughput and utilization
  Measured in Mb/s

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 repurposed.

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 Workload Optimization Manager enables automation at the hardware level, including automated provisioning of hosts.

Prerequisites

- A service account Workload Optimization Manager 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.

  Workload Optimization Manager 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 Workload Optimization Manager will use to connect to the HPE OneView target.

  specify the IP address and credentials for HPE OneView. Workload Optimization Manager 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

Workload Optimization Manager recommends actions for the various entities of the HPE OneView Fabric Network as follows:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Machines</td>
<td>▪ Provision additional resources (VMem, VCPU)</td>
</tr>
<tr>
<td></td>
<td>▪ Move Virtual Machine</td>
</tr>
<tr>
<td></td>
<td>▪ Move Virtual Machine Storage</td>
</tr>
<tr>
<td></td>
<td>▪ Reconfigure Storage</td>
</tr>
<tr>
<td></td>
<td>▪ Reconfigure Virtual Machine</td>
</tr>
<tr>
<td>Physical Machines</td>
<td>▪ Start Physical Machine</td>
</tr>
<tr>
<td></td>
<td>▪ Provision Physical Machine</td>
</tr>
<tr>
<td></td>
<td>▪ Suspend Physical Machine</td>
</tr>
<tr>
<td>Fabric Interconnect</td>
<td>▪ Add Port to Port Channel</td>
</tr>
<tr>
<td></td>
<td>▪ Remove Port from Port Channel</td>
</tr>
<tr>
<td></td>
<td>▪ Add Port</td>
</tr>
<tr>
<td>DPod</td>
<td>▪ Provision new DPod</td>
</tr>
</tbody>
</table>

Monitored Resources

Workload Optimization Manager monitors the following commodities of the HPE OneView target:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>VirtualMachine</td>
<td>▪ Virtual Memory (VMem)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the VMem allocated to the hosting VM</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td></td>
<td>▪ Virtual CPU (VCPU)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the VCPU allocated to the hosting VM</td>
</tr>
<tr>
<td></td>
<td>Measured in Megahertz (MHz)</td>
</tr>
<tr>
<td></td>
<td>▪ Virtual Storage (VStorage)</td>
</tr>
<tr>
<td></td>
<td>The utilization of the virtual storage capacity allocated for the VM</td>
</tr>
<tr>
<td></td>
<td>Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td></td>
<td>▪ Storage Access Operations Per Second (IOPS)</td>
</tr>
<tr>
<td></td>
<td>The utilization of IOPS allocated for the VStorage on the VM</td>
</tr>
<tr>
<td></td>
<td>Measured in IOPS</td>
</tr>
<tr>
<td></td>
<td>▪ Latency</td>
</tr>
<tr>
<td></td>
<td>The utilization of latency allocated for the VStorage on the VM</td>
</tr>
<tr>
<td></td>
<td>Measured in milliseconds (ms)</td>
</tr>
</tbody>
</table>
Physical Machine

- **Memory (Mem)**
  The utilization of the PM's memory reserved or in use
  Measured in Kilobytes (KB)

- **CPU**
  The utilization of the PM's CPU reserved or in use
  Measured in Megahertz (MHz)

- **IO**
  The utilization of the PM's IO adapters
  Measured in Kilobytes per second (KB/s)

- **Net**
  The utilization of data through the PM's network adapters
  Measured in Kilobytes per second (KB/s)

- **Swap**
  The utilization of the PM's swap space
  Measured in Kilobytes (KB)

- **Balloon**
  The utilization of shared memory among VMs running on the host. ESX-only
  Measured in Kilobytes (KB)

- **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)

Storage

- **Storage Amount**
  The utilization of the datastore's capacity
  Measured in Megabytes (MB)

- **Storage Provisioned**
  The utilization of the datastore's capacity, including overprovisioning.
  Measured in Megabytes (MB)

- **Storage Access Operations Per Second (IOPS)**
  The utilization of the storage access operations per second on the datastore
  Measured in Operations per second

- **Latency**
  The utilization of latency on the datastore
  Measured in Milliseconds (ms)

I/O Module

- **NetThroughput**
  Rate of message delivery over a port
  Measured in Megabits per second (Mb/s)

Fabric Interconnect

- **NetThroughput**
  Rate of message delivery over a port
  Measured in Mb/s

- **PortChannel**
  Amalgamation of ports with a shared net throughput and utilization
  Measured in Mb/s
DPod

- **Memory (Mem)**
  The utilization of the DPod's memory reserved or in use
  Measured in Kilobytes (KB)

- **CPU**
  The utilization of the DPod's CPU reserved or in use
  Measured in Megahertz (MHz)

- **Storage**
  The utilization of the storage attached to the DPod
  Measured in Kilobytes (KB)

- **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)
UCS Director

Workload Optimization Manager supports dynamic execution of UCS Director workflows, enabling provisioning, resizing and decommissioning of entities in a UCS environment.

Prerequisites

- UCS Director 5.0+
- UCS Director user account with administrator permissions
- UCS Director Workflow Configuration (see below)

**NOTE:** If UCS Director is managing other services which are also Workload Optimization Manager targets (for example, NetApp or vCenter), these targets must be added using the same convention (Hostname or IP) in both UCS Director and Workload Optimization Manager.

Adding UCS Director Targets

To add UCS Director targets, select the **Orchestration > UCS Director** option on the Target Configuration page and provide the following information:

- **Address**
  - IP of the UCS Director Instance
- **Username**
  - Username for the UCS Director Instance
- **Password**
  - Password for the UCS Director Instance
- **Port Number**
  - Port Number used to access the UCS Director Instance

Binding A UCS Director Workflow to a Workload Optimization Manager Action Execution Policy

**NOTE:** Orchestration workflows can only be associated to action execution in the HTML5 UI.

To add a UCS Director workflow, perform the following steps:

1. Navigate to **Settings > Policies**, and select the **Automation Policy** button.
2. Select the entity that the workflow affects, bringing you to the policy configuration page.
3. Under **Action Orchestration**, select the action that the workflow affects.

4. In the **Run In** dropbox that appears after the action is selected, choose UCS Director.

5. Click **Link Workflow** and select the applicable workflow.

6. Click **Save and Apply**. The workflow is now activated.

### Supported Workflows

To execute each workflow, Workload Optimization Manager will provide a set number of pre-defined parameters to Workload Optimization Manager as outlined below. Your workflow must be designed to accept the parameters mentioned below for Workload Optimization Manager integration to succeed. No parameters may be omitted, or integration will fail.

Workflow discovery will occur once per day. To discover new workflows sooner, you must manually rediscover the UCS Director target.

**NOTE:** For example workflows that leverage these parameters, please see the following Cisco documentation: [https://communities.cisco.com/docs/DOC-75351](https://communities.cisco.com/docs/DOC-75351).

- **Host Provision**

**NOTE:** The intent behind this workflow is to provide a user with the information they need to enable a new UCS Server and to configure a hypervisor on that server.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Sample Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>POD</td>
<td>The name of the Pod</td>
<td>Default Pod</td>
</tr>
<tr>
<td>SERVER_FILER</td>
<td>The UCSM IP/FQDN of the host</td>
<td>ucsmanager.domain.com</td>
</tr>
<tr>
<td>SERVER</td>
<td>The stitched IP/FQDN of the host</td>
<td>vcenter1.domain.com</td>
</tr>
<tr>
<td>REFERENCE_HOST</td>
<td>The name of the reference host</td>
<td>hypervisor.domain.com</td>
</tr>
<tr>
<td>HOST_PROFILE</td>
<td>The name of the host profile</td>
<td>vcenter1@HostProfileName</td>
</tr>
<tr>
<td>SERVICE_PROFILE_TEMPLATE_ID</td>
<td>The ID of the service profile template</td>
<td>ucspe;org-root;org-root/ls-sp1_template</td>
</tr>
<tr>
<td>SERVICE_PROFILE_ORGANIZATION</td>
<td>The name of the service profile organization</td>
<td>org-root</td>
</tr>
<tr>
<td>HV_ACCOUNT</td>
<td>The account name of the hypervisor target</td>
<td>vcenter1</td>
</tr>
<tr>
<td>REFERENCE_SERVER</td>
<td>The name of the UCS Manager reference server</td>
<td>sys/chassis-1/blade-1</td>
</tr>
<tr>
<td>UCSM_ACCOUNT</td>
<td>The name of the UCS Manager account</td>
<td>ucsmanager</td>
</tr>
<tr>
<td>DATACENTER</td>
<td>The name of the datacenter for the new host</td>
<td>DataCenter1</td>
</tr>
<tr>
<td>CLUSTER</td>
<td>The name of the cluster for the new host</td>
<td>Cluster-1</td>
</tr>
</tbody>
</table>

- **Host Suspend**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Sample Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>POD</td>
<td>The name of the Pod</td>
<td>Default Pod</td>
</tr>
<tr>
<td>SERVER_FILER</td>
<td>The UCSM IP/FQDN of the host</td>
<td>ucsmanager.domain.com</td>
</tr>
</tbody>
</table>
### Storage Resize

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Sample Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>POD</td>
<td>The name of the Pod</td>
<td>Default Pod</td>
</tr>
<tr>
<td>SERVER_FILER</td>
<td>The UCSM IP/FQDN of the storage</td>
<td>netapp-cluster1.domain.com</td>
</tr>
<tr>
<td>SERVER</td>
<td>The stitched IP/FQDN of the hypervisor</td>
<td>vcenter1.domain.com</td>
</tr>
<tr>
<td>SC_DATASTORE</td>
<td>The name of the datastore in the Storage Controller</td>
<td>ESXvol1</td>
</tr>
<tr>
<td>SC_ACCOUNT</td>
<td>The account name of the storage controller target</td>
<td>netapp-cluster1</td>
</tr>
<tr>
<td>HV_DATASTORE</td>
<td>The names of the datastores in the Hypervisor</td>
<td>NETAPP8.3-VOL1</td>
</tr>
<tr>
<td>HV_ACCOUNTS</td>
<td>The account names of the Hypervisor targets</td>
<td>vcenter1</td>
</tr>
<tr>
<td>SIZE</td>
<td>The target size of the storage in GB</td>
<td>3.75</td>
</tr>
<tr>
<td>HOSTS</td>
<td>The hosts that the datastore is exposed to</td>
<td>hypervisor1.domain.com, hypervisor2.domain.com, hypervisor3.domain.com</td>
</tr>
<tr>
<td>LUN_NAME</td>
<td>The LUN to resize on the Storage Target</td>
<td>NETAPP8.3–LUN1</td>
</tr>
</tbody>
</table>

### Storage Delete

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Sample Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>POD</td>
<td>The name of the Pod</td>
<td>Default Pod</td>
</tr>
<tr>
<td>SERVER_FILER</td>
<td>The UCSM IP/FQDN of the storage</td>
<td>netapp-cluster1.domain.com</td>
</tr>
<tr>
<td>SERVER</td>
<td>The stitched IP/FQDN of the hypervisor</td>
<td>vcenter1.domain.com</td>
</tr>
<tr>
<td>SC_DATASTORE</td>
<td>The name of the datastore in the Storage Controller</td>
<td>ESXvol1</td>
</tr>
<tr>
<td>SC_ACCOUNT</td>
<td>The account name of the storage controller target</td>
<td>netapp-cluster1</td>
</tr>
<tr>
<td>HV_DATASTORE</td>
<td>The names of the datastores in the Hypervisor</td>
<td>NETAPP8.3-VOL1</td>
</tr>
<tr>
<td>HV_ACCOUNTS</td>
<td>The account names of the Hypervisor targets</td>
<td>vcenter1</td>
</tr>
<tr>
<td>HOSTS</td>
<td>The hosts that the datastore is exposed to</td>
<td>hypervisor1.domain.com, hypervisor2.domain.com, hypervisor3.domain.com</td>
</tr>
<tr>
<td>LUN_NAME</td>
<td>The LUN to resize on the Storage Target</td>
<td>NETAPP8.3–LUN1</td>
</tr>
</tbody>
</table>
Storage Provision

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Sample Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>POD</td>
<td>The name of the Pod</td>
<td>Default Pod</td>
</tr>
<tr>
<td>SERVER_FILER</td>
<td>The UCSM IP/FQDN of the storage</td>
<td>netapp-cluster1.domain.com</td>
</tr>
<tr>
<td>SERVER</td>
<td>The stitched IP/FQDN of the hypervisor</td>
<td>vcenter1.domain.com</td>
</tr>
<tr>
<td>SC_REFERENCE_DATASTORE</td>
<td>The name of the reference datastore in the Storage Controller</td>
<td>ESXvol1</td>
</tr>
<tr>
<td>SC_ACCOUNT</td>
<td>The account name of the storage controller target</td>
<td>netapp-cluster1</td>
</tr>
<tr>
<td>DATASTORE_PROVIDER</td>
<td>The provider (DiskArray / LogicalPool) of the new datastore</td>
<td>netapp-cluster1:aggr1</td>
</tr>
<tr>
<td>HOSTS</td>
<td>The hosts that the datastore is exposed to</td>
<td>hypervisor1.domain.com,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>hypervisor2.domain.com,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>hypervisor3.domain.com</td>
</tr>
<tr>
<td>HV_ACCOUNTS</td>
<td>The account names of the Hypervisor targets</td>
<td>vcenter1</td>
</tr>
<tr>
<td>SIZE</td>
<td>The target size of the storage in GB</td>
<td>3.75</td>
</tr>
<tr>
<td>LUN_NAME</td>
<td>The LUN to resize on the Storage Target</td>
<td>NETAPP8.3–LUN1</td>
</tr>
</tbody>
</table>
Load Balancer Targets

A load balancer is a network appliance that provides Level 4 load balancing of requests to application services. Level 4 load balancing routes traffic according to business rules so that servers with the least load or fastest response times will receive requests from the load balancer.

Workload Optimization Manager supports Citrix NetScaler load balancers.

If you have installed the Application Edition of Workload Optimization Manager, you can add load balancers as targets. When you add these targets, Workload Optimization Manager can discover the associated virtual applications.

Workload Optimization Manager recommends actions on the VMs that host the underlying applications. If the VM hosts an application with a signature that is associated with a virtual application, then provisioning the new VM will automatically bind the underlying application to the virtual application. In this way, Workload Optimization Manager can control the underlying resources that support the load balancer’s demand.

Supply Chain

A load balancer target adds virtual applications to the supply chain. Workload Optimization Manager discovers the virtual applications (sometimes called virtual servers) that are managed by that load balancer. The virtual application is a proxy for multiple instances of actual applications. When a client requests application services, it requests them through the virtual application. The load balancer distributes the requests to balance the workload on the underlying applications that provide transactions to the virtual application.

Configuring Load Balancer Discovery

After you add a load balancer as a target, you must configure Workload Optimization Manager to discover the virtual applications that load balancer manages.

The steps to do this are:

1. Specify discovery for the applications the load balancer will manage

   The load balancer manages workload across instances of running applications in your environment. Workload Optimization Manager must be configured to discover and manage these running applications before it can recognize that they are managed by the load balancer. For example, to specify discovery of a specific application, you define its application signature and then provide credentials for the protocol (WMI, SNMP, or JMX) that Workload Optimization Manager can use to access the VMs that host the application. For more information, see “Application Discovery” in the User Guide.

2. Assign application signatures to specific virtual applications

   Workload Optimization Manager discovers the virtual applications that the load balancer uses to manage applications. After you have specified signatures and discovery for the applications you want the load balancer to manage, you can then assign those application signatures to specific virtual applications. For more information, see “Load Balancer Discovery” in the User Guide.

   For example, assume the load balancer uses virtual applications named web and sql to manage web servers and SQL databases. Also assume that you have defined an application signature named IIS for IIS Web Server applications, and another signature named SQL for Microsoft SQL Server applications. In that case, you need to map
the IIS signature to the web virtual application, and SQL to the sql virtual application (as explained in the Load Balancer Discovery section). Now Workload Optimization Manager can discover these applications and represent them as the running components within the load balancer.

Adding Citrix NetScaler Targets

To add NetScaler targets, select the Load Balancers > NetScaler option on the Target Configuration page and provide the following information:

- **Address:** The IP address of the primary NetScaler load balancer server

  Workload Optimization Manager discovers the service types that are assigned to that load balancer. These service types appear in the Workload Optimization Manager supply chain as virtual applications. To enable discovery of virtual applications, you must configure load balancer discovery.

- **Username/Password:** The credentials of an account Operations Manager can use to connect to the load balancer.

Actions

Workload Optimization Manager recommends actions for the Load Balancer supply chain as follows.

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Applications</td>
<td>Workload Optimization Manager does not recommend actions to perform on the virtual application itself, but it does recommend actions to perform on the VMs that host bound applications. For example, assume a virtual application that manages three SQL databases. If a surge in requests degrades performance across all three databases, then Workload Optimization Manager can start a new VM to run another instance of the database application, and bind it to the virtual application. On the other hand, if SQL requests drop off so that the load balancer only forwards requests to two of the databases, Workload Optimization Manager can suspend the dormant database and unbind it from the virtual application. Virtual Applications will only be discovered if there is a load balancer configured.</td>
</tr>
<tr>
<td>Applications</td>
<td>Without discovered Guest OS Processes, Workload Optimization Manager doesn’t perform actions on applications. Instead, it performs resize actions on the host VMs. If host utilization is high enough on the physical machine running the application VM, Workload Optimization Manager may also recommend provisioning a new host. For specific applications, see the individual application entry.</td>
</tr>
<tr>
<td>Virtual Machines</td>
<td>- Provision additional resources (VMem, VCPU)</td>
</tr>
<tr>
<td></td>
<td>- Move Virtual Machine</td>
</tr>
<tr>
<td></td>
<td>- Move Virtual Machine Storage</td>
</tr>
<tr>
<td></td>
<td>- Reconfigure Storage</td>
</tr>
<tr>
<td></td>
<td>- Reconfigure Virtual Machine</td>
</tr>
</tbody>
</table>
## Monitored Resources

Workload Optimization Manager monitors the following resources for the Load Balancer supply chain:

<table>
<thead>
<tr>
<th>Entity Type</th>
<th>Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Applications</td>
<td><strong>Transactions</strong>&lt;br&gt;The utilization of the allocated transactions per second for the given virtual application&lt;br&gt;Measured in transactions per second</td>
</tr>
<tr>
<td></td>
<td><strong>Virtual Memory (VMem)</strong>&lt;br&gt;The utilization of the VMem allocated to the hosting VM&lt;br&gt;Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td></td>
<td><strong>Virtual CPU (VCPU)</strong>&lt;br&gt;The utilization of the VCPU allocated to the hosting VM&lt;br&gt;Measured in Megahertz (MHz)</td>
</tr>
<tr>
<td></td>
<td><strong>Transactions</strong>&lt;br&gt;The utilization of the allocated transactions per second for the given virtual application&lt;br&gt;Measured in transactions per second</td>
</tr>
<tr>
<td></td>
<td><strong>Heap</strong>&lt;br&gt;The utilization of the application server’s heap&lt;br&gt;Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td></td>
<td><strong>Response Time</strong>&lt;br&gt;The utilization of the server’s allocated response time&lt;br&gt;Measured in Milliseconds (ms)</td>
</tr>
<tr>
<td></td>
<td><strong>Threads</strong>&lt;br&gt;The utilization of the server’s thread capacity&lt;br&gt;Measured in Threads</td>
</tr>
<tr>
<td></td>
<td><strong>DBMem</strong>&lt;br&gt;The utilization of the database’s memory capacity. Only applicable to database servers&lt;br&gt;Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td></td>
<td><strong>Connection</strong>&lt;br&gt;The utilization of the connection capacity. Only applicable to database servers&lt;br&gt;Measured in Connections</td>
</tr>
<tr>
<td></td>
<td><strong>TransactionLog</strong>&lt;br&gt;The utilization of the server’s capacity for storage devoted to transaction logs&lt;br&gt;Measured in Kilobytes (KB)</td>
</tr>
<tr>
<td></td>
<td><strong>Garbage Collection</strong>&lt;br&gt;The of server uptime spent garbage collecting&lt;br&gt;Measured in of uptime (%)</td>
</tr>
</tbody>
</table>
- **Virtual Memory (VMem)**
  - The utilization of the VMem allocated to the hosting VM
  - Measured in Kilobytes (KB)

- **Virtual CPU (VCPU)**
  - The utilization of the VCPU allocated to the hosting VM
  - Measured in Megahertz (MHz)

- **Virtual Storage (VStorage)**
  - The utilization of the virtual storage capacity allocated for the VM
  - Measured in Kilobytes (KB)

- **Storage Access Operations Per Second (IOPS)**
  - The utilization of IOPS allocated for the VStorage on the VM
  - Measured in IOPS

- **Latency**
  - The utilization of latency allocated for the VStorage on the VM
  - Measured in milliseconds (ms)
Workload Optimization Manager Targets for Aggregation

For large virtual environments, you can use more than one Workload Optimization Manager instance to manage your workload. By aggregating multiple instances in this way, you can view the entire environment through a single GUI. One special installation of Workload Optimization Manager serves as the aggregating instance to display the combined data of each underlying target instance. For more information about Workload Optimization Manager aggregation, see "Aggregated Workload Optimization Manager installations" in the User Guide.

License Requirements

All Editions of Workload Optimization Manager support aggregated deployments.

Prerequisites

The Workload Optimization Manager instance that aggregates other Workload Optimization Manager servers cannot have any other targets — it can only manage other instances of Workload Optimization Manager.

Adding Workload Optimization Manager Targets

To add an aggregated instance of Workload Optimization Manager, select the Workload Optimization Manager Appliance option on the Target Configuration page and provide the following information:

NOTE: All the targets of an aggregating instance must be target instances of Workload Optimization Manager. You cannot use an aggregating instance to manage other types of targets.

- Address
  The name or IP address of the Workload Optimization Manager server.

- Username/Password
  Credentials for the administrator account on the Workload Optimization Manager server.

- Appliance ID
  An ID string that you can use to identify this particular Workload Optimization Manager server.

The Server ID appears in the aggregating user interface when the user needs to access an underlying server. For example, assume you’re logged into an aggregating server and want to run a plan. When you display the Plan view, you will see the underlying target servers, listed by their Server IDs.
Appendix – Target Configuration

This appendix contains topics that are related to configuring Workload Optimization Manager targets.

Secure Setup of WSMan

Workload Optimization Manager 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:

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

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

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

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

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

4. Verify the presence of configured listeners:

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

Enabling Windows Remote Management

**NOTE:** This topic covers the setup of WinRM for a single host. For enabling WinRM on multiple hosts, see the following topics:

- Enabling WinRM Via Global Policy Objects on page 186
- Enabling WinRM Via PowerShell on page 187
Workload Optimization Manager 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 a Service Principal Name (SPN) for the host machine.

   The machine must have a 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 my-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"}
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.

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:
   b. Double-click each of following settings and configure as specified:

<table>
<thead>
<tr>
<th>Setting</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allow automatic configuration of listeners (&quot;Allow remote server management through WinRM&quot; on older versions of Windows Server):</td>
<td>Enabled IPv4 filter: *</td>
</tr>
<tr>
<td>Allow Basic authentication:</td>
<td>Enabled</td>
</tr>
<tr>
<td>Allow unencrypted traffic:</td>
<td>Enabled</td>
</tr>
</tbody>
</table>

6. Configure the WinRM service to run automatically:
   a. In the Group Policy Management Editor, expand Computer Configuration > Preferences > Control Panel Settings.
   c. In the New Service Properties window, configure the following settings:

<table>
<thead>
<tr>
<th>Setting</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Startup:</td>
<td>Automatic</td>
</tr>
<tr>
<td>Service name:</td>
<td>WinRM</td>
</tr>
<tr>
<td>Service option:</td>
<td>Service start</td>
</tr>
</tbody>
</table>
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](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 Cisco requires changes to the default quickconfig settings, create a batch file containing the following command:

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

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

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

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

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

   **NOTE:** If you get an error message when executing this command, add the **-h** option (**.\PsExec.exe -h**).
Port Configuration

To support communication with different target technologies, Workload Optimization Manager requires open access to the following ports:

<table>
<thead>
<tr>
<th>Target</th>
<th>Port(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vcenter (Monitoring)</td>
<td>80, 443</td>
</tr>
<tr>
<td>Vcenter (Tags)</td>
<td>443, 10443</td>
</tr>
<tr>
<td>Hyper-V</td>
<td>5985, 5986</td>
</tr>
<tr>
<td>RHEV</td>
<td>80, 443</td>
</tr>
<tr>
<td>XenCenter</td>
<td>80, 443</td>
</tr>
<tr>
<td>Vcloud Director</td>
<td>80, 443</td>
</tr>
<tr>
<td>CloudStack</td>
<td>80, 443</td>
</tr>
<tr>
<td>OpenStack</td>
<td>5000, 8774, 8776, 8777</td>
</tr>
<tr>
<td>VMM</td>
<td>5985, 5986</td>
</tr>
<tr>
<td>CloudFoundry</td>
<td>80, 443</td>
</tr>
<tr>
<td>VMAX</td>
<td>5988, 5989</td>
</tr>
<tr>
<td>Dell Compellent</td>
<td>5988, 5989</td>
</tr>
<tr>
<td>Nutanix</td>
<td>9440</td>
</tr>
<tr>
<td>XtremIO</td>
<td>80, 443</td>
</tr>
<tr>
<td>Pure</td>
<td>80, 443</td>
</tr>
<tr>
<td>HPE 3PAR</td>
<td>5988, 5989, 8080</td>
</tr>
<tr>
<td>NetApp</td>
<td>80, 443</td>
</tr>
<tr>
<td>NetScaler</td>
<td>80, 443</td>
</tr>
<tr>
<td>Cisco UCS</td>
<td>80, 443</td>
</tr>
<tr>
<td>sFlow</td>
<td>80, 443</td>
</tr>
<tr>
<td>Netflow</td>
<td>80, 443</td>
</tr>
</tbody>
</table>
Cisco Unified Computing System

UCS Blade Provisioning

When managing a UCS fabric target, Workload Optimization Manager can provision any blade servers that are installed in a chassis but not currently in operation. If the workload demands more physical compute resources, Workload Optimization Manager 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 Workload Optimization Manager 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 Workload Optimization Manager 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, Workload Optimization Manager can direct vCenter Server to move workloads onto the server.

Workload Optimization Manager 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:


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, Workload Optimization Manager sets the Host Provision action to Recommend.

For any hosts other than blade servers managed by UCS, Workload Optimization Manager 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, Workload Optimization Manager 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, Workload Optimization Manager 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.

Workload Optimization Manager 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.