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What's New

This release of Turbonomic includes the following new features:

- **User Interface Enhancements**
  
  We have added the following improvements to the Turbonomic user interface:
  
  - **Scheduled Action Windows** — You can now specify multiple action restrictions per scheduled window. You can also create a scheduled window that has no end date.
  
  - **Target Configuration** — When you add targets, Turbonomic automatically validates each new target and begins discovery. To help working with many targets, you can filter the list to show only targets of a given type.
  
  - **Standard Dashboards** — The Supply and Demand dashboard and the Application QoS dashboard both have charts to show actions executed over time. You can compare the types of actions performed, and you can compare how many actions were automated vs executed manually.
  
  - **Custom Dashboards** — You can now share custom dashboards with an Active Directory group. As members log onto Turbonomic they will see the shared dashboards in their My Dashboards folder.

- **Hypervisor Support**
  
  This release includes support for IBM PowerVM targets. Turbonomic recognizes a PowerVM Frame as a single physical host, and supports management of workload across the entire pool of resources.

- **Integration Enhancements**
  
  This release of Turbonomic supports integration with VMware vRealize Automation. You can use Turbonomic analysis to determine optimal placement of workload, and include those decisions in the vRealize workflow.

- **Documentation**
  
  This release introduces a new document, the Target Configuration Guide. This document describes target setup and configuration in greater detail. Also, the Online Help has been reorganized. You can still find a description of the target configuration user interface in the Turbonomic Reference, but for specific details about each target, refer to the Target Configuration Guide. For more information, see "TargetConfiguration" in the Target Configuration Guide.
Introducing Turbonomic

Thank you for choosing Turbonomic, the premier solution for intelligent workload management of cloud and virtual environments. Turbonomic maintains your environment within the desired state — operating conditions that achieve the following conflicting goals at the same time:

- Assured application performance
  Prevent bottlenecks, provision physical resources, upsize VMs, prioritize workload.

- Efficient use of resources
  Consolidate workload, downsize VMs, prevent VM sprawl and dormant VMs.

Turbonomic is a server application running on VM that you install on your network. You then assign Virtual Management services running on your network to be Turbonomic targets. Turbonomic discovers the devices each target manages, and then performs analysis, anticipates risks to performance or efficiency, and recommends actions you can take to avoid problems before they occur.

How Turbonomic Works

To keep your infrastructure in the desired state, Turbonomic performs Intelligent Workload Management. This is an ongoing process that solves the problem of assuring application performance while simultaneously achieving the most efficient use of resources that is possible.

This is not a simple problem to solve. Intelligent Workload Management has to consider many different resources, numerous control points for each device, and how devices and resources are used in relation to each other. As you add devices to your infrastructure, the factors for each decision increase exponentially. On top of that, the environment is constantly changing — to stay in the desired state, you are constantly trying to hit a moving target.

To perform Intelligent Workload Management, Turbonomic models the environment as a market made up of buyers and sellers. These buyers and sellers make up a supply chain that represents tiers of devices in your inventory.

See the The Supply Chain View on page 124 for a visual layout of the buyer and seller relationships.
Turbonomic uses *Virtual Currency* to give a budget to buyers and assign cost to resources. This virtual currency assigns value across all tiers of your environment, making it possible to compare the cost of application transactions with the cost of space on a disk or physical space in a data center.

The price that a seller charges for a resource changes according to the seller's supply. As demand increases, prices increase. As prices change, buyers and sellers react. Buyers are free to look for other sellers that offer a better price, and sellers can duplicate themselves (open new storefronts) to meet increasing demand. Turbonomic uses its *Economic Scheduling Engine* to analyze the market and make these decisions. The effect is an invisible hand that dynamically guides your IT infrastructure to the optimal use of resources.

To get the most out of Turbonomic, you should understand how it models your environment, the kind of analysis it performs, and the desired state it works to achieve.

## The Desired State

![Diagram of Delay vs. Utilization](image)

The goal of Intelligent Workload Management is to assure performance while maintaining efficient use of resources. When performance and efficiency are both maintained, you are in the desired state. You can measure performance as a function of delay, where zero delay gives the ideal QoS for a given service. Efficient use of resources is a function of utilization where 100% utilization of a resource is the ideal for the most efficient utilization.

If you plot delay and utilization, the result is a curve that shows a correlation between utilization and delay. Up to a point, as you increase utilization, the increase in delay is slight. There comes a point on the curve where a slight increase in utilization results in an unacceptable increase in delay. On the other hand, there is a point in the curve where a reduction in utilization doesn't yield a meaningful increase in QoS. The desired state lies within these points on the curve.

You could set a threshold to post an alert whenever the upper limit is crossed. In that case, you would never react to a problem until delay has already become unacceptable. To avoid that late reaction you could set the threshold to post an alert before the upper limit is crossed. In that case, you guarantee QoS at the cost of over-provisioning — you increase operating costs and never achieve efficient utilization.

Instead of responding *after* a threshold is crossed, Turbonomic analyzes the operating conditions and constantly recommends actions to keep the entire environment within the desired state. If you execute these actions (or let Turbonomic execute them for you), the environment will maintain operating conditions that assure performance for your customers, while ensuring the lowest possible cost thanks to efficient utilization of your resources.

For a quick view of your current environment and how it is converging on the desired state, see *The Workload View* on page 166.
The Market and Virtual Currency

To perform Intelligent Workload Management, Turbonomic models the environment as a market, and uses market analysis to manage resource supply and demand. For example, bottlenecks form when local workload demand exceeds the local capacity — in other words, when demand exceeds supply. By modeling the environment as a market, Turbonomic can use economic solutions to efficiently redistribute the demand or increase the supply.

Turbonomic uses two sets of abstraction to model the environment:

- Modeling the physical and virtual IT stack as a service supply chain
  The supply chain models devices in your environment as managed entities. These include applications, VMs, host machines (physical machines, or PMs), storage, and data centers. Every entity is a buyer, a seller, or both. A host machine buys physical space, power, and cooling from a data center. The physical machine sells host resources such as CPU cycles and memory to VMs. In turn, VMs buy host services, and then sell their resources (VMem and VCPU) to applications.

  See the The Supply Chain View on page 124 for a visual layout of the buyer and seller relationships.

- Using virtual currency to represent delay or QoS degradation, and to manage the supply and demand of services along the modeled supply chain
  The system uses virtual currency to value these buy/sell transactions. Each managed entity has a running budget — the entity adds to its budget by providing resources to consumers, and the entity draws from its budget to pay for the resources it consumes. The price of a resource is driven by its utilization — the more demand for a resource, the higher its price.

The Economic Scheduling Engine

Turbonomic tracks price for resources in terms of the Utilization Index (UI). The higher this index for a resource, the more heavily the resource is utilized, the greater the delay for consumers of that resource, and the greater the risk to your QoS. Turbonomic constantly works to keep the UI within acceptable bounds.
You can think of UI as the cost for a resource — Turbonomic works to keep the cost at a competitive level. This is not simply a matter of responding to threshold conditions. Turbonomic analyzes the full range of buyer/seller relationships, and each buyer constantly seeks out the most economical transaction that is available.

This last point is crucial to understanding Turbonomic. The virtual environment is dynamic, with constant changes to workload that correspond with the varying requests your customers make of your applications and services. By examining each buyer/seller relationship, the Economic Scheduling Engine arrives at the optimal workload distribution for the current state of the environment. In this way, Turbonomic constantly drives your environment toward the desired state.

For example, assume a single PM that hosts one VM with a critical application, and also hosts two VMs with non-critical applications. Consider these similar situations:

- The critical application has increased use, and the non-critical applications are dormant
  In this case, Turbonomic can suspend the two unused VMs (reduce VM sprawl) and devote more host resources to the critical application.

- The critical application has increased use, and both non-critical applications see increased use
  In this case, Turbonomic can move the non-critical VMs to another host and devote more host resources to the critical application.

This is a very simple case, but it illustrates the value of constant analysis of all the relationships. For the critical application, the results are the same. But for the environment as a whole, the results arrive at different, economical solutions, that are best for the actual conditions. The Economic Scheduling Engine considers all the entities and resources in your environment, and analyzes them to constantly tend toward the desired state.

**NOTE:** The default Turbonomic configuration is ready to use in many environments. However, you can fine-tune the configuration to address special services and resources in your environment. Turbonomic provides a full range of policies that you can set to control how the software manages specific groups of entities. Before you make such policy settings, you should understand default Turbonomic operation. For more information about policies, see *The Policy View* on page 325.

**The Turbonomic Supply Chain**

Turbonomic models your environment as a market of buyers and sellers. It discovers different types of entities in your environment via the targets you have configured for your installation. Discovery maps these entities to the supply chain so Turbonomic can monitor them and manage the workloads they support. For example, for a hypervisor target Turbonomic discovers VMs, the PMs and datastores that provide resources to the VMs, and the applications that use VM resources. The entities in your environment form a chain of supply and demand where some entities provide resources while others consume the supplied resources.

For information about specific members of the supply chain, see *The Supply Chain View* on page 124.

**Supply Chain Terminology**

Turbonomic introduces specific terms to express IT resources and utilization in terms of supply and demand. These terms are largely intuitive, but you should understand how they relate to the issues and activities that are common for IT management.
Introducing Turbonomic

Turbonomic, Inc. www.turbonomic.com

Turbonomic Host Requirements

Turbonomic runs on hosts that meet the following requirements:

<table>
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<th>Supported Hypervisor Technology</th>
<th>Storage Requirements</th>
<th>Memory</th>
<th>CPUs</th>
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</thead>
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<tr>
<td>VMware:</td>
<td>150GB or greater disk storage + swap space to match the RAM allocation (for example, 150GB + 16GB = 166GB)</td>
<td>16GB</td>
<td>2 vCPUs — 4 vCPUs preferred</td>
</tr>
<tr>
<td>vCenter versions 4.x — 6.0 running with ESX 3.x, 4.x, or 5.x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Citrix:</td>
<td>150GB or greater disk storage</td>
<td>16GB</td>
<td>2 vCPUs — 4 vCPUs preferred</td>
</tr>
<tr>
<td>XenServer versions 5.6.x and 6.x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Microsoft:</td>
<td>150GB or greater disk storage</td>
<td>16GB</td>
<td>2 vCPUs — 4 vCPUs preferred</td>
</tr>
<tr>
<td>Hyper-V as bundled with Windows 2008R2, or Hyper-V Server 2012</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Hat Enterprise Virtualization: RHEV 3.x</td>
<td>150GB or greater disk storage</td>
<td>16GB</td>
<td>2 vCPUs — 4 vCPUs preferred</td>
</tr>
</tbody>
</table>

You can assign instances of the following technologies as Turbonomic 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 — 6.0 running with ESX 3.x, 4.x, 5.x, and 6.x
- **Cloud Managers**
  - CloudStack 3.0.2 — 4.1
  - 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, and kilo
  - Amazon AWS
  - 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 7.x and 8.0.x
- **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
- **Microsoft Applications**
  - Microsoft Exchange
- **Load Balancers**
  - Citrix NetScaler
- **Storage Managers**
  - NetApp Storage Systems running Data ONTAP version 8 or later
  - EMC VNX Series Storage Systems (for version details, see the EMC VNX Support KB article)
  - Pure Storage FlashArray
  - HP 3PAR StoreServ
  - Nutanix
  - Dell Compellent
- **Fabric Managers**
  - Cisco UCS 2.0 and higher
- **Network Flow Collectors**
  - NetFlow/sFlow: NFDUMP — Turbonomic provides an OVA download with NFDUMP preconfigured for NetFlow and sFlow collection
  - Arista EOS+
- **Turbonomic Targets**

To configure an aggregated deployment of Turbonomic, you can assign Turbonomic servers as targets. The versions of target instances must match the version of the aggregating instance.

The following sections describe these targets. For information about assigning targets to Turbonomic, see Configuring Targets on page 297.
Hypervisors

Turbonomic can use a range of VM managers as targets. For general discussion, this document refers to the various supported VM managers as hypervisors.

Turbonomic supports the following hypervisor targets:

- Citrix XenServer
- Microsoft Hyper-V
- Red Hat RHEV-M
- VMware vCenter

Turbonomic uses hypervisor targets to access information about the managed VMs, hosts, and datastores, and also to execute commands such as provisioning, resizing, or reconfiguring entities in the environment. Through the hypervisor, Turbonomic can perform system monitoring, report on wasted storage, recommend actions, execute moves for VMs and VM storage, and execute VM reconfiguration (change CPU count, memory, etc.).

The entities Turbonomic discovers through hypervisor targets include:

- VMs
- Physical machines that host VMs
- Datastores that support the VMs
- Datacenters

Cloud Managers

Cloud Managers provide a layer of control to deliver virtual infrastructures that can be deployed automatically, or in a self-service offering to customers. They define and manage virtual datacenters (VDCs) — provider VDCs to manage the physical and virtual resources that support the cloud offering, and consumer VDCs that present limited resources to customers.

Turbonomic supports the following cloud manager targets:

- Apache CloudStack
- Microsoft Virtual Machine Manager (VMM)
- VMware vCloud Director
- OpenStack Cloud Operating System

Turbonomic has visibility into the full VDC chain, from the resources provided by the underlying hosts and physical datastores, through the resources consumed by a provider VDC, to the resources consumed by VMs hosted on a consumer VDC.

You can create special Turbonomic user accounts for consumer VDC customers. Such an account has a limited scope, and the user cannot see any of the resources outside of that scope. In this way, you can offer Turbonomic to cloud customers without exposing any proprietary infrastructure data to them. For more information, see User Authentication Configuration on page 288.
The entities Turbonomic discovers through cloud manager targets include:

- **Consumer VDCs**
  Virtual resources that are available to customers.

- **Provider VDCs**
  Physical resources that provide the infrastructure to support Consumer VDCs.

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

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<th>vCloud Director</th>
<th>vCenter Server</th>
<th>VMM</th>
<th>CloudStack</th>
<th>OpenStack</th>
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<tr>
<td><strong>Consumer VDC</strong></td>
<td>Organization VDC (Child)</td>
<td>Resource Pool (Child)</td>
<td>Tenant or TenantQuota</td>
<td>Accounts</td>
<td>Tenant</td>
</tr>
<tr>
<td><strong>Provider VDC</strong></td>
<td>Provider VDC</td>
<td>Resource Pool (Root)</td>
<td>Cloud</td>
<td>Pod</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### Application Servers

An application server operates in the middle tier of a multi-tier application environment. It provides reliability and scalability, and it ensures high performance in the middle tier. Many application servers support some form of clustering, where one application server is a master, or Domain Manager, to multiple slave application servers. This can enable load balancing, and failover availability.

Turbonomic supports the following application server targets:

- IBM WebSphere Application Server
- Oracle WebLogic
- JBoss
- Apache Tomcat

The target can be a specific application server, or it can be a Domain Manager that manages a cluster of application servers. Turbonomic manages the resources used by application servers, including heap, threads, transactions, and response time in the server process, and VMem and VCPU in the VM that hosts the application server.

### Database Servers

A database server hosts processing for the database component of a client/server or multi-tier application. Turbonomic attaches as a client to the database server’s listener.

Turbonomic supports the following database server targets:

- Microsoft SQL Server 2008 R2, 2012, and 2014
- Oracle 11g R2 and 12c
Load Balancers

A load balancer is deployed in front of multiple application servers, and distributes client requests in a way that achieves the best utilization of application resources. Client requests come in to virtual applications (in NetScaler, virtual servers), and the load balancer passes the requests to the bound underlying applications according to its criteria.

Turbonomic supports the following load balancer targets:

- Citrix NetScaler

Turbonomic discovers the virtual applications that are configured for a load balancer. It can also discover applications running in your environment and automatically bind them to the correct virtual application. Turbonomic can then monitor the health of those bound applications and decide whether to provision or decommission application instances. As it provisions new instances, it automatically binds them to the correct virtual application. (For information about discovering applications to bind to a load balancer, see Load Balancer Discovery on page 375.)

The entities Turbonomic discovers through load balancer targets include:

- Virtual Applications
- Applications

Storage Managers

Storage managers provide management and distribution of data storage across disk arrays. Storage managers can support thin provisioning, deduplication, and HA architectures. Turbonomic monitors resource utilization across the storage system to optimize placement and provisioning of volumes and disk arrays, as well as management of storage controller resources.

Turbonomic supports the following storage manager targets:

- NetApp Storage Systems running Data ONTAP version 8 or later
  The actions Turbonomic can recommend and perform are different for systems running in 7-Mode or Cluster-Mode.
- EMC VNX Series Storage Systems — for version details, see the EMC VNX Support KB article.

The entities Turbonomic discovers through storage manager targets include:

- Storage Controllers (NetApp controllers/filers, VNX processors)
- Disk Arrays (aggregates, clustered aggregates, storage pools, RAID groups)
- Datastores (volumes or LUNs)

Fabric Managers

Fabric managers provide a point of control for fabrics that unify compute, network, storage, and virtual resources within a single system.

Turbonomic supports the following fabric manager targets:

- Cisco UCS Fabric Manager
The entities Turbonomic discovers through fabric managers targets include:

- UCS Domains
- Chassis
- Fabric Interconnects
- IO Modules

**Turbonomic Servers as Targets**

In large virtual environments, you can use more than one Turbonomic instance to manage your workload. To manage the full environment through a single client user interface, you add these Turbonomic instances as targets to a master instance of Turbonomic. This creates an aggregated installation of Turbonomic. For more information, see Aggregated Turbonomic Installations on page 395 or "Adding Turbonomic Targets for Aggregation" in the Target Configuration Guide.

**Turbonomic Actions**

Turbonomic does more than track problems in your environment. Before problems occur, Turbonomic identifies actions you can take to avoid the problems. You can perform these actions manually, direct Turbonomic to perform the actions on command, or direct Turbonomic to perform actions automatically as they arise. You can set different action modes (whether to automate or not) globally or for specific groups or clusters within your environment (see Action Modes on page 354).

Turbonomic performs four general types of actions:

- Provision — Add resource capacity, usually by adding an entity
- Decommission — Stop, suspend, or remove an entity
- Place — Place a consumer on a different provider
- (Re) Configure — Change the allocation of resources on an entity

**Provision**

Provisioning actions add capacity to your environment. For example, provisioning a PM adds more compute capacity that is available to host VMs. Provisioning a VM adds capacity to run applications. Turbonomic can provision the following:

- Application Servers (only with Provision scaling policy)
- VMs
- PMs
- Storage
- Storage Controllers (only for planning scenarios)
- Disk Arrays

Under certain circumstances, Turbonomic can also recommend that you provision a virtual datacenter.
Decommission

Decommissioning actions either suspend entities (set resources aside without removing them from the environment) or terminate entities (remove them from the environment). Suspended capacity is still available to be brought back online, but is currently not available for use. Suspended resources are candidates for termination. Turbonomic can decommission the following:

- Application Servers (only with Provision scaling policy)
- VMs
- PMs
- Storage
- Disk Arrays

Turbonomic can also recommend that you decommission a virtual datacenter.

Place

Placement actions determine the best provider for a consumer. Move actions change a consumer to use a different provider. For example, moving a VM assigns the VM to be hosted on a different PM. Moving a VM’s storage means the VM will use a different datastore. Turbonomic can move the following:

- VMs
- Storage

Shared-Nothing Migration Actions

If you have enabled storage moves and VM moves, Turbonomic can perform shared-nothing migrations, which move the VM and the stored VM files simultaneously. For example, assume a VM on a host also uses local storage on that host. In that case, Turbonomic can move that VM and move its data to a different host in a single action.

Shared-nothing migrations are available for any environments that support automation of both VM moves and storage moves. In addition, you must have the action modes for VM and storage moves set to Manual or Automated. If you meet these criteria, then all VM moves will take advantage of this feature.

If you want to limit the effect of shared-nothing migration, you can use the Lock VMs to Datastores setting in the Policies view. This will ensure that specific VMs stay within a specified storage cluster. For more information, see Controlling Shared-Nothing Migration on page 353.

Currently, the following targets support Shared-Nothing Migrations:

- vSphere, versions 5.1 or greater
- VMM for HyperV 2012

Cross-vCenter vMotion

VMware vSphere 6.0 introduces functionality that enables migration of virtual machines between different vCenter Server instances. Turbonomic supports this capability — it considers cross-vCenter locations when calculating placement, and can recommend or execute moves to different vCenter servers.
(Re) Configure

These are configure, reconfigure, and resize actions. Configure and reconfigure actions can add necessary network access, or reconfigure storage. Resize actions allocate more or less resource capacity on an entity, which can include adding or subtracting VCPUs or VMem on a VM, adding or subtracting capacity on a datastore, and adding or subtracting volumes in a disk array. Turbonomic can resize the following:

- Application Servers (only with Resize scaling policy)
- VMs
- Storage
- Disk Arrays
- Virtual Datacenters

Actions Summary

The following table summarizes the actions Turbonomic can perform or recommend for the inventory items in the supply chain:

<table>
<thead>
<tr>
<th>Entity</th>
<th>Provision</th>
<th>Decommission</th>
<th>Place</th>
<th>(Re) Configure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Virtual Application</strong></td>
<td></td>
<td>N/A</td>
<td></td>
<td>• Bind — For virtual applications</td>
</tr>
<tr>
<td>(only available with the</td>
<td></td>
<td></td>
<td></td>
<td>• Unbind — For virtual applications</td>
</tr>
<tr>
<td>Application Control Module)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Application</strong></td>
<td></td>
<td>N/A</td>
<td></td>
<td>• For applications discovered via JMX, resize the JVM heap</td>
</tr>
<tr>
<td>(only available with the</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Application Control Module)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Application Server</strong></td>
<td></td>
<td>N/A</td>
<td></td>
<td>• Resize heap</td>
</tr>
<tr>
<td>(only available with the</td>
<td></td>
<td></td>
<td></td>
<td>• Resize threads</td>
</tr>
<tr>
<td>Application Control Module)</td>
<td></td>
<td></td>
<td></td>
<td>For VMs hosting the application server, resize VMEM and vCPU. Resize is only with a Resize scaling policy.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Database Server</strong></td>
<td></td>
<td>N/A</td>
<td></td>
<td>• Resize DBMem</td>
</tr>
<tr>
<td>(only available with the</td>
<td></td>
<td></td>
<td></td>
<td>• Resize Connections</td>
</tr>
<tr>
<td>Application Control Module)</td>
<td></td>
<td></td>
<td></td>
<td>• Resize transaction log</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Turbonomic discovers virtual applications for Load Balancer targets, and for application targets if Auto Scale is disabled. For target information about discovery on load balancer targets, see Load Balancer Discovery on page 375.
## Introducing Turbonomic

<table>
<thead>
<tr>
<th>Entity</th>
<th>Provision</th>
<th>Decommission</th>
<th>Place</th>
<th>(Re) Configure</th>
</tr>
</thead>
<tbody>
<tr>
<td>VM</td>
<td>• Start</td>
<td>For VMs that host non-critical applications (only available with the Application Control Module) • Suspend • Terminate (remove VM)</td>
<td>• Move VM (to different host, datastore, etc.)</td>
<td>• Reconfigure (including add missing network or reconfigure storage) • Resize (change capacity, limit, or reservation)</td>
</tr>
<tr>
<td>PM</td>
<td>• Start</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Storage (datastores for VMs)</td>
<td>• Start</td>
<td>• Provision</td>
<td>• Suspend • Terminate (remove datastore)</td>
<td>• Move (to different storage device — only available with the Storage Control Module) • Resize (only available with the Storage Control Module)</td>
</tr>
<tr>
<td>Disk Array (only available with the Storage Control Module)</td>
<td>• Start</td>
<td>• Provision</td>
<td>• Suspend</td>
<td>• Move (For NetApp, only in C-mode) • Resize (Resize Up, only)</td>
</tr>
<tr>
<td>Storage Controller (only available with the Storage Control Module)</td>
<td>• Provision</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>IO Module (only available with the Fabric Control Module)</td>
<td>Add northbound and southbound ports</td>
<td>Remove northbound and southbound ports</td>
<td>N/A</td>
<td>Resize port channel</td>
</tr>
<tr>
<td>Fabric Interconnect (only available with the Fabric Control Module)</td>
<td>Add northbound and southbound ports</td>
<td>Remove northbound and southbound ports</td>
<td>N/A</td>
<td>Resize port channel</td>
</tr>
<tr>
<td>Datacenter</td>
<td>N/A</td>
<td>Turbonomic does not recommend actions to perform on the datacenter itself, but it does recommend actions to perform on the entities running in the datacenter.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provider Virtual Datacenter</td>
<td>N/A</td>
<td>Turbonomic does not recommend actions to perform on the VDC itself, but it does recommend actions to perform on the entities running in the VDC. For example, to increase VDC capacity, Turbonomic can recommend provisioning more host or storage resources.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumer Virtual Datacenter</td>
<td>If resize up actions are not performed, Turbonomic can recommend to provision a VDC.</td>
<td>If resize down actions are not performed, Turbonomic can recommend to decommission a VDC.</td>
<td>N/A</td>
<td>• Resize (change the amount of CPU, memory, or storage allocated to a VDC)</td>
</tr>
</tbody>
</table>
Resource Descriptions

To perform intelligent workload balancing, Turbonomic collects raw data from its target servers (hypervisors, cloud management stacks, or load balancers). Turbonomic polls its target servers at 10-minute intervals to collect the target’s latest data samples. It then uses these 10-minute data points for analysis and to display data in the GUI.

The way Turbonomic collects host memory data from vCenter Server illustrates how this works. vCenter Server collects peak metrics from its managed VMs at 20-second intervals. Every ten minutes Turbonomic polls vCenter Server to collect its last round of data samples (30 samples in 10 minutes). To track a VM’s utilization of host memory, Turbonomic requests `memory.active` data samples from vCenter. From that polling, Turbonomic can track:

- Max Memory Utilization - Turbonomic uses the greatest value in each polling sample. This gives the highest percentage of active memory utilization for the selected VM (or group of VMs), calculated over the selected time period. For a maximum value, Turbonomic uses the highest observed active memory value in the data sample.
- Average Memory Utilization - Turbonomic averages all the values in each polling sample.

The following table lists the metrics Turbonomic collects, and includes details about how they are collected or measured. When the Turbonomic user interface plots charts of clusters or groups of devices, these charts show the average of the percentage of allocated resources that are used.

<table>
<thead>
<tr>
<th>Resource:</th>
<th>Description:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- 2- 4-CPU Rdy</td>
<td>Wait time in the ready queue on the host, measured in ms. Turbonomic monitors 1-CPU, 2-CPU, 4-CPU, up to 32-CPU ready queues on hosts. Charts show 1 - 4 CPU values. The charts show the percentage allocated ready queue capacity that is in use on the host. For host charts, this is a measure of the total ready queue wait time for all the VMs running on that host.</td>
</tr>
</tbody>
</table>
| Balloon           | Ballooning capacity on the PM, measured in KBytes. This capacity is the greater of:  
  • 65% of the VMem configured for all powered-on VMs that the PM hosts  
  • The physical memory capacity of the PM  
  Charts show the percentage of the PM’s ballooning capacity that is in use.                                                                                                                                                                                                 |
| Buffer            | For network environments that support buffered switch ports (Arista networks), this resource measures utilization of a port buffer. For example, if a host connects to the network through port 1 on a switch, and that port has enough traffic to cause packet buffering, this resource will show utilization.                                                                                                    |
| Connection        | The connections in use, as a percentage of the maximum connections allowed on the database. Database configuration determines the capacity for this resource.                                                                                                                                                                                        |
| Cooling           | Allocated cooling indicates the highest acceptable running temperature for a physical device, such as a chassis in a compute fabric.                                                                                                                                                                                                                         |
| CPU               | Host CPU capacity, measured in MHz. This shows what percentage of CPU cycles are devoted to processing instructions.  
  • Host charts show the percentage of the host’s CPU capacity that is in use.  
  • VM charts show the percentage of the host’s CPU capacity that is consumed by the given VM.                                                                                                                                                                                                             |
<p>| DBMem             | The memory in use by the database, as a percentage of the allocated capacity. Database configuration determines the capacity for this resource. Note that for databases, Turbonomic uses this resource to drive actions, instead of the VMem on the hosting VM. This means that actions are driven by the actual memory consumption on the database. |
| Flow0 — InProvider Flow | For measuring network flow, the flow that is within a single provider — For example, the network flow between VMs that are hosted by the same physical machine. This measures network flow between consumers that are on the same set of closely connected providers. Charts show the percentage of capacity that is utilized. Note that Turbonomic assumes an unlimited supply of InProvider Flow because this flow does not go across the physical network. |</p>
<table>
<thead>
<tr>
<th>Resource:</th>
<th>Description:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow1 — InDPOD Flow</td>
<td>For measuring network flow, the flow that is local to the given DPOD. This measures network flow between consumers that are on the same set of closely connected providers. Charts show the percentage of capacity that is utilized.</td>
</tr>
<tr>
<td>Flow2 — CrossDPOD Flow</td>
<td>For measuring network flow, the flow that is between different DPODs. This measures network flow between consumers that are on different sets of closely connected providers. Charts show the percentage of capacity that is utilized.</td>
</tr>
<tr>
<td>Heap</td>
<td>The heap capacity allocated for an application. Charts show the percentage of capacity that is used by an application.</td>
</tr>
<tr>
<td>HotStorage</td>
<td>For Nutanix platforms, the storage capacity on the server-attached flash.</td>
</tr>
<tr>
<td>IO</td>
<td>Data rate through the host’s IO adapter, measured in KBytes/sec. • Datacenter charts show the average percentage of the host IO capacity that is in use, for all the hosts in the datacenter. • Host charts show the percentage of the host’s total IO capacity that is in use.</td>
</tr>
<tr>
<td>IOPS</td>
<td>Storage access operations per second. Charts show the percentage of allocated IOPS capacity that is used on a datastore.</td>
</tr>
<tr>
<td>Latency</td>
<td>Allocated capacity for latency on a datastore. This measures the latency experienced by all VMs and hosts that access the datastore. Charts show the percentage of allocated latency that is in use on the datastore.</td>
</tr>
<tr>
<td>Mem</td>
<td>Host memory, measured in Kbytes. • Host charts show the percentage of the host’s memory that is in use. • VM charts show the percentage of the host’s memory that is consumed by the given VM.</td>
</tr>
<tr>
<td>NET</td>
<td>Data rate through the host’s Network adapter, measured in Kbytes/sec. • Datacenter charts show the average percentage of the host NET capacity that is used for all the hosts in the datacenter. • Host charts show the percentage of the host’s total NET capacity that is in use.</td>
</tr>
<tr>
<td>Power</td>
<td>A measure of the power that is consumed by a physical device.</td>
</tr>
<tr>
<td>QoS</td>
<td>A measure of impact on the QoS for an application or group of applications. Increased utilization of SLA indicates an increased impact on the QoS for the affected application. Charts show the percentage of the SLA “capacity” that is utilized. Increased utilization of SLA also increases the budget available to the application. By increasing the budget, impact to QoS can drive actions to resize or provision VMs. If an application has no SLA capacity set to it, then the application has infinite budget, and resize actions are driven by VM utilization. SLA depends on custom monitoring to measure the features that define an application’s QoS requirements. This is implemented outside of Turbonomic — typical deployments use the Turbonomic REST API to integrate with the monitoring process. <strong>NOTE:</strong> You should not set SLA capacity to applications unless you have integrated a system that monitors QoS impact and updates the SLA consumption.</td>
</tr>
<tr>
<td>Storage</td>
<td>Datastore capacity, measured in Kbytes. Datastore charts show the percentage of a datastore’s capacity that is in use.</td>
</tr>
<tr>
<td>Storage Provisioned</td>
<td>How much the given storage is over-subscribed. Storage Provisioned capacity is the storage capacity multiplied by the Storage Overprovisioned Percentage (200 by default). The higher this value, the greater the risk that storage is over-committed.</td>
</tr>
<tr>
<td>Swap</td>
<td>Allocated swap space on the host. Charts show the percentage of a host’s allocated swap space that is in use.</td>
</tr>
<tr>
<td>Threads</td>
<td>Allocated thread capacity. Charts show the percentage of thread capacity that is consumed by an application server.</td>
</tr>
<tr>
<td>TransactionLog</td>
<td>The disk space devoted to transaction logging for a database.</td>
</tr>
</tbody>
</table>
Transactions

Transactions per second in an application. Charts show the percentage of an application’s allocated transaction capacity that is in use.

UI

A measure of the impact on Quality of Service (QoS) that a consumer will experience. The higher the UI on a provider, the more risk to QoS for any consumer of that provider’s services.

For all the resources that impact performance or risk, charts show the UI for the most utilized resource of a given entity. For example, if a host has a UI of 6 for MEM and 12 for CPU, the chart will show the higher value.

VCPU

The CPU capacity allocated to a VM guest OS, measured in MHz. Charts show the percentage of a VM’s VCPU cycles that are devoted to processing instructions.

VMem

The memory allocated to a VM guest OS, measured in Kbytes. Charts show the percentage of a VM’s allocated VMem that is in use.

Note that percentages of allocated VMem are measured against whichever is the less of: The VMem limit (if set) or the allocated VMem capacity. This is also true in reports and recommended actions. For example, assume a VM with allocated VMem of 8 GB, but a limit of 4 GB. In this case, the percentage in a chart shows the percentage utilized of 4GB.

VStorage

Virtual storage allocated to a VM, measured in Kbytes. Charts show the percentage of a VM’s allocated VStorage that is in use.

Turbonomic Editions and Control Modules

Turbonomic can perform intelligent workload management on a wide range of entities in your environment. Depending on your management needs, you can license different control modules to extend Turbonomic control into more technologies and entities in your environment. This section describes the base installations — Virtual Health Monitor and Turbonomic. It also describes the different control modules you can license to add features to your base installation of Turbonomic.
Turbonomic

The base Turbonomic product provides full, end-to-end management of your environment, from the datacenter, through physical hosts and storage, to your virtual machines. Management extends to include load balancers, guest OS, and other discovered application processes. Base management also covers private cloud infrastructure including consumer and provider virtual datacenters.

Turbonomic analysis and control includes real-time management, planning, and optimized placement of workload. Turbonomic is a unified platform that you can use across multiple VM and cloud technologies for capacity planning, workload reservation and deployment, and intelligent workload management that guarantees performance and efficiency across your infrastructure.

Turbonomic uses real-time calculations of workload demand and resource availability to intelligently manage your workloads. It identifies actions you can execute to keep your environment in the desired state. You get these action recommendations before things go wrong — you can execute these actions manually, and you can automate these actions for your entire environment, or for specific clusters or groups.

Private Cloud Management

For cloud management you can set up silos in your cloud platform, and Turbonomic will have visibility into capacity and utilization of resource per silo, as well as performance of VMs within each silo.
Note that different cloud platforms use their own terminology to describe physical resource silos, as well as the groups of VMs based on customer or departmental divisions, as follows:

<table>
<thead>
<tr>
<th>Cloud Platform</th>
<th>Physical Resource Silo</th>
<th>Group of VMs</th>
</tr>
</thead>
<tbody>
<tr>
<td>vCloud</td>
<td>Provider VDC</td>
<td>Organization VDC</td>
</tr>
<tr>
<td>vCenter</td>
<td>Resource Pool</td>
<td>Child Resource Pool</td>
</tr>
<tr>
<td>Microsoft VMM</td>
<td>Cloud</td>
<td>Tenant / Tenant Quota</td>
</tr>
<tr>
<td>OpenStack</td>
<td>[no concept]</td>
<td>Tenant</td>
</tr>
<tr>
<td>CloudStack</td>
<td>Pod</td>
<td>Account</td>
</tr>
</tbody>
</table>

Turbonomic lists these in the user interface as Provider VDCs for physical resources, and Organization VDCs for groups of VMs. As you use the product, you will see that it can automatically resize Provider VDCs as demand in Organization VDCs fluctuates.

If you have added SMB 3.0 shares as storage devices in your VMM service center, Turbonomic recognizes these as datastores, and includes them in the supply chain. Calculations for workload placement in the VMM environment will take the capacity and utilization of resources on these shares. Please refer to Microsoft documentation for information about adding SMB shares to your VMM service center.

**Load Balancer Management**

When you provide a load balancer target, Turbonomic 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.

Turbonomic uses discovery policies to associate applications with a load balancer. The virtual applications on the load balancer are divided by service type — Turbonomic discovers the service types that are defined for the load balancer. To bind applications to a virtual application, Turbonomic uses application signatures that you have defined. For more information, see Load Balancer Discovery on page 375 and "ApplicationDiscovery" in the Target Configuration Guide.

Turbonomic 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, Turbonomic can control the underlying resources that support the load balancer’s demand.

**Associated Targets**

- Hypervisors
  - Citrix XenServer
  - Microsoft Hyper-V
  - Red Hat RHEV-M
  - VMware vCenter
• Private Cloud
  - Apache CloudStack
  - Microsoft VMM
  - VMware vCloud Director
  - OpenStack Cloud
• Load Balancers
  This version of Turbonomic supports Citrix NetScaler load balancers. Turbonomic discovers NetScaler virtual applications according to application signatures that you provide.

Use Cases
• Intelligently manage workload across:
  - VMs
  - Hosts
  - Storage
  - Cloud resource pools
  - Applications managed by a load balancer
• Monitor and investigate
  Turbonomic gives you the following views to monitor your environment — You can always see and execute the current set of recommended actions:
  - Dashboards View
    Use dashboards to check conditions at a glance. You can scope dashboards, drill down to specifics, and generate reports from the dashboard views. You can also create and save custom dashboards.
  - Supply Chain View
    Navigate your environment through the chain of buyers and sellers — From applications, through VMs, out to Hosts or Datastores. From this view you can inspect individual entities, and drill down for more details.
  - Workload View
    Get a high-level view of the distribution of workload over hosts and datastores. You can see the current state, and the state our would achieve if you executed the current set of recommended actions.
  - Inventory View
    This view shows your complete infrastructure in a hierarchical display. Navigate to specific entities and view their resource consumption, or other data about their current state.
• Reserve and deploy workload resources
  Use Turbonomic to calculate the best placement for future workloads, reserving the resources and maintaining your environment in a state that best supports the reserved resources as real-time changes occur. When the time comes to deploy these workloads, Turbonomic executes the deployment, placing the VMs for you.
• Perform capacity planning
  The Turbonomic Plan View simulates what-if scenarios you can run to see how your current or planned infrastructure holds up. The plan includes a complete list of actions that will result in an environment that best supports the planned workload. After running a plan, you can save it or generate a report to keep the recommended actions on hand.
• Reporting:
  - One-time or scheduled reporting
    You can generate reports on demand or schedule regular runs, including subscriptions to email reports to listed addresses.
  - Create custom reports
    You can create custom dashboards, and generate reports from their data. You can schedule these reports and set up subscriptions.

• Configuration
  Of course Turbonomic is flexible. You can configure it to meet the requirements of your environment. For example:
  - Create custom groups to manage like entities in a like manner
  - Enable or disable discovered placement policies
  - Create your own placement policies — For example, you can specify placement across cluster boundaries, so Turbonomic can optimize placement even more.
  - Use discovered HA or specify how you want Turbonomic to reserve resources
  - Automate actions globally, or per group or cluster
  - Configure email or SNMP trap notifications

• For Private clouds:
  - 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
  - Use reservations to optimally deploy new workloads
  - Plan hardware requirements — the planning scenarios takes cloud architectures into account

Virtual Health Monitor
The Virtual Health Monitor is provided at no cost and with no infrastructure limitations. It provides basic real-time visibility across all virtualized hosts and virtual machines, helping you identify issues and understand the breadth of problems in your environment. It also provides a set of infrastructure reports to show historical performance across your virtual datacenter.

**NOTE:** Virtual Health Monitor is a free product that does not perform intelligent workload management. It uses Turbonomic analysis to monitor the health of your environment, but it does not recommend or execute actions to avoid problems.

Virtual Health Monitor presents dashboards to list performance issues and opportunities to improve performance or efficiency. Starting from a global view of your infrastructure, you can drill down to see metrics on VMs, hosts, and datastores. The health monitor also gives you reports that you can schedule and email to subscribers.

**Associated Targets**

- Citrix XenServer
- Microsoft Hyper-V
- Red Hat RHEV-M
- VMware vCenter

**Use Cases**

- Generate reports
- Monitor performance for:
  - Workload
  - Hosts and servers
  - Storage
- Get insights into capacity planning
- Gauge infrastructure efficiency and network performance
The Application Control Module adds applications running within the virtual environment to the entities Turbonomic discovers and manages. You can specify the following types of targets:

- **Application Servers**
  Turbonomic measures resource consumption on the application server, and can scale it vertically or horizontally in response to demand. This version supports:
  - IBM WebSphere Application Server
  - Oracle WebLogic
  - JBoss
  - Apache Tomcat

- **Database Servers**
  Similar to management of Application Servers, Turbonomic measures resource consumption on the database server, and can scale it vertically or horizontally in response to demand. This version supports:
  - Microsoft SQL Server 2008 R2, 2012, and 2014
  - Oracle 11g R2 and 12c
  - MySQL 5.5.26 and higher, and all 5.6 releases

- **Microsoft Applications**
  - Microsoft Exchange
Application Servers

### Applications (123)
- Apps_Guestload (120)
- Apps_WEBSHERE (3)
  - eva1Cell01:eva1Node01:server1
  - eva1Cell01:eva3Node01:server1
  - eva2Node01Cell:eva2Node01:server1

Application servers provide platforms that deliver application services to end users. When you provide an application server as a target, Turbonomic discovers and manages the following resources on the application server:

- Heap
- Threads
- Transactions per second
- Response time

In addition, Turbonomic can identify when to resize the vMEM and vCPU resources for the VM that hosts the application server.
With visibility into these resources, Turbonomic can make recommendations to scale the application server either:

- Horizontally to provision more application servers as a way to add capacity
- Vertically to resize resources available to the application server, without provisioning a new one

Turbonomic includes policy settings to specify response time and transaction capacities, as well as a Scaling Policy to specify **Provision** actions (horizontal scaling) or **Resize** actions (vertical scaling) for application servers (see Application Server Settings on page 345 and Application Control Module Actions on page 355).
Database Servers

Database servers provide enterprise-level database management processing. When you provide a database server as a target, Turbonomic discovers and manages the following resources on it:

- Database Memory
- Connections
- Transactions per second
- Response time
- Storage devoted to Transaction Logs

In addition, Turbonomic can identify when to resize the vMEM and vCPU resources for the VM that hosts the database server.
Associated Targets

The Application Control Module adds support for the following targets:

- **Application Servers:**
  - IBM WebSphere Application Server
  - Oracle WebLogic
  - JBoss
  - Apache Tomcat

- **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

In addition, you can specify application signatures to discover and manage applications via SNMP and JMX.

Use Cases

- Set up application priorities for tiers of service to ensure QoS for critical workloads
- Monitor real-time performance at the application layer, and execute actions to assure workload performance
- Monitor real-time performance at the database layer, and execute actions to assure workload performance
- Integrate with load-balanced applications

Hybrid Cloud Control Module

This module extends Turbonomic to provide hybrid cloud management with the intelligence to match application workload demands with the right resources, whether those resources reside in your datacenter private cloud, the public cloud, or a hybrid cloud combination.
Introducing Turbonomic

Turbonomic analysis calculates the most efficient placement while also assuring performance. In a hybrid environment, the cost of running on a subscribed cloud account may appear to show savings, but you still have to consider the applications’ business requirements. When analyzing a hybrid environment, Turbonomic actions take into account the differences of performance and cost for cloud and enterprise datacenters.

This module is ideal for environments with stateless applications that experience bursts of activity exceeding your private physical resources. In that case, Turbonomic can move the applications to an account on a public cloud (AWS or Azure) and scale your applications appropriately. If demand increases, Turbonomic will deploy copies of the application VMs to the public cloud. If demand falls off so that it’s more efficient to run the applications on your private infrastructure, Turbonomic will move the applications back to your datacenter.

The Application Control Module is highly recommended to accompany this module. Then for workload bursts, Turbonomic can work with a Global Server load balancer to manage the sudden demand by efficiently distributing applications across the hybrid environment.

With the Hybrid Cloud Control Module, when Turbonomic decides to provision a new application or VM, it decides where to place that new workload, including:

• Which physical host, if placing in the datacenter
• Which cloud, if placing on a virtual datacenter
• Which zone, if placing on a public cloud

Associated Targets

• Amazon AWS accounts
• IBM SoftLayer
• Microsoft Azure subscriptions

Use Cases

• 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

Requirements

It is strongly suggested that you use the Hybrid Cloud Control Module along with the Application Control Module in a load-balanced environment. The Application Control Module is required if you want to take advantage of NetScaler Global Server load balancing.
The Storage Control Module adds physical storage management to Turbonomic, and refines VM placement decisions for IO-intensive applications. This control module performs the following tasks:

- Corrects and prevents storage performance issues that stem from storage contention and bottlenecks
- Maps end-to-end relationships from VMs to underlying storage — Volumes/LUNs, Aggregates/Storage Pools, physical disks/spindles, and storage controllers/processors
- Holistically optimizes the hypervisor, storage, and Cisco UCS platform for customers adopting Vblock, VCE, and FlexPod converged infrastructure

IOPS and latency can be the most constrained resources in a virtual environment. By extending control into storage pools and disk arrays in the SAN, the Storage Control Module can identify, remedy, and maintain performance across all storage contention points.

It manages IOPS and IO latency, wasted and reserved snapshot disk space, and includes overprovisioning in its calculations. It also integrates with disk arrays to manage volumes in storage aggregates and storage controller resources.

**Associated Targets**

- NetApp Data ONTAP
- EMC VNX, VMAX, and XtremIO
- Pure Storage FlashArray
- HP 3PAR StoreServ
- Nutanix
- Dell Compellent
Use Cases

- Manage disk arrays to:
  - Size array capacity
  - Remedy overutilization of IOPS
  - Fully utilize physical capacity
  - Get advanced warning to deploy new arrays before capacity runs out
  - Identify and prioritize critical VM storage paths
  - Understand how array performance impacts users
- Maintain storage pool performance
- Prevent datastore issues

Fabric Control Module

The Fabric Control Module adds fabric management to Turbonomic. It connects with Cisco UCS Manager and enables Turbonomic to map end-to-end relationships between virtual workloads, chassis, domains, blade servers, I/O modules and fabric interconnects.

Associated Targets

- Cisco UCS

Use Cases

- Get visibility into relationships between application workloads, and compute, storage, and fabric resources
- Increase efficiency — reduce the tendency to overprovision blades
- Use north- and south-bound statistics to drive actions that rightsize ports
Network Control Module

This module extends Turbonomic to 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. Obviously, they would see the best network performance if they were placed on the same physical host, and would exhibit latency if they were placed far from each other. With the Network Control Module, Turbonomic can compare costs of the full set of resources (such as compute and storage) with the benefits of localizing network traffic.

The Network Control Module supports the following network flow target types:

- NetFlow and sFlow Collectors
  NFDUMP — Turbonomic provides an OVA download with NFDUMP preconfigured for NetFlow and sFlow collection.

- Arista EOS+

When you assign a flow collector as a target, Turbonomic discovers:

- Network flow
  The NetFlow or sFlow data that is being collected.

- 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 — 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.

In this scheme, DPods provide network flow to VPods, and VPods provide flow to their constituent consumers. For example, as Turbonomic 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.
Introducing Turbonomic

- 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.

**NOTE:** As a requirement for Network Control, you must have licensed either the Storage Control Module, the Fabric Control Module, or both — Turbonomic discovers DPods through storage controllers or UCS chassis. Keep in mind that DPods are an important feature of the Network Control Module. The most efficient network traffic results when each VPod can be restricted to a single provider. However, such an environment is unlikely. Turbonomic does have a likely chance of restricting most VPods to single DPods. This can give much better network performance than placing consumers arbitrarily across the hybrid datacenter.

**Actions**

- Move a VM to improve network latency
- Move a VPod across DPods
- Provision a new DPod — Recommend adding a new storage controller, its datastores, and hosts consuming the storage resources.

**Associated Targets**

- NetFlow flow controllers
- sFlow flow controllers
- Arista switches

**Use Cases**

- Manage workload placement and latency of distributed applications as the datacenter scales out
- Move from static to dynamic or virtual networks

**Requirements**

The Network Control Module requires that either the Storage Control Module, the Fabric Control Module, or both are also licensed.
Container Control Module

The Container Control Module includes application containers in Turbonomic Intelligent Workload Management. You can see the containers in the Inventory View to monitor their resource utilization and drill down to the hosting VM or the providers of physical resources. If there is resource contention within the container, Turbonomic can recommend resizing the container.

**Actions**

- Resize container

**Associated Targets**

For the Container Control Module, you do not specify connections with target services. Instead, Turbonomic discovers containers running on VMs.

- Docker
  
  Turbonomic discovers Docker containers running on VMs in your environment. To set this up you:
  
  - Create a group of VMs that host Docker containers
  - Expose a port on each VM for Docker Turbonomic to connect to the Docker API
  - For the group of VMs, specify that exposed port number in the Docker Port field of the Application Discovery policy
  - For the applications running in the containers, set up application discovery (see "Application Discovery" in the Target Configuration Guide)

**Use Cases**

- Gain visibility into the application containers deployed in your environment
- Resize containers to assure performance and efficiency

**Requirements**

The Container Control Module requires that the Application Control Module is also licensed.
VDI Control Module

The VDI Control Module is geared toward managing the execution of tasks across the Virtual Desktop Infrastructure. For example, executing an OS patch on hundreds or thousands of VMs at the same time is sure to impact resource capacity such as IOPS on your datastores.

To manage the execution of jobs across the VDI, this control module uses an Actions Manager that throttles the number of jobs to run at one time, and queue pending job requests. Job requests appear as actions in the To Do list, and Turbonomic then executes these actions automatically.

Setting up VDI jobs and registering them with the Actions Manager requires a certain amount of scripting. Please consult the REST API documentation, and feel free to contact Turbonomic support.

Use Cases

- Manage job execution across all the virtual desktops in your environment

Requirements

The VDI Control Module requires that the Storage Control Module is also licensed.
The Turbonomic User Interface

To use Turbonomic, you open a web browser to the IP address of your product installation. Turbonomic serves the user interface to your browser, where you can observe, analyze, and manage your environment. The following figure shows the user interface opened to the Dashboards view.
This section describes the different components of the user interface, including the following:

- **Menu Bar** on page 44
- **Tool Bar** on page 46
- **Fly-out Panels** on page 47
- **Notifications Bar** on page 51
- **Standard Panel Controls** on page 52
- **Information Panels** on page 59
- **Utilization History** on page 69

## Menu Bar

Turbonomic presents views for the different activities you can perform. The menu bar at the top of the application window includes buttons you click to display these views. Turbonomic provides the following views:

- **The Dashboards View** on page 82 — See dashboards that focus on:
  - Assuring service performance
  - Maintaining efficient allocation of resources
  - Projecting future resource requirements for clusters
  - Trending environment status over the last month
  - Headroom capacity for VMs on clusters
  - How recommended actions impact costs to consumers and profit margin to providers
  - A comparison of the current state to the improvements you can expect
  - Overviews of your environment
- **The Supply Chain View** on page 124
  Follow the supply chain to navigate your inventory and see supply/demand relationships between entities.
- **The Workload View** on page 166
  See charts that show the current workload distribution compared to the most desirable workload distribution.
- **The Deploy View** on page 172
  Use Turbonomic to deploy new VMs in your environment, while maintaining the environment within the desired state.
- **The Plan View** on page 189
  Run what-if scenarios to investigate how to change your infrastructure to achieve optimal performance.
- **The Inventory View** on page 235
  See real-time and historical information about the various resources, services, and components in your environment.
- **The Admin View** on page 288
  Attach Turbonomic to specific hypervisors, create user accounts, specify data retention policies, and perform other maintenance activities.
- **The Policy View** on page 325
  Define groups and make settings to define workload placement, analysis, and other policies.
- **The Reports View** on page 387
  View reports and manage subscriptions.
You can also open views to show information about specific components. For example, when you search for a specific virtual machine (see Search in Tool Bar on page 46), Turbonomic opens a new view for that VM. That view includes a navigation panel and information panels that list only information about the given VM. When you are through with this kind of view, click the view button’s close box to discard it.

You can choose which buttons to include on the menu bar, and Turbonomic will save your changes with your user account. If you remove buttons from the menu bar, you can add them back again at any time.

Deleting, Adding, and Arranging Menu Buttons

To delete a button from the menu bar, click the close box in the button’s upper-right corner.

To add a button to the menu bar, click the PLUS icon at the right side of the menu bar, then drag buttons from the menu panel to the menu bar. To change the order of buttons in the menu bar, drag them to the position you want.
Tool Bar

The Turbonomic tool bar provides the following:

- **Search**
  
  The search tool opens a dialog box you can use to search for components or services by name. As you type a Search Expression, the dialog box lists all the items that match your string. When you select an item and click **OK**, Turbonomic opens a new view to show information about that item. You can select multiple items. Use Shift-Click to extend the selection, or use Ctrl-Click to select discontiguous items.

- **Logout**
  
  Use this tool to log out of your Turbonomic session.

- **Green Circle**
  
  Open a browser window to visit the Green Circle — The Turbonomic community web site.

The Settings Menu

The Turbonomic Settings Menu provides the following:

- **General**
  
  Use this dialog box to set the refresh rate for Turbonomic data. This sets how often Turbonomic will update the display with underlying data. As you open a view, Turbonomic updates that view with the latest data. It will update that data again according to the refresh rate you set. To refresh immediately, you can always click the **Refresh** button at the bottom of the window.
Fly-out Panels

Most of the views in Turbonomic include a fly-out panel that displays navigation trees, lists of groups, or lists of features the view supports.

The Dashboards view includes a fly-out panel that lists available dashboards, as well as controls to create or delete custom dashboards. The Inventory and Optimize views include fly-out panels that show hierarchical trees of resources, services, and components in your environment.

For example, the following figure shows the fly-out panel for the Inventory view.
Fly-out Panel for the Inventory View

This figure shows the Inventory tree, and a button to open the Groups tree. You can navigate these trees to see what each item contains. The Inventory tree shows a hierarchy of items in your environment. When you select an item, the information panels on the right display data about the selected item.

Setting Fly-out Panel Location

By default, the navigation panels open on the left side of the view. You can drag a panel to place it anywhere in the view, and you can drag the bottom-right corner to resize it. You can also pin a navigation panel to attach it to the view.
Pinned Navigation Panel

Navigation Tree Hierarchies

The navigation tree shows the hierarchy of services and commodities Turbonomic has discovered in your environment. The Inventory tree groups these according to the supply chain — Virtual Applications, Applications, Virtual Machines, Physical Machines, Storage, etc. The Groups tree displays the items in groups defined by Turbonomic, as well as other groups that you define.

A tree branch for a given service (a named VM or named storage, for example) can include the following:

- **Composed Of**
  The constituent parts that make up the service; for example, a physical machine might include four CPUs in the Composed Of list, but only show one Processor entry in the Commodities list.

- **Consumes**
  The service providing commodities that the parent service consumes; for example, a VM consumes a Host and a data store.

- **Hosts**
  For a physical machine, the VMs hosted on that PM.

For example, the following figure shows a selected virtual machine named DF-Test. The information panel shows the properties of this VM's virtual CPU.
Inventory Tree Showing the constituents of a VM

Browsing Disabled

In some circumstances, the item you want to expand in the tree contains more than 500 items. To keep from tying up the GUI in displaying a very large tree node, Turbonomic disables the display of that tree node. When you open the tree node, it displays the statement, “Browsing Disabled”.

Resource Icons

The Navigation Panel displays icons for the different resources Turbonomic handles. These icons indicate:

- Resource type
- Hypervisor type
- Resource State
Notifications Bar

Turbonomic generates notifications to alert you when events occur that affect the operation of the Turbonomic server. For example, if a target hypervisor loses connectivity, or if other network problems occur, you need to troubleshoot the issue and resolve it so Turbonomic can continue to manage your workload. You can review these notifications to see whether such problems have occurred.

**NOTE:** Do not confuse these notifications with recommended actions in the To Do list, or their associated risks and opportunities. The notifications described in this topic do not represent the health of your virtual environment. They pertain to the connectivity between your target hypervisors and Turbonomic, or to other operational details, such as whether your target hypervisors have the proper tools installed.

The Turbonomic GUI displays a notifications bar at the bottom-right of the window. This bar lists the number of notifications that are currently active. The color of the bar indicates the severity of the active notifications. For example, if the Turbonomic server currently has a critical notification, the bar will be red.
Notification Bar and Notification Log

To display the notification log, click an icon in the notification bar.

Standard Panel Controls

Chart panels include a number of controls you can use to display more details, or to customize how the charts show data. These controls include:

- **Tooltips** on page 53
- **Chart Legend Pulldowns** on page 54
- **Chart Display Radio Buttons** on page 55
- **Maximize/Minimize** on page 55
- **Export to XML** on page 55
- **Customize Panel** on page 56
Tooltips

To show extra details about an item in the information panels, hover the pointer over the item until a tooltip appears. The tooltip displays extra information such as the actual value of a data point or the resource it is charting.

Most lists and tables display tooltips. If a data field in a list or table is not large enough, use the tooltip to display the complete information.

Most buttons and other controls in the GUI also display tooltips that provide a brief description of the action that control will perform.

Displaying a Tooltip
Chart Legend Pulldowns

To save space, many charts show their legends on a pulldown.

Click to show/hide the chart legend

Displaying a Pulldown Legend
Chart Display Radio Buttons

Many charts include radio buttons you can use to determine which metrics to plot. If the chart panel is too small to display all the radio buttons, you can scroll them to the left or right.

Choosing the Metrics to Plot

In this figure, the chart is plotting maximum and average IOPS values.

Maximize/Minimize

Information panels include a Maximize/Minimize icon ( ) you can click to toggle between normal and maximum view.

Export to XML

Many panels have an Export to XML icon ( ). These panels display data that can be represented in a table or spreadsheet. When you click the icon, you can navigate to a directory and export the panel data to an XML file. You can then open that XML in a spreadsheet.
Customize Panel

Most panels include a Settings icon ( ) you can use to set the panel’s name, scope, and for some types of panels, the resources the panel displays. For any panels that you cannot customize, the Settings icon is disabled.

Some panels include the Modify icon ( ) that opens the Customize Charts dialog box. For those panels, you can use this dialog box to set the resources the panel displays.

Panel Scope and Name

Each panel has a scope that determines the source entities for the data it displays. The user interface often changes scope depending on selections you make in Navigation Trees or in other panels and lists. Standard Dashboards also set a scope to the overall dashboard view, and you can change dashboard scope globally (for more information, see Setting Dashboard Scope on page 85).

When you set the scope to an individual panel, the change is temporary. When you start a new session or change the view, Turbonomic returns the panel to its default scope.
Display the **Name and Scope** tab, and make your changes.
Panel Resources

If the Edit Pane dialog box includes a Resources tab, then you can use that tab to set the resource to plot in that panel.

Choose which resources to plot

When you're done, the panel displays data for the resource you chose

If the panel has a Modify icon ( MODIFY ), you can use that in a similar way to set the panel's resources:
Information Panels

As you select a dashboard or an item in the navigation panel, you can see information about that item in panels to the right. These panels show different charts and listings of properties, depending on the item you select.

The panels have standard controls you can use to modify their display (see Standard Panel Controls on page 52).

Utilization Charts

When you select a named service or group in the Inventory tree, Turbonomic displays panels for that item. One of the panels is the Utilization Chart. This chart shows utilization percentage and utilization index for the selected item. If the item represents a group of resources, the panel displays a bar chart showing utilization values for each resource. To show utilization history of a single service, click the corresponding bar in the chart.

The following figure shows utilization for the data stores in the current environment. It also shows the latency of a single data store. You can hover over a data point to display its tooltip, or click the data point to display a chart.
Panels Showing the Utilization
Dashboard Panels

In the Dashboards view, you select the dashboard you want, and Turbonomic displays system data in the associated dashboard panels. These panels include a To Do list, various charts, and expanding tables.

Health Charts

Choose the type of entity to plot

Some dashboard charts include the option to choose which type of device to plot. Choose the type from the drop-down menu.
Expanding Tables

Expand entries to show more information

Click an entry to drill down for more details

<table>
<thead>
<tr>
<th>Cluster Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Name</strong></td>
</tr>
<tr>
<td>PMS_hp-dl386.eng.vmTurbo</td>
</tr>
<tr>
<td>11/2014</td>
</tr>
<tr>
<td>12/2014</td>
</tr>
<tr>
<td>1/2015</td>
</tr>
<tr>
<td>4/2015</td>
</tr>
<tr>
<td>7/2015</td>
</tr>
<tr>
<td>10/2015</td>
</tr>
<tr>
<td>PMS_DataCenter55\Cluster-3</td>
</tr>
<tr>
<td>PMS_DataCenter55\Cluster-1</td>
</tr>
<tr>
<td>PMS_DataCenter55\Cluster-2</td>
</tr>
<tr>
<td>PMS_DataCenter55\Cluster-1</td>
</tr>
<tr>
<td>PMS_DataCenter55\Cluster-1</td>
</tr>
<tr>
<td>PMS_Xen\DataCenter\Resources</td>
</tr>
<tr>
<td>PMS_Xen\DataCenter\Resources</td>
</tr>
<tr>
<td>PMS_VirtualCloud\Cluster-1</td>
</tr>
</tbody>
</table>

Expanding Table

Some dashboard tables include items that expand to show more data. You can quickly browse to the item you want to inspect, then expand it to see more information. Often, you can click the main entry to open a window that shows charts and details for that item.

Show Top or Bottom Items in Chart

For an environment with a large inventory, it’s not practical to chart every device in a single panel. For this reason, bar charts and data grids are designed to show the top or bottom items in the given list, sorted by the values of a given commodity. For example, a summary chart of VMs can show the top 30 VMs, sorted by Utilization Index (UI) or VMem consumption.

For these charts, you can specify:
- Whether to show the top or bottom items
- What commodities to show in the chart
- Which commodity to sort by when showing the top or bottom items
For charts that show multiple commodities per charted device (multiple bars for each VM, for example), you specify these settings in a **Customize Chart** dialog box.

Choose sort order

Choose which resource to sort by

Choose which resources to plot
For charts that show only one commodity at a time, you make these settings directly on the chart.

![Projected Improvements By VM Per Host](image)

**Sorting of Comparison Charts**

A number of charts in Turbonomic compare the current state of your environment with a target state. These comparison charts sort according to the values in the target. You can find comparison charts in the:

- Projected Improvements chart of the Assure Service Performance dashboard (see Projected Improvements on page 90)
- Plan summary charts in the Plan view (see The Plan View on page 189)
- Optimize Summary dashboard (see Optimize Summary on page 106)

**Viewing Entity Constraints**

As you browse the hierarchy in the Inventory view, you can drill down to specific entities to see information about their utilization of the resources they consume, as well as consumption of resources by related entities. For example, for a single physical machine you can see how its resources are consumed, as well as how the VMs that machine hosts consume its physical resources.
For many types of entities the Inventory view shows a Resources panel that lists resource details for the specific entity such as:

- Resources on the entity, showing utilization percent, actual utilization, peak consumption, and capacity
- Consumed resources — For example, a VM consumes resources from the physical machine that hosts it

These panels also include a Constraints button ( ) that switches the panel to show the constraints that are in effect for the given entity.

To view the constraints, it’s best to maximize the panel ( ), then switch to the Constraints view ( ).
As you look at this panel, you can investigate some of the restrictions that Turbonomic respects as it calculates placement for this entity. If the recommended move for a VM seems unusual to you, there is probably a constraint that explains this recommendation. You can use this panel to identify such a constraint.

If you decide to loosen the constraints on this entity, you can go to the Policies view to manage imported placement policies, or Turbonomic segments you might have created for your environment. For more information about placement policies and Turbonomic segments, see Workload Placement Segments on page 336.
Inspecting Available Providers

For entities that consume resources, constraints can limit the set of providers that are available. For example, if a VM is constrained to a specific cluster of PMs, then only those PMs can provide compute resources. Also, if some hosts are constrained to specific datastores, then the VM can be further constrained to storage resources from different datastores, depending on which host the VM is on.

For another example, assume Host A with access to Storage 1. A VM on Host A can move to any other storage that is attached to Host A. Also, that VM can move to any other host that is attached to Storage 1. Wherever the VM moves, its next moves will be constrained by where it currently resides.

Select the constraint you want to inspect, and click **Show Providers**. This gives you a list of the available providers.

<table>
<thead>
<tr>
<th>Select</th>
<th>Constrained By</th>
<th>Provider</th>
<th>Num of Providers</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔</td>
<td>Cluster 'Development41\Cluster-</td>
<td>hp-esx29.corp.vmturbo.com</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>DataCenter 'Development41'</td>
<td>hp-esx29.corp.vmturbo.com</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Storage 'QS2:ESXDC3DS2'</td>
<td>hp-esx29.corp.vmturbo.com</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>PhysicalMachine 'hp-esx29.corp.\</td>
<td>QS2:ESXDC3DS2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Network::VM Network</td>
<td>hp-esx29.corp.vmturbo.com</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>StorageCluster with key free_sto</td>
<td>QS2:ESXDC3DS2</td>
<td>26</td>
</tr>
</tbody>
</table>

You can select multiple constraints to see which providers are available. Usually, the more constraints you select, the fewer providers are available.

Inspecting Consumers

If you select an entity that provides resources up the supply chain to VMs, then the constraints limit which VMs can use those resources. Similar to inspecting providers, you can select a provider and see which consumers are currently running on that provider. Note that the panel only shows consumers that are currently active.
## Constraints - QS2:ESXDC6DS2

<table>
<thead>
<tr>
<th>Select</th>
<th>Constraint</th>
<th>Num of Consumers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PhysicalMachine 'hp-esx44.corp.vmturbo'</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>PhysicalMachine 'hp-esx43.corp.vmturbo'</td>
<td>0</td>
</tr>
<tr>
<td>✔</td>
<td>PhysicalMachine 'hp-esx41.corp.vmturbo'</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>PhysicalMachine 'hp-esx42.corp.vmturbo'</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>StorageCluster 'QS2'</td>
<td>13</td>
</tr>
</tbody>
</table>

### Consumers

- guy-vm-wind2008-r2-datacenter-205_clone1
- guy-vm-wind2008-r2-datacenter-205
- opensuse04
Utilization History

When you select an entry for a specific device in the Inventory tree or Groups tree, the corresponding Utilization panel displays metrics for that device. By default, the panel displays metrics for the last two hours.

You drag a slider to set the range to view. Note that Turbonomic has to have been running long enough to display the range of data you want. For example, if it has only been running for 30 days, you cannot view more than 30 days of data.
Before problems occur, Turbonomic identifies actions you can take to *avoid* problems. By continually performing these actions, you can keep your virtual environment running within the desired state. You can perform these actions manually, direct Turbonomic to perform the actions on command, or direct Turbonomic to perform actions automatically as they arise.

To show you the actions it recommends, the Turbonomic user interface includes To Do lists in most of the views. The To Do panel includes one view to list the actions, and another view to list the risks and efficiency opportunities those actions address.

Some views include a Navigation tree. As you select items in the Navigation tree, the To Do list focuses on the items you select.

To Do Panel

- Execute selected actions
- Filter by string match
- Filter entries by category and severity
- Switch between To Do and Risks/Opportunities

Tooltips show more
NOTE: For very long lists of entries, the To Do panel uses paging to limit the number of entries it loads and displays at one time. To display different pages, click the << and >> buttons or the page numbers at the bottom-left of the panel.

The To Do panel switches between an Action Log (listing recommended actions) and a log of opportunities and risks. The panel includes the following toggle buttons to change its views. Click these buttons to switch from one view to the other:

- View Recommended Actions
- View Risks/Opportunities

The To Do list shows the actions Turbonomic recommends. It can perform many of these actions, but other actions (such as installing more memory in a physical machine) are recommendations that an operator must perform. When using the To Do list you can:

- Filter the actions by category, severity, or string match
- Select one or more actions to perform
- Direct Turbonomic to perform the actions
- View the progress of each action as Turbonomic performs it

The Risks/Opportunities log gives you a detailed view of the health of your environment. When using the Risks/Opportunities log you can:

- See risks or efficiency opportunities as they arise
- Open detailed views of the issues, including associated charts and recommended actions

The following sections describe how to work with To Do lists:

- Viewing Recommended Actions on page 71
- Executing Recommended Actions on page 75
- Viewing Risks and Efficiency Opportunities on page 76
- Action Categories on page 77
- Examples of Risks and Actions on page 79

### Viewing Recommended Actions

The To Do list shows actions that Turbonomic recommends for you to achieve optimal performance in your environment. For views that include a Navigation Panel, the list updates to show actions for navigation items you select. For example, if you select Summary in the Inventory tree, the panel shows actions for the whole environment. Then if you select a single physical machine, the panel updates to show only the actions identified for that machine.

The Recommended Actions list includes the following information:

- To Do: The short name of the action to perform; for example, a Move or Resize action (hover to display the long description in a tooltip)
- Target: The resource that will be changed; for example, the VM to move
- From: The resource that contains the target (the PM that hosts the VM), or the resource to be modified (the memory to be resized)
- To: The resulting resource; for example, the PM that will host the moved VM, or the new memory capacity
To Do Lists - Maintaining QoS

- Risk/Opportunity: The risk or opportunity that justifies the action
- Status: Recommended, Pending, or other states for this action
- Category: See Action Categories on page 77 for full descriptions

Recommended Actions

You can also view the recommended actions for individual entities on a Summary panel. To view the recommended actions, click the item's risk icon. This view shows only the recommended actions for the given entity.

Problems and Recommended Actions in the Summary View

The summary panel shows icons for risks. Click an icon to see related To Do actions.
Viewing Action Details

As you look at actions in the To Do list, you can see a description of the action by displaying the tooltip over the To Do field.

In this example, the recommended action is to move a VM to prevent memory congestion on the host.

To investigate the cause of this action further, click the action’s **Details** button ( ). This opens up a view for the affected entity. In that view, you can see panels that show resource utilization related to the affected entity. For example, a VM’s view would show:

- Utilization of the VM’s resources
- Related datastore utilization
- Related physical machine utilization
- All the actions for the affected VM
- An audit log of all actions that have been taken for the VM
In this example, the view shows the utilization of memory on the physical machine that hosts the VM. You can see that memory utilization is dangerously high, and that it would improve the health of your environment if you were to move a VM off of that host. Turbonomic analysis identified the best VM to move, and recommended that action in the To Do list.
Executing Recommended Actions

The To Do list shows actions that Turbonomic recommends. By performing these actions, you can keep your environment within the desired state.

**NOTE:** The To Do List can show a large number of actions, many of which share the same source and destination. When performing actions, you should always click the Show Top radio button to limit the list of actions. These top-10 actions do not share the same source or destination, and it is safe to perform these actions all at once.

You can execute actions in the following ways:

- **Automatically**
  Turbonomic performs the actions as it recommends them. You don’t need to do anything to perform these actions.

- **Manually, through Turbonomic**
  Turbonomic shows the actions in the To Do list, with active check boxes you can select. You select the actions to perform, and then click **Apply**.

- **Externally, outside of Turbonomic**
  Turbonomic recommends the action, but cannot execute it. Either a Turbonomic policy specifies that the action cannot be executed, or there is no way for Turbonomic to direct the hypervisor to perform the action. For example, there is no way for Turbonomic to install a new physical machine in your environment. You execute these actions outside of Turbonomic.

In addition, you can create policies that completely disable certain actions. Turbonomic never shows disabled actions in the To Do list, and it will not execute those actions automatically. In addition, Turbonomic never considers those actions in its calculations. For example, if you disable Resize for all VMs in a cluster, then analysis will still drive toward the desired state, but will do so without considering resize actions for those VMs.

You can specify action policies for most of the entity types that are included in the Turbonomic supply chain. These policies determine how to execute each action. You can specify global policies for all entities of each type, and you can also specify policies for specific groups of entities. For more information, see **Action Modes** on page 354.

Select actions to execute, then click **Apply**

<table>
<thead>
<tr>
<th>Select</th>
<th>To Do</th>
<th>Target</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔️</td>
<td>Move Virtual Machine</td>
<td>Win2003-Web</td>
<td>Quantastor584:ESXDC3DS2</td>
<td></td>
</tr>
</tbody>
</table>

Executing Recommended Actions
To execute actions, select them in the To Do list, and click Apply. In the illustration above:

- Clicking **Apply** directs Turbonomic to execute the Move action
- Any actions that were set to Automatic in the policies have already been executed by Turbonomic

## Viewing Risks and Efficiency Opportunities

Turbonomic logs events for risks and opportunities that arise in your current environment. You can think of risks and opportunities as justifications for actions in the To Do list. The log shows icons for severity—for a given risk or opportunity, the severity can be:

- **Critical** — These affect the QoS that your environment can deliver, and you are strongly advised to address them
- **Major** — These can affect QoS and should be addressed
- **Minor** — These affect cost or workload distribution, but they do not impact the QoS your users will experience

**Recommended Actions**

In this figure you can see major and minor risks and opportunities. If you can’t see the full text of a table cell, hover over that cell to display the text in a tooltip.

You can choose to filter the listings by Top-10:

- **Severity** — The impact (to see the impact value for an item, hover over the Severity icon)
- **Duration** — How long the item has been active
- **Count** — How often the same risk or opportunity has occurred

If you click the Details button for a log entry, Turbonomic opens a new view that provides a full summary of the affected host machine.
If you click the Severity icon, Turbonomic displays a panel that shows recommended actions, and a chart of details related to the problem.

### Problem Resolutions Panel

### Action Categories

Turbonomic organizes entries in the To Do log into different categories. These categories do not strictly define the severity of an issue, but they indicate the nature of the issue.

### Prevention

Turbonomic constantly monitors conditions, and works to keep your environment running in the desired state. As it finds issues that risk moving the environment out of this state, it places these issues in the Prevention category. You should attend to these issues, and perform the associated actions. If you do not, the environment may drift away from the desired state, and the QoS for some services may be put at risk.
To Do Lists - Maintaining QoS

Performance Assurance

Ultimately, the reason to keep your environment running within the desired state is to assure performance and meet QoS goals. When Turbonomic detects conditions that directly put QoS at risk, it places the associated actions and risks in the Performance Assurance category. You can consider these critical conditions, and you should execute the recommended actions as soon as possible.

<table>
<thead>
<tr>
<th>Actions</th>
<th>Risks/Opportunities</th>
</tr>
</thead>
</table>
| • Move VM  
  • Start VM or PM | • <Resource> Congestion  
  High resource utilization on the named VM, host, or datastore. For example, CPU congestion or Memory congestion can occur on a VM or physical machine, or an IOPS bottleneck can occur on a datastore.  
  • Workload Balancing  
  Excess workload on a given physical machine that can be addressed by moving a VM to another host. |

Compliance

A virtual environment can include policies that limit workload placement or availability of resources. It’s possible that the environment configuration violates these defined policies. It’s also possible that an entity is mis-configured in some way. For example, a VM might be configured to access a network that is not available in its current cluster. In such cases, Turbonomic identifies the violation and recommends actions that bring the entity back into compliance.

<table>
<thead>
<tr>
<th>Actions</th>
<th>Risks/Opportunities</th>
</tr>
</thead>
</table>
| • Bind a new application (to a virtual application)  
  • Provision a new VM, PM, datastore  
  • Increase number of VCPUs  
  • Decrease number of VCPUs  
  • Increase resource  
  • Reduce resource | • <Resource> Congestion  
  High utilization of application managed by a load balancer. High utilization of resources on VM, PM, or datastore. |

<table>
<thead>
<tr>
<th>Actions</th>
<th>Risks/Opportunities</th>
</tr>
</thead>
</table>
| • Move VM  
  • Provision VM, PM, datastore, Network | • Placement Violation  
  The placement of a VM is in violation of a Turbonomic policy or an imported Placement Policy.  
  • Misconfiguration  
  The configuration violates discovered requirements. For example, a VM is configured to access a network that is not available from the current cluster. |
Efficiency Improvement

Efficient utilization of resources is an important part of running in the desired state. Running efficiently maximizes your investment in hardware and reduces cost. When Turbonomic discovers underutilized resources, it recommends actions to consolidate your operations. For example, it can recommend that you move certain VMs onto a different host. This can free a physical machine to be shut down.

There are times when Turbonomic suspends a VM in order to free up resources for a critical application. When those resources are no longer stressed by the critical application, Turbonomic can restart the suspended VM. This is a special type of efficiency improvement—rather than consolidating workload and shutting down unused machines, this action restarts a suspended VM to increase resource utilization and provide more services.

### Examples of Risks and Actions

Following are some types of the risks and efficiency opportunities Turbonomic can identify, and actions it can recommend to optimize your system deployment.

#### Critical Over-Utilization

Whenever any system resource reaches critical utilization, your infrastructure can experience bottlenecks. Applications running on VMs that are hosted by critically over-utilized machines will show performance problems, and so your QoS may suffer.

The resources that can be affected are:

- Memory
- CPU
- IO
- Network utilization
- CPU Ready Queues
- Data storage

Possible Resolutions:

- Move VMs from the affected host to a host with less utilization. Turbonomic can perform this action automatically.
- Start or provision a new host machine. You must perform this action manually.
- Provision a new data store. You must perform this action manually.

<table>
<thead>
<tr>
<th>Actions</th>
<th>Risks/Opportunities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disconnect Virtual App</td>
<td>Overprovisioning</td>
</tr>
<tr>
<td>Move VM</td>
<td>Excess resource capacity in a PM or datastore.</td>
</tr>
<tr>
<td>Suspend VM</td>
<td></td>
</tr>
<tr>
<td>Delete VM</td>
<td></td>
</tr>
<tr>
<td>Terminate VM</td>
<td></td>
</tr>
<tr>
<td>Reduce resource</td>
<td></td>
</tr>
<tr>
<td>Restart suspended VM</td>
<td></td>
</tr>
</tbody>
</table>
Low Utilization

Under-utilization presents an opportunity to increase efficiency, because it results in higher costs to maintain excessive hardware.

The resources that can be affected are:

- Memory
- CPU
- IO
- Network utilization
- CPU Ready Queues

Possible Resolutions:

- Move VMs from an under-utilized host to another host. Turbonomic can perform this action automatically.
- Suspend the under-utilized host. Turbonomic can perform this action automatically.

Mis-configured VMs

Bottlenecks can arise when a VM is not configured with enough virtual processing power to support its applications. For example, reducing the number of VCPUs on a VM can actually improve performance if wait time on the multi-CPU ready queue is excessive. If the CPU utilization can allow reducing the CPUs for the VM, then Turbonomic will recommend that action.

The resources that can be affected are:

- Number of VCPUs in a virtual machine
- VMem capacity

Possible Resolutions:

- Reconfigure the affected VM. You must perform this action manually.

Mis-configured Infrastructure

Turbonomic can identify general configuration problems in your infrastructure. These problems can result in poor QoS, even though none of the hosts show over-utilization problems.

The resources that can be affected are configuration of:

- Network
- Cluster
- Storage

Possible Resolutions:

- Reconfigure the affected infrastructure resource. You must perform these actions manually.
Logging In to Turbonomic

To get started, you open a web browser to your Turbonomic installation. Turbonomic serves the user interface to your browser, where you can use it to observe your environment. In this way, you can access the unique capabilities of Turbonomic from any internet connection. Before you can log in, an instance of Turbonomic must be installed in your environment. To get a Turbonomic installation package, contact Turbonomic — you can register online at http://turbonomic.com.

To log in to Turbonomic:

1. **Navigate your Web browser to the Turbonomic installation**
   For the URL, provide the IP address or machine name for the installation. This URL opens the Turbonomic Login page. You should bookmark this URL for future use.

   ![Login Page](image)

2. **Provide the user name and password for your account**
   Your system administrator creates user accounts. Contact your system administrator for login information.

After you log in, the browser opens to the The Dashboards View on page 82. This view presents different dashboards to show your environment’s overall operating health.

To display this information, Turbonomic communicates with target platforms such as hypervisors, load balancers, and cloud stacks. Note that your Turbonomic administrator sets up the target configuration. For more information, see Configuring Targets on page 297.
The Dashboards View

The Dashboards View presents different dashboards to show your environment’s overall operating health. You can also use dashboards to set up custom reports — you can create a custom dashboard and save it as a report.

At a glance the Dashboards view gives you insights into service performance health, overall efficiency of your workload distribution, projections into the future, trends over the last month, and headroom capacity per cluster. The dashboards show you whether your environment is staying within the desired state, what actions you can take to return to the desired state, and the improved operating conditions that you would see if you accepted the recommended actions.
Choose and manage dashboards

Dashboard panels

Dashboards View

When using the Dashboards view, you can view Standard Dashboards, and you can also create and view Custom Dashboards (see Standard Dashboards on page 86, and Custom Dashboards on page 115).
Generating Reports From the Dashboard View

You can export the current dashboard display to a PDF report. These reports capture a snapshot of the current dashboard, which you can save for later review, or send to interested parties. Note that you can select standard or custom dashboards, and you can set the dashboard scope before exporting to PDF.

Click to open the menu

Choose to generate a PDF or XSLX report of the current dashboard. Or you can save the dashboard as a report that you can schedule in the Reports view.

Exporting PDF for the selected dashboard

When you save a dashboard as a report, you can then schedule the report to be generated at regular intervals, and set up subscriptions to send these reports specific recipients. For more information about reports, see The Reports View on page 387.
Setting Dashboard Scope

You can set the scope of the dashboard view. For example, you can focus the standard dashboards on a specific cluster or a group you have created. This limits the dashboards to only display data for that cluster or group.

After you set the scope, you can save the currently selected dashboard as a custom dashboard. After saving it, you can edit it the same as you would any custom dashboard (see Scoping Standard Dashboards on page 115).

Scope affects the following standard dashboards:

- Assure Service Performance
- Improve Overall Efficiency
- Monthly Summary (Physical Machine Clusters, only)
- Cluster Capacity (Physical Machine Clusters, only)
- Optimize Summary
- Utilization Summary
To set the scope of a selected dashboard:

1. **Open the Scope dialog box.**
   
   Click the **Scope** button ( ) in the fly-out panel.

2. **Choose the scope you want.**
   
   Navigate to the cluster or group you want to focus on. The dashboard updates its display to show the scope you have selected.

3. **When satisfied with the scope you chose, click OK.**
   
   You can always click **Cancel** to close the dialog box and return to the original scope.

At any time, you can click the **Reset Scope** button ( ) in the fly-out panel. This returns the dashboard view to the default scope.

### Standard Dashboards

Turbonomic ships with the following standard dashboards:

- **Assure Service Performance** on page 87 — Shows environment health, focusing on actions you can execute to assure performance and QoS.
- **Improve Overall Efficiency** on page 91 — Shows how you can consolidate services and utilize physical resources more efficiently.
- **Project Cluster Resources** on page 95 — Based on historical workload data, projects the future capacity requirements for different clusters in your environment.
- **Monthly Summary** on page 99 — Based on historical data, shows the trend for workload distribution and utilization of resources such as memory and storage space.
- **Cluster Capacity** on page 100 — Based on capacity planning scenarios, shows how many VMs you can safely add to a given cluster.
- **Impact Summary** on page 104 — Compares the current state of your environment to the state it would be in if you executed all of the recommended actions, in terms of cost for consumers and profit margin for providers.
- **Optimize Summary** on page 106 — Compares the current state to the state your environment would achieve if you accept all the recommended actions.
- **Supply and Demand** on page 108 — Compares the efficiency of workload distribution in your environment to the execution of recommended actions.
- **Application QoS** on page 112 — Shows how the overall health of your environment affects QoS.

To switch between dashboards, open the **Dashboards** fly-out panel and choose the one you want from the Dashboards list.

In addition, from the **Dashboards** fly-out panel you can perform the following Dashboard actions:
Assure Service Performance

This dashboard illustrates how to assure workloads have the resources they need to perform well. Use this dashboard to prevent performance degradation.

You can use this dashboard to inspect the workload and utilization of resources on hosts and on datastores. You can see how VMs utilize resources and what actions you can take to achieve an optimal workload distribution. If utilization levels present risks to the final QoS for end users, this dashboard points out the risks and gives you a list of actions you can take to correct the situation before any problems arise.

The dashboard displays this information in the following panels:
The Dashboards View

To Do

This panel displays actions you can execute to maintain optimal operating conditions. You can toggle the panel between a To Do list and a list of current risks to service performance. (For a complete description of To Do panels, see To Do Lists - Maintaining QoS on page 70.)

Execute selected actions
Filter entries by category and severity
Filter by string match
Switch between To Do and Risks/Opportunities

Tooltips show more

The To Do list shows actions that you can execute in the following ways:

- **Automatically**
  Turbonomic performs the actions as it recommends them. You don’t need to do anything to perform these actions.

- **Manually, through Turbonomic**
  Turbonomic shows the actions in the To Do list, with active check boxes you can select. You select the actions to perform, and then click Apply.

- **Externally, outside of Turbonomic**
  Turbonomic recommends the action, but cannot execute it. Either a Turbonomic policy specifies that the action cannot be executed, or there is no way for Turbonomic to direct the hypervisor to perform the action. For example, Turbonomic cannot add physical memory to a physical machine. You execute these actions outside of Turbonomic.

**NOTE:** You can specify action policies for VMs, hosts, storage devices, and cloud stacks. These policies determine how to execute each action. You can specify global policies for all entities of each type, and you can also specify policies for specific groups of entities. For more information, see Action Modes on page 354.
The Health chart shows the current status of the physical machines, storage, or VMs in your environment. You can choose to chart host machines or storage. The pie chart shows the status of your physical devices. You can click the chart to open a To Do list associated with the charted entities.
Projected Improvements

The Projected Improvements chart shows the current state of your environment, compared to the target results you would achieve if you executed all the recommended actions in the To Do list. The bars show the current state, and the line chart shows the target results. You can set the chart to show data for the hosts or datastores in your environment.

When charting hosts, you can select the following metrics to show in the chart:

- **UI** — The Utilization Index, a measure of the most utilized resource on the host
- **Mem** — The percentage of the host’s memory capacity (measured in Kbytes) that is utilized
- **CPU** — The percentage of the host’s CPU capacity (measured in MHz) that is utilized
- **IO** — The percentage of the host’s IO capacity that is utilized
- **Net** — The percentage of the host’s network throughput capacity that is utilized
- **VMs per host** — The number of VMs running on each host

When charting datastores, you can show the following metrics:

- **UI** — The Utilization Index, a measure of the most utilized resource on the datastore
- **Storage** — The percentage of the storage capacity that is utilized
- **IOPS** — The percentage of the capacity for read and write IO operations per second that is utilized
- **Latency** — The percentage of latency capacity (measured in ms) that is utilized

To see precise utilization values, hover over a data point to display a tooltip.

Optimal Operating Zone

This chart projects how your environment can change over time from the current state, to converge upon the Desired State (see The Desired State on page 11). You can view projections for Memory and CPU utilization, aggregated for all the hosts in your environment.
The chart shows the historical data that it uses to make the projection. You can drag the Time sliders to set dates for the historical data.

The chart then projects the values for maximum, minimum, and average forward into a period of one week. This projection assumes you have accepted the actions in the To Do list. The Max, Average, and Min values should show a trend toward the same point, indicating that the size of the operating zone is shrinking to within an acceptable range of deviations from the average.

**Improve Overall Efficiency**

This dashboard shows you opportunities you can exploit to improve the operating efficiency of your environment. You can use this dashboard to see how to consolidate workloads and utilize underlying infrastructure more efficiently.

The dashboard displays this information in the following panels:

**To Do List**

This panel displays actions you can execute to improve operational efficiency. You can toggle the panel between a To Do list and a list of current efficiency opportunities. (For a complete description of To Do panels, see To Do Lists - Maintaining QoS on page 70.)
## Virtual Machine and Storage

This panel lists clusters of VMs that you can inspect to see how they consume storage resources.

<table>
<thead>
<tr>
<th>Name</th>
<th># of VMs</th>
<th>Storage Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>VMs_hp-dl386.eng.vmtrurl</td>
<td>5</td>
<td>45,056 MB</td>
</tr>
<tr>
<td>VMs_hp-dl386.eng.vmtrurl</td>
<td>4</td>
<td>23,552 MB</td>
</tr>
<tr>
<td>VMs_Development41\Cluster</td>
<td>21</td>
<td>200,595 MB</td>
</tr>
<tr>
<td>Active</td>
<td>6</td>
<td>130,479 MB</td>
</tr>
<tr>
<td>Dormant</td>
<td>0</td>
<td>0 MB</td>
</tr>
<tr>
<td>Powered Off</td>
<td>15</td>
<td>70,116 MB</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>0 MB</td>
</tr>
<tr>
<td>VMs_DataCenter55\Cluster</td>
<td>6</td>
<td>8,416 MB</td>
</tr>
<tr>
<td>VMs_VirtualCloud\Cluster</td>
<td>26</td>
<td>47,240 MB</td>
</tr>
<tr>
<td>VMs_Development41\Cluster</td>
<td>9</td>
<td>28,725 MB</td>
</tr>
<tr>
<td>VMs_DataCenter55\Cluster</td>
<td>14</td>
<td>1,100 MB</td>
</tr>
<tr>
<td>VMs_hp-dl386.eng.vmtrurl</td>
<td>3</td>
<td>3,048 MB</td>
</tr>
</tbody>
</table>

When you expand a VM cluster, the panel shows how many VMs are in the cluster, and how much storage is devoted to them. The panel also shows how many VMs are dormant (no application is active on the VM) and how many are powered off. In this way, you can see how much storage is held in reservation for unused VMs.
Wasted Storage

NOTE: The Policy View includes a storage setting named Disable Datastore Browsing that determines whether Turbonomic will scan datastores for wasted storage. The Global Setting disables wasted storage management by default (Disable Datastore Browsing is checked for the Global scope). The Wasted Storage panel only appears when you have enabled this setting globally. For more information, see Wasted Storage Management on page 353.

The Wasted Storage panel lists datastore clusters, showing the amount of wasted storage for each. In Turbonomic, wasted storage is any disk space devoted to files that are not required for operations of the devices or applications in your environment. For datastores that you have set aside to support VMs, wasted storage may indicate opportunities for you to free up disk space, and provide more disk capacity to running VMs and applications.

Virtual Machine Efficiency

This panel lists VM clusters, showing how they consume their available memory and CPU resources. Expand a cluster to see the consumption values. The table shows a resource type, how many VMs in the cluster consume that type of resource, and the following values:

- Current Amount — How much of the resource is currently devoted to the indicated VMs
- Desired Amount — If Turbonomic sees an opportunity to improve efficiency by reducing resource allocation, the amount that should be devoted to the indicated VMs
- Change — The resource savings you would see by executing the change
The table shows up to three rows for each resource type:

- **Reservation** — The amount of the resource that is reserved for the indicated VMs; before starting up a VM, the host must be able to provide the reserved amount — Turbonomic will not resize a VM down beyond that lower limit
- **Limit** — A hard limit for that resource as set on the indicated VMs; Turbonomic will not resize the VM up beyond that limit
- **Capacity** — The amount of the resource that the indicated VMs can utilize; capacity is a property of the VM, and indicates how much of the resource that VM is able to use — Turbonomic resize actions can change a VM’s capacity for a given resource

<table>
<thead>
<tr>
<th>Virtual Machine Efficiency</th>
<th>Name</th>
<th># of VMs</th>
<th>Current Amount</th>
<th>Desired Amount</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>VMs_Development4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VMem reservation</td>
<td>1</td>
<td>131,072 KB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VMem limit</td>
<td>5</td>
<td>16,777,216 KB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VMem capacity</td>
<td>21</td>
<td>65,085,440 KB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VCPU reservation</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VCPU limit</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VCPU capacity</td>
<td>21</td>
<td>28</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VStorage capacity</td>
<td>6</td>
<td>45,998 MB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For example, assume the above illustration. For the expanded cluster, you can say the following about VMem:

- One VMs has a total of 131 MB VMem reserved
- Five VMs have a VMem limit of 16.8 GB
- The current total of VMem capacity for 21 VMs in the cluster is 28 GB
You can click a VM Cluster item to display details, including a To Do list and resource consumption of each VM in the cluster.

**Project Cluster Resources**

This dashboard projects your future needs for VMs, hosts, and datastores. With it you can see when and where you will you need additional resources to satisfy growing workload demand. The dashboard starts from the current state of your environment and:

- Shows the deployment you would achieve if you accepted the recommended actions in the Turbonomic To Do list
- Projects your needs into the future, assuming you maintain system health by continually executing recommended actions
- Updates its projections daily to respond to changing patterns of workload requirements
To make these projections, Turbonomic adds the projected number of VMs to a hypothetical environment for the given projection period. It then runs planning scenarios for the given clusters on your environment, without taking constraints into account. The dashboard shows a series of projections for:

- One month
- Two months
- Three months
- Six months
- Nine months
- One year

**NOTE:** When you first install and start up Turbonomic, it can take a number of days before it runs projections for all the clusters in your environment.

The reliability of a projection depends on the amount of historical data it can use to establish a curve and extrapolate. For example, a 12 month projection based on two weeks of data is not as reliable as 12 months based on 90 days of historical data. If the system has not been running long enough to accumulate 60 days of data, Turbonomic uses the available data to generate projections as follows:

- With less than 6 days of historical data, the first- and second-month projections will show flat lines. The other projections will be blank.
- With less than 30 days of historical data, the dashboard calculates the first- and second-month projections. The other projections will be blank.
- With more than 30 days of historical data, the dashboard calculates projections up to the 12th-month.

The projections use historical data to investigate how workload has been added in the past, and project the anticipated workload in the future. For example:

- For the first-month projection, it looks at how many VMs were added in the previous month, and are still present in your environment. For example, if you added 6 VMs last month, and one has been removed, then the 1-month projection adds another five VMs.
- For the second-month projection, Turbonomic uses two months of history in a similar way. For example, if you added eight VMs two months ago, and five of those are still in your environment, then the projection assumes 10 VMs — five for two months ago, and five for last month.
- For the third-month projection, the calculations are the same, only using three months of data.
- For the 6-, 9- and 12-month projections, Turbonomic uses the three-month calculation, and multiplies it by 2, 3, and 4, respectively.

As workload changes and you add more VMs to your environment, the projections assume a similar rate of growth. If growth continues at that rate, the projections show when you will need to add new physical resources to support growing demand.

The dashboard displays the following panels:
Cluster Summary

This panel lists the current state of the VM clusters in your environment.

<table>
<thead>
<tr>
<th>Name</th>
<th>Date</th>
<th>Virtual M...</th>
<th>Physical ...</th>
<th>Datastores</th>
</tr>
</thead>
<tbody>
<tr>
<td>PMs_Development41\Cluster-1</td>
<td>Today</td>
<td>16</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>5/2015</td>
<td></td>
<td>22</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>6/2015</td>
<td></td>
<td>28</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>7/2015</td>
<td></td>
<td>34</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>10/2015</td>
<td></td>
<td>52</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>1/2016</td>
<td></td>
<td>70</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>4/2016</td>
<td></td>
<td>88</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>PMs_Development41\Cluster-2</td>
<td>Today</td>
<td>13</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>PMs_Hyper-V Datacenter\hp-clus</td>
<td>Today</td>
<td>41</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td>Today</td>
<td>70</td>
<td>12</td>
<td>NA</td>
</tr>
</tbody>
</table>

Totals for all the clusters in your environment.

Select a cluster to scope the dashboard view.
Expand a cluster entry to see details.

You can use this panel to see details about the current deployment of VMs, hosts, and datastores. You can expand a cluster entry to see the counts for VMs, hosts, and datastores into the future.

**NOTE:** This release of Turbonomic does not support the projection of totals for datastores. If you expand the Total item, the Datastores column shows NA for each row.

As you select a cluster in this panel, the other dashboard panels update to show data for that cluster. In this way you can see how each cluster will change into the future. To see projection data for the full environment, select the **Total** item.
Host and Storage Projection Charts

These charts show projections of utilization for the hosts and datastores that are in the currently selected cluster. These projections are based on the historical performance of your environment. When you select an item in the Cluster Summary panel, these charts update to show the associated projection data.

Provisioning Projections

These charts show how your requirements for VMs, hosts, and datastores will change into the future.

The green horizontal line indicates the number of devices you have in the environment today. The bars show the projected number of devices you will need into the future, with blue bars for projections within the current capacity, and red bars for projections that exceed the current capacity. Note that while the projections for physical machines and datastores are below current capacity, you can probably save money by consolidating your VMs on fewer physical devices. When projections exceed capacity, the charts indicate when you will need to invest in more hardware resources.

In the above example, the dashboard projects that you will not need to add storage in the next year. However, it appears that you will need eight physical machines within the next 12 months.
Monthly Summary

This dashboard shows how your environment has changed over the last month. You can spot trends such as periods of peak load, or a constant increase in demand. This information can help you understand the actions Turbonomic posts in the To Do list, so you can better prioritize the actions and choose which to execute first.

NOTE: When you first start Turbonomic, it will not have the historical data necessary to display charts in this dashboard. As historical data accumulates, the charts will show more information.

By default, the dashboard scope is for the entire virtual environment. You can set the dashboard scope to see monthly summaries of individual clusters (see Setting Dashboard Scope on page 85 for information about setting scope).

Summary

This panel compares the current state of your environment to its state the previous month.

Each cell in the panel shows the following information:

- Last Month
  The average of last month’s data for that cell.

- This Month
  The average of the data collected so far this month for that cell.

- Monthly Change
  The difference between Last Month and This Month.

- Desired
  The value you would have if you executed the current set of recommended actions. If the value is a dash, this means there are no recommended actions that will change the Desired value for this cell. Note that Turbonomic doesn’t calculate a Desired value for every cell in this panel — in that case Desired is gray (NA).

  Hover over the cell for a tooltip that describes which metrics make up the basis for the Desired calculation.

Device Summaries

These charts show how the number of VMs and PMs, and the consumption of storage space has changed over a period of months. Each data point shows the average value for the given month. The image below shows two months of historical data.
The charts show data for the current dashboard scope. Note that the Storage chart shows two plots:

- Storage Capacity — The amount of storage that is available to the clusters in the current scope
- Allocated Storage — The amount of storage that is used by the VMs running on the clusters in the current scope

## Cluster Capacity

This dashboard answers the question, “How many VMs can I safely add to a given cluster?” The dashboard shows how much extra capacity your clusters have as VM*headroom*. It can show headroom on the physical hosts or the datastores in a cluster.

To calculate cluster capacity and headroom, Turbonomic runs planning scenarios that take into account all the conditions in your current environment. The plan uses the Economic Scheduling Engine to identify the optimal workload distribution for each cluster. This can include moving your current VMs to other hosts within the given cluster, if such moves would result in a more desirable workload distribution. The result of the plan is a calculation of how many more VMs the cluster can support.

**NOTE:** Turbonomic runs ten Capacity Plans per day. If you have more than ten clusters in your environment, when you first start Turbonomic you will have to wait one or more days before all clusters appear in this dashboard. For any clusters that have no plan data, the *Headroom* value will be **NA** — the **Total** row will also show **NA** and the **Cluster Headroom** chart for Total will be blank. Tooltips in the Summary panel show when the plan was last run for each cluster.

To calculate VM headroom, the plan must assume each additional VM has been allocated a certain capacity for its resources. To accomplish this, the plan uses a VM template as a profile for the VMs that fill the cluster’s headroom. For this reason, the count of VMs given for the headroom is an approximation based on that VM template.

You can specify the VM template to use for the entire environment, or for a specific cluster. For more information, see [Cluster Capacity Configuration on page 381](#).

## Summary

This panel lists the clusters in your environment, showing the current count of VMs, physical machines and datastores in each cluster, as well as a total for all the physical machines in the dashboard scope. For example, you can see that 13 VMs are running on a cluster of four physical hosts, and that the hosts access three different datastores.

The list also shows headroom — how many more VMs you can add to the cluster and still remain in the desired state.
Note that the **Total** row displays **NA** for total Datastores. This is because one datastore can be used by more than one cluster. As a result, you cannot add up the numbers in the Datastores column to arrive at a total.

As you select a cluster in this panel, other panels in the dashboard update to show data for that cluster. If you select the **Total** row, the dashboard displays data for all the clusters in the current scope.

---

**Cluster Resource Summary**

This panel shows a summary of the resources for the selected cluster. Each field shows the total consumption of the resource, compared to its allocated capacity. While other panels in this dashboard show results from running capacity plans, this panel shows *current* values taken from real-time data in your environment.

The **Utilization** value shows the percentage of capacity that is in use:

- **Host Resources**
  Utilization of available resources on the physical machines in the selected cluster. This table shows utilization by all consumers — VMs running on the cluster, host OS, and any other consumers.

- **Datastore Resources**
  Utilization of available storage resources in the selected cluster. This table shows utilization by all consumers -- the VMs running in the cluster, wasted storage, and any other storage consumers.

  **Local Storage** shows resources for storage on individual host machines.

- **VM Consumed Resources**
  Total utilization of physical resources by VMs in the selected cluster. Note that the values here can be different than values for the same resource on the physical device. For example, the VM utilization of memory might be 1.53 GB. That means that all the VMs in the cluster consume a total of 1.53 GB memory. However, the Host Resources might show 6.09 GB utilization. This indicates that the physical machines are using memory for processes other than hosting virtual machines.
• **VM Allocated Resources**

  Information about the resources allocated to the VMs in the selected cluster:

  - **Mem** - Total VMem compared to total physical memory in the cluster
  - **VCPU/Core ratio** - The ratio of VCPUs to physical cores in the cluster
  - **VM Density** - The average number of VMs per host.
  - **VMem/Ram ratio** - The ratio of VMem capacity to RAM capacity in the cluster
**Number of VMs Per Host/Storage**

This chart shows the number of VMs per host or storage, and also shows the desired count of VMs, assuming you want to fill the headroom completely. Note that the Desired bars show the result of running a plan. This can include moving your current VMs to different hosts, but the plan always respects the cluster — it never moves VMs to hosts on different clusters.

![Number of VMs per Host/Storage](image)

**Cluster Headroom**

This chart shows the total number of VMs running in the cluster, plus the total headroom for the cluster.

![Cluster Headroom](image)
Impact Summary

This dashboard compares the current state of your environment to the state it would be in if you executed all of the recommended actions. The dashboard shows this comparison in market terms covering:

- The overall expense to entities that consume resources
- The overall gain, or profit margin, for entities that provide resources

Remember that Turbonomic models your environment as a supply chain of buyers and sellers — Entities that consume resources buy those resources from other entities that provide the resources. By selling more resources, an entity increases its budget. If the entity sells resources at a rate that exceeds its costs for purchasing resources, the entity gets increased more priority when competing for resources on a given provider.

For example, a VM consumes physical memory and CPU processing from a physical host. The VM sells VMem and VCPU to applications. The more virtual resources the applications consume, the more budget the VM has to purchase physical resources from the host. This can increase the VM’s priority for resources on the hosting physical machine.

Another point about increased budget — If the profit margin gets very high, that indicates that the provider is overutilized, and this is a candidate for provisioning a new instance. Likewise, if the profit margin falls deeply into the negative, this indicates that the entity is underutilized, and so is a candidate for suspension or termination.

Impact Trend

This panel shows the overall expense and the overall profit margin for the current scope of the dashboard. It shows both the current state, and the state you would achieve if you executed all the recommended actions. This gives you an overview of your current environment, showing how much in demand the resources are (Consumer Expense), and how much the providers are utilized (Provider Profit Margin).

QoS Panel

This panel appears when you set the scope of the dashboard to one or more applications, application servers, or database servers. For the applications in scope, this shows the risk to QoS adherence.

NOTE: Measurement of QoS requires instrumentation to monitor QoS-related metrics, or integration of third-party monitoring systems with Turbonomic. Also, the applications must have QoS Tolerance set to them. Applications that are not monitored for QoS show no values in this chart.
To Do List

This panel displays actions you can execute to improve operational efficiency. You can toggle the panel between a To Do list and a list of current efficiency opportunities. (For a complete description of To Do panels, see To Do Lists - Maintaining QoS on page 70.)
**Actions Executed Log**

This panel lists the Turbonomic actions that have been accepted or executed in your environment.

This log shows the actions associated with the current scope, including actions on consumer and provider entities. For example, if the current scope shows only VMs, this log will show actions performed directly on those VMs, as well as actions performed on the physical hosts and datastores that provide resources to those VMs.

The User column indicates how the action was initiated. When User is SYSTEM, this means Turbonomic executed the action automatically. Other values indicate the user account that was used to log onto the target that has actually executed the action.

![Actions Executed Log Table]

**Optimize Summary**

This dashboard shows the current status of your environment, side-by-side with the status you would achieve if you executed all of the current actions in the To Do list. You can view charts for Host, Storage, and VM entities, as well as get utilization details for each type of entity, or review the To Do list (see To Do Lists - Maintaining QoS on page 70).

The Optimize Summary dashboard displays the following panels:

- Utilization Summary Panel
- To Do Panel

**Utilization Summary**

This panel lists utilization in your environment for the current state and for the improvements you would achieve if you execute all of the current recommended actions.
To see utilization in tabular format, click the Details icon.
The Dashboards View

To Do List
This panel displays actions you can execute to improve operational efficiency. You can toggle the panel between a To Do list and a list of current efficiency opportunities. (For a complete description of To Do panels, see To Do Lists - Maintaining QoS on page 70.)

Actions Executed Log
This panel lists the Turbonomic actions that have been accepted or executed in your environment.
This log shows the actions associated with the current scope, including actions on consumer and provider entities. For example, if the current scope shows only VMs, this log will show actions performed directly on those VMs, as well as actions performed on the physical hosts and datastores that provide resources to those VMs.

The User column indicates how the action was initiated. When User is SYSTEM, this means Turbonomic executed the action automatically. Other values indicate the user account that was used to log onto the target that has actually executed the action.

Supply and Demand
This dashboard compares the efficiency of workload distribution in your environment to the execution of recommended actions. Efficiency of distribution refers to increasing the number of consumers per host and datastore, while always ensuring application performance. The consumers you can plot in this dashboard are VMs and Containers.
Depending on the starting state of your environment, you should see the following correlations:

- Overprovisioned
  If the environment was overprovisioned, an increasing trend of executed actions should also increase in the number of consumers per host or datastore.

  If your environment is overprovisioned, then you should initially see a low count of consumers per host or consumers per datastore. In this case, Turbonomic will recommend actions that consolidate workload on fewer providers. This gives you opportunities to increase workload without adding to your infrastructure, or to suspend providers that are not necessary to assure performance for the current workload.

- Underprovisioned
  If the environment was underprovisioned, an increasing trend of executed actions should give you a decrease in the number of VMs per host or datastore.

  If your environment is underprovisioned, then you should initially see a high count of consumers per host or consumers per datastore. In this case, Turbonomic will recommend actions to provision new providers, and migrate workload to them. The result should be improved performance for your applications as they see more desired levels of resource utilization.

The Supply and Demand dashboard displays the following panels:

- Supply and Demand
- Executed Actions

**Supply and Demand**

This panel shows the counts of consumers compared to the counts of providers, over time. It shows daily averages for the distribution of your workload across the entire environment.

Turbonomic recommends actions that drive toward the optimal workload distribution — This results in counts of consumers per provider that assure application performance while efficiently using the provider resources. As Turbonomic executes recommended actions, you should see a trend toward the best number of consumers per provider for your environment.
**Executed Actions**

This chart shows the number of recommended actions that you have executed via Turbonomic, per day. It tracks actions that were executed either in Automated or Manual mode.

The executed actions panel charts the following information:

- Executed Actions

This shows the count of actions executed over time. If you see a spike in executed actions, this means Turbonomic found many opportunities to improve your environment, and you have executed the corresponding actions. You should see corresponding changes in the Supply and Demand panel, as your environment moves toward an optimal distribution of consumers per provider.
- **Risks Avoided**

  ![Risks Avoided by VMTurbo](image)

  This is a stacked area chart that shows the types of issues that were addressed by executing the actions. Each color represents a different category. This gives you a picture of the kinds of issues you avoided by taking these actions, and it also shows how your environment evolves over time.

  Use the chart legend to match action categories to the different colors in the chart.

- **Manual vs Automated**

  ![Automated vs Manual](image)

  This stacked chart shows how you have automated actions over time. The light green area shows automated actions and the dark green shows actions you have taken manually.
Application QoS

This dashboard shows how the overall health of your environment affects QoS. The health is indicated by utilization of key resources — The higher the utilization, the greater the impact to your overall QoS.

The QoS dashboard displays the following panels:

- QoS Impacts
- QoS Level

QoS Impacts

This panel shows the health of your environment over time, in terms of utilization of resources. It charts utilization as a percentage of allocated resources, showing average utilization per day. Very high values indicate issues that can impact QoS. Over time, as you execute more recommended actions, you should see these values settle into a range that supports assured performance while utilizing your resources as efficiently as possible.

QoS Level

This chart shows the overall risk to QoS adherence in your environment, averaged per day. The lower the values the less the risk.

Note that applications that experience higher risk to QoS can see a preference when competing for resources with other applications.
**Executed Actions**

This chart shows the number of recommended actions that you have executed via Turbonomic, per day. It tracks actions that were executed either in Automated or Manual mode.

The executed actions panel charts the following information:

- Executed Actions

  This shows the count of actions executed over time. If you see a spike in executed actions, this means Turbonomic found many opportunities to improve your environment, and you have executed the corresponding actions. You should see corresponding changes in the Supply and Demand panel, as your environment moves toward an optimal distribution of consumers per provider.
• Risks Avoided

This is a stacked area chart that shows the types of issues that were addressed by executing the actions. Each color represents a different category. This gives you a picture of the kinds of issues you avoided by taking these actions, and it also shows how your environment evolves over time.

Use the chart legend to match action categories to the different colors in the chart.

• Manual vs Automated

This stacked chart shows how you have automated actions over time. The light green area shows automated actions and the dark green shows actions you have taken manually.
Custom Dashboards

The standard dashboards give you preset views into your environment. In many cases, you might want to store custom dashboards that focus on specific aspects of your environment. Turbonomic supports two ways to create custom dashboards:

- **Scoping Standard Dashboards** on page 115
  
  Simple to create, you set the scope of a standard dashboard and save that result to the My Dashboards folder.

- **Building Custom Dashboards** on page 116
  
  You choose the scope and type of information panels that you will add to a new dashboard.

No matter which method you use to create a dashboard, you can always select and edit the dashboard contents.

From the **Dashboards** fly-out panel you can perform the following Custom Dashboard actions:

- Set the scope to create a Scoped dashboard
- Return the dashboard to full scope
- Create and edit, custom dashboards
- Save a scoped custom dashboard
- Delete a custom dashboard
- Generate a report for the current dashboard view

**Scoping Standard Dashboards**

As you view standard dashboards, you can set their scope to focus on specific clusters or groups (see **Setting Dashboard Scope** on page 85). After setting a scope that you want, you can then save the resulting display as a copy of this standard dashboard in the **My Dashboards** folder. For example, you can save separate scoped dashboards for each cluster in your environment. In that way, you can use standard dashboards to inspect the whole environment, and use scoped copies of these dashboards to quickly zoom in on specific clusters.

You can scope and save the following dashboard types:

- Assure Service Performance
- Improve Overall Efficiency
- Monthly Summary
- Cluster Capacity
- Utilization Summary

To create a scoped copy of a standard dashboard:

1. **Open the Dashboards fly-out panel.**
   
   This panel displays the list of available dashboards, and the controls to create a custom dashboard.

2. **Select a standard dashboard — either Assure Service Performance, Improve Overall Efficiency, Monthly Summary, Cluster Capacity, or Optimize Summary.**
   
   You cannot set scope on the Cluster Projection dashboard.
3. Set the scope of the current dashboard.

Click the **Scope** button ( ) to open the **User Scope** dialog box, then set the scope. For more information, see Setting Dashboard Scope on page 85.

4. Save the scope results as a copy of the standard dashboard

If you are satisfied with the scope results, click the **Save** button ( ) to open the **Enter Scoped Group Name** dialog box. Name the dashboard and click **Ok**. The new dashboard appears in the **My Dashboards** folder.

5. Return the standard dashboard to its default scope.

Select the standard dashboard and click the **Reset Scope** button ( ) to return to the default scope.

---

### Building Custom Dashboards

Each standard dashboard includes a predefined set of information panels to focus on a specific question. What if you have a different question in mind? In that case, you can build a custom dashboard to focus on the information that interests you the most. You can choose which panels to include in the dashboard, and set the scope of each panel individually.

For example, you can create one dashboard with many panels examining the same cluster of hosts. Or you can create a dashboard that examines different clusters via the same type of panel. The following figure shows a dashboard that displays a Health pie chart for a cluster of hosts, and displays the resource utilization trend for each individual physical machine.
Custom Dashboards

Image of Custom Dashboards showing various graphs and charts.
To create a custom dashboard:

1. **Open the Dashboards** fly-out panel and then open the **Create Dashboard panel**.

   ![Create Dashboard panel]

2. **Drag a panel type into the dashboard.**
   
   You can choose from all the different panel types that Turbonomic uses to display information in the user interface. To see examples of each panel type in action, go to the standard dashboards or look in the Inventory View.
3. **Name the panel and set its scope.**

   When you drag a panel type onto the grid, the **Edit Panel** dialog box appears where you can name the panel and set its scope.

   Scope determines what part of your environment the panel will focus on. For example, you can set up a dashboard with a Change Log panel that shows all the changes that have occurred on a specific cluster. You can set a different scope to each panel you add to the dashboard, or you can add a number of panels all with the same scope.

4. **Drag the panel to place it in the grid, or to resize it.**

5. **Repeat these steps to add more panels to the dashboard**

6. **When you are satisfied with the panel collection, save the dashboard.**

   Click the **Save** icon ( ) and name the dashboard. You can now use this dashboard to view your environment in real time, or to generate reports. You can go to the Reports view to schedule generation of this dashboard’s report at regular intervals.
You can always edit an existing dashboard:

- To drag new panels onto the grid, select the dashboard in the **Dashboards** fly-out panel and click **Edit ( )**. This opens the **Create Dashboard** panel, which you can use to place different panels on the dashboard.

- To change a panel’s scope or name, click the a panel, click the panel’s **Settings** icon.
- To delete the a panel, click the panel’s **Close** box.

## Editing Dashboards

You can always edit an existing custom dashboard, and you can create a customized copy of a standard dashboard. In either case, the steps are the same — you change the layout of the panels in the dashboard, or you change the properties of panels in the dashboard. Then you save your changes.

When you save your changes, you get different results, depending on the type of dashboard you’re editing:

- **Standard Dashboard**
  - When you save changes to a standard dashboard, you create a copy of that dashboard — you do not modify the standard dashboard itself. This preserves the same set of standard dashboards for all Turbonomic users.

- **Custom Dashboard**
  - When you save changes to a custom dashboard, that preserves the changes you made to the custom dashboard.

The types of changes you can make are:

- Change dashboard layout
- Change a panel’s properties
- To drag new panels onto the grid, select the dashboard in the **Dashboards** fly-out panel and click **Edit ( )**. This opens

- To change a panel’s scope or name, click the a panel, click the panel’s **Settings** icon.
- To delete the a panel, click the panel’s **Close** box.

## Change Dashboard Layout

You can rearrange the panels on a dashboard, delete panels from it, or add new panels to it. After you make you changes, be sure to click the **Save** icon ( ).

To rearrange the panels on a dashboard, you simply drag the bottom-right corner to change the panel size. You can drag a panel by its title bar to move it to a different location in the dashboard grid.

To delete a panel, click the panel’s **Close** box.

To add new panels to the current dashboard, click **Edit ( )** to open the list of panel types that you can drag onto the dashboard grid. Before dragging a panel onto the grid, you should rearrange the current panels to make room for the new one.
Change Panel Properties

To change a panel’s properties, click the panel’s **Settings** button ( ). This opens the **Edit Panel** dialog box, where you can change the panel’s scope or name.

![Edit Panel dialog box](image)

Sharing Custom Dashboards

Users with Administrator privileges can share their custom dashboards with other users who have accounts on the Turbonomic instance. When an administrator user selects a custom dashboard, the Share Dashboard icon appears in the fly-out pane. You can click that icon to choose the users to share the dashboard with.
After you share the dashboard, each user you chose will see the dashboard in his or her My Dashboards list.

- For shares with groups, the dashboard name also shows which group the dashboard is shared with
- For shares to individual users, the dashboard name also shows the administrator user who shared it

**Editing and Deleting Shared Dashboards**

Any user who can see a dashboard that has been shared to a single user (not shared in a group) can use it the same as any other dashboard. The user can change the dashboard name, change the scope of individual panels, or add and remove panels in the dashboard. The user can also save the dashboard as a report.
If the dashboard is shared in a group, then any group member can save changes or delete the dashboard, as follows:

- **Save Changes:**
  - Members of a group that has an **administrator** role can save changes globally, which will change the dashboard for all group members.
  - For a group that has less than an **administrator** role, members can save changes locally, only for that specific user.

- **Delete:**
  - Members of a group that has an **administrator** role can delete the dashboard globally for all group members.
  - For a group that has less than an **administrator** role, members can delete the dashboard locally, only for that specific user.

### Bookmarks to Dashboards

You can specify the URL to open Turbonomic so that it displays a specific dashboard by default. In this way you can set up different URL bookmarks for different users or different departments.

To specify the URL, give the URL to your instance of Turbonomic, followed by the `defaultDashboard` parameter, as follows:

https://<InstallAddress>/com.vmturbo.UI/UIMain.html?defaultDashboard=<Dashboard_Name>

In this example:

- `<InstallAddress>` is the hostname or IP address of the VM that hosts Turbonomic
- `<Dashboard_Name>` is the name of the dashboard
  
  You can give the name of a standard dashboard or a custom dashboard.

For example, to specify the Supply and Demand dashboard:


When the user opens Turbonomic with this URL, the Supply and Demand dashboard will load by default.

Remember that you can specify custom dashboards as well. Provide the name as a case-sensitive string. If the dashboard name contains spaces, most browsers will represent the space characters with the code, `%20`. 
The Supply Chain View

Turbonomic models your environment as a market of buyers and sellers linked together in a supply chain. This supply chain represents the flow of resources from the datacenter, through the physical tier of your environment into the virtual tier, ultimately delivering these resources to customers through applications. By managing relationships between these buyers and sellers, Turbonomic provides closed-loop management of resources, from the datacenter, through to the application. For more information about Turbonomic processing, see How Turbonomic Works on page 10.
The Supply Chain View provides a way to navigate the supply chain and inspect the entities in your environment. For example, in the above figure you can see:

- The view focus is on Virtual Machines
- The first VM in the list is selected
- The selected VM sells resources to one application, and purchases resources from one PM and one datastore
- For this VM you can see the current set of recommended actions, and a chart of the VM’s resource consumption over time
Choosing an Entity to View

The Supply Chain Navigator shows a diagram of entity types, with arrows to show the flow of resources — a Datacenter provides resources to Physical Machines, while a Physical Machine and datastore (Storage) supply resources to a Virtual Machine.

To browse your environment’s inventory, choose an entity type, and then choose a specific item in the Entities list. As you select items in the Entities list, the view focus changes to show data for that item.

Viewing Related Entities

When you select an item in the Entities list, the view updates to show that entity, plus any related entities. The top item in the Related Entities list is the currently selected item.
Each entry in the list shows the item’s current utilization, plus the expected improvement for that item. To display full details for a given item, click its Details icon.

Browsing Supply Chain Entities

You can use the Supply Chain View to browse your environment’s inventory. As you select an item in the Related Entities list, the view updates to focus on that selected entity.
Click an item in the list to bring that entity to the top of the list.

The Virtual Machine named **vm_vc205-1** is now the focus of the Supply Chain View.
Setting Supply Chain Scope

To set the scope of the view, open the Scope fly-out panel and choose the group or cluster you want to focus on.

Supply Chain Entities

The Turbonomic user interface displays the following entity types in the supply chain:

- Supply Chain - Virtual Application on page 135
- Supply Chain - Application on page 136
- Supply Chain - Virtual Machine on page 140
- Supply Chain - Physical Machine on page 142
- Supply Chain - Storage on page 144
- Supply Chain - Disk Array on page 146
- Supply Chain - Storage Controller on page 148
- Supply Chain - IO Module on page 150
- Supply Chain - Fabric Interconnect on page 151
- Supply Chain - Chassis on page 152
Your Turbonomic license determines how much of the supply chain your current installation will manage. The following table illustrates the supply chain that is supported by each license, and lists the targets that Turbonomic supports to manage that supply chain.

<table>
<thead>
<tr>
<th>License</th>
<th>Supply Chain</th>
<th>Associated Targets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Health Monitor</td>
<td>Application</td>
<td>vCenter Server</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RHEV-M</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hyper-V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>XenServer</td>
</tr>
<tr>
<td></td>
<td>Virtual Machine</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Physical Machine</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Storage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DataCenter</td>
<td></td>
</tr>
<tr>
<td>License</td>
<td>Supply Chain</td>
<td>Associated Targets</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>--------------</td>
<td>---------------------------------------------------------</td>
</tr>
<tr>
<td>Turbonomic (base product)</td>
<td></td>
<td>vCenter Server</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RHEV-M</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hyper-V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>XenServer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VCloud Director</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Microsoft VMM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Apache CloudStack</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OpenStack Cloud</td>
</tr>
</tbody>
</table>

![Diagram of Supply Chain Entities](image-url)
<table>
<thead>
<tr>
<th>License</th>
<th>Supply Chain</th>
<th>Associated Targets</th>
</tr>
</thead>
</table>
| Application Control Module | ![Supply Chain Diagram] | NetScaler  
IBM WebSphere  
Oracle WebLogic  
JBoss  
Apache Tomcat  
Microsoft SQL Server  
Oracle Database Servers |
<table>
<thead>
<tr>
<th>License</th>
<th>Supply Chain</th>
<th>Associated Targets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hybrid Control Module</td>
<td></td>
<td>Amazon AWS Accounts, Microsoft Azure Subscriptions</td>
</tr>
<tr>
<td></td>
<td><img src="SupplyChainEntities-HybridControlModule.png" alt="Diagram" /></td>
<td></td>
</tr>
<tr>
<td>Storage Control Module</td>
<td></td>
<td>NetApp Storage Systems, EMV VNX series, Pure Storage FlashArray, HP 3PAR StoreServ</td>
</tr>
<tr>
<td></td>
<td><img src="SupplyChainEntities-StorageControlModule.png" alt="Diagram" /></td>
<td></td>
</tr>
<tr>
<td>License</td>
<td>Supply Chain</td>
<td>Associated Targets</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Fabric Control Module</td>
<td><img src="image" alt="Supply Chain Diagram" /></td>
<td>Cisco UCS</td>
</tr>
</tbody>
</table>
Supply Chain - Virtual Application

A virtual application is the client’s point of contact to request services from an application that is managed by a load balancer. The virtual application is a proxy for multiple instances of actual applications. For client requests to a virtual application, the load balancer forwards the requests to actual applications that perform the service.

To create a virtual application, the load balancer binds actual application instances to the virtual application. For information about binding load-balanced applications to the virtual application, see Load Balancer Discovery on page 375.

**Synopsis**

<table>
<thead>
<tr>
<th>Budget:</th>
<th>A virtual server has unlimited budget to buy application resources. As a result, a virtual application will never be suspended.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provides:</td>
<td>Transactions to end users and other applications.</td>
</tr>
<tr>
<td>Consumes:</td>
<td>Applications running on VMs.</td>
</tr>
<tr>
<td>Discovered through:</td>
<td>Turbonomic discovers virtual application servers through load balancer targets (see Adding and Removing Targets on page 299).</td>
</tr>
</tbody>
</table>

**Monitored Resources**

Turbonomic monitors the following resources for a virtual application:

- Transaction (transactions per second)
  - The percentage utilization of the allocated transactions per second for the given virtual application.

**Actions**
Turbonomic 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 Turbonomic 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, Turbonomic can suspend the dormant database and unbind it from the virtual application.

Turbonomic 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 Turbonomic 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, Turbonomic can suspend the dormant database and unbind it from the virtual application.

Supply Chain - Application

In a virtualized environment, an application is a process running on a VM. Applications typically serve human users or other applications. They provide transactions to their users.
Supply Chain Entities

**Synopsis**

<table>
<thead>
<tr>
<th>Budget:</th>
<th>By default applications have a priority of Mission Critical. This gives applications unlimited budget. If you override this setting to lower an application's priority, it gains budget as a function of its activity, as measured by utilization of transactions. The more active an application is (the more transactions the application performs), the more it is selling its services to a user.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provides:</td>
<td>Transactions to other applications, to load balancer Virtual Application Servers, and to end users.</td>
</tr>
<tr>
<td>Consumes:</td>
<td>VM resources, including VCPU, VMem, and VStorage.</td>
</tr>
<tr>
<td>Discovered through:</td>
<td>Turbonomic uses WMI and SNMP to discover applications through the current target hypervisors. With the Application Control Module, Turbonomic also performs discovery through load balancers, application servers, and database servers. For information, see Adding and Removing Targets on page 299.</td>
</tr>
</tbody>
</table>

**Application Discovery**

By default, Turbonomic discovers the following applications:

<table>
<thead>
<tr>
<th>Application Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSASS</td>
<td>Microsoft Active Directory services</td>
</tr>
<tr>
<td>IIS</td>
<td>Microsoft Internet Information Services</td>
</tr>
<tr>
<td>XenDesktop</td>
<td>Citrix XenDesktop</td>
</tr>
<tr>
<td>VMView</td>
<td>VMware View</td>
</tr>
<tr>
<td>MSSQL</td>
<td>Microsoft SQL Server</td>
</tr>
<tr>
<td>SharePoint</td>
<td>Microsoft Sharepoint Server</td>
</tr>
<tr>
<td>Guest Load</td>
<td>The resources that Turbonomic has not assigned to any specific application. By default, every VM has a Guest Load application. (For more information, see Guest Load, below.)</td>
</tr>
</tbody>
</table>

In addition, your installation of Turbonomic might be configured to discover other applications running in your environment. For more information, see "ApplicationDiscovery" in the Target Configuration Guide.

If you have installed a license for the Application Control Module, then Turbonomic discovers the following types of entities as well:

- **Application Servers**
  
  Turbonomic measures resource consumption on the application server, and can scale it vertically or horizontally in response to demand. This version supports:
  
  - IBM WebSphere Application Server
  - Oracle WebLogic
  - JBoss
  - Apache Tomcat
• **Database Servers**
  Similar to management of Application Servers, Turbonomic measures resource consumption on the database server, and can scale it vertically or horizontally in response to demand. This version supports:
  - Microsoft SQL Server 2008 R2, 2012, and 2014
  - Oracle 11g R2 and 12c
  - MySQL 5.5.26 and higher, and all 5.6 releases

• **Microsoft Applications**
  - Microsoft Exchange

**Guest Load**

The **Apps_GuestLoad** item is a special entry in the Applications hierarchy. This item tracks the resources that Turbonomic has not assigned to any specific application. This can occur for the following reasons:

• You do not have the licenses required to support Application monitoring
  In this case, Turbonomic lists all the consumed VM resources in the Apps_GuestLoad entry—this is the only entry under Applications.

• Turbonomic cannot discover some applications, or some applications are not registered for discovery (see "Application Discovery" in the Target Configuration Guide).
  In this case, Turbonomic displays entries for the applications it has discovered, and lists the VM resources that are not accounted for under Apps_GuestLoad.

• VM resources are devoted to infrastructure, and not part of any application
  Turbonomic lists these resources under Apps_GuestLoad, and provides entries for the applications it has discovered.

**Monitored Resources**

Turbonomic monitors the following resources for an application:

• **VMem**
  The percentage utilization of the VMem (in Kbytes) that was allocated to the hosting VM.

• **VCPU**
  The percentage utilization of the VCPU (in MHz) allocated for the hosting VM.

• **Transaction (transactions per second)**
  For virtual applications discovered through a Load Balancer target or for application servers, the percentage utilization of the allocated transactions per second.

• **Heap**
  For application servers, the percentage utilization of the application server’s heap.

• **Transactions**
  For application servers and database servers, the percentage utilization of the server’s transaction capacity, in transactions per second.

• **Response Time**
  For application servers, the percentage utilization of the server’s allocated response time.
- **Threads**
  For application servers, the percentage utilization of the server’s thread capacity.

- **DBMem**
  For database servers, the percentage utilization of the database’s memory capacity.

- **Connection**
  For database servers, the percentage utilization of the connection capacity.

- **TransactionLog**
  For database servers, the percentage utilization of the server’s capacity for storage devoted to transaction logs.

## Actions

With the basic license, Turbonomic doesn’t perform actions on applications. Instead, it performs actions on the host VMs. If utilization is high enough on an application, Turbonomic can create a new copy of the host VM. When an application is idle, it loses budget. Ultimately, if the budget falls enough, Turbonomic will recommend to suspend or terminate the host VM.

By default applications have a priority of Mission Critical. This gives applications unlimited budget so its host VM will never be suspended. You can override this priority for select applications. For more information, see Application Priority on page 369.

For application servers, Turbonomic can execute resize actions on heap and threads.

For database servers, Turbonomic can execute actions on database memory, connections, and the transaction log.

**NOTE:** For database servers, resize actions based on the TransactionLog resource depend on support for vStorage in the underlying hypervisor technology. Because current versions of Hyper-V do not provide API support for vStorage, Turbonomic cannot support TransactionLog resize actions for database servers running on the Hyper-V platform.
A virtual machine (VM) is a software emulation of a physical machine, including OS, virtual memory and CPUs, and network ports. VMs host applications.

**Synopsis**

**Budget:**
A VM gains its budget by selling resources to the applications it hosts. If utilization is high enough, Turbonomic can allocate more resources to the VM, or move the VM to a host that has more resources. If utilization falls off, the VM loses budget. Ultimately, if the budget isn’t enough to pay for the host services it consumes, Turbonomic will recommend suspending or power off the VM.

**Provides:**
Resources for hosted applications to use:
- VMEM (Kbytes)
- VCPU (MHz)
- VStorage
- IOPS (storage access operations per second)
- Latency (capacity for disk latency in ms)

**Consumes:**
- Physical host resources, including CPU and Mem
- Storage

**Discovered through:**
Turbonomic discovers VMs through hypervisor targets. For information, see Adding and Removing Targets on page 299.

Note that the Inventory View groups VMs by the physical machines that host them. In the user interface, this is a logical grouping that makes it easier to visualize the distribution of VMs across your environment. Also, the VM icons identify managing hypervisors by vendor and VM state (see Resource Icons on page 50).
**Monitored Resources**

Turbonomic monitors the following resources for a VM:

- **VMem**
  The percentage utilization of the virtual memory (measured in Kbytes) allocated for the VM.

- **VCPU**
  The percentage utilization of the virtual CPU capacity (measured in MHz) allocated for the VM.

- **VStorage**
  The percentage utilization of the virtual storage capacity (measured in Kbytes) allocated for the VM.

- **IOPS (Storage Access Operations per Second)**
  The percentage utilization of IOPS allocated for the VStorage on the VM.

- **Latency**
  The percentage utilization of latency (measured in ms) allocated for the VStorage on the VM.

**Actions**

Turbonomic recommends the following actions for a VM:

- **Terminate (Remove) VM**
  For a VM that has been suspended for a long period.

- **Suspend VM**
  For low utilization of VM’s resources.

- **Provision additional resources for:**
  - High resource utilization on VM

- **Move VM for:**
  - High resource utilization on VM
  - High resource utilization on hosting PM
  - Excess IOPS or Latency in VStorage
  - Workload placement violation
  - Hosting PM is underutilized (move before suspending PM)

- **Move VM Storage**
  For excess utilization of the current datastore, or for more efficient utilization of datastores in the environment.

- **Reconfigure Storage**
  For overutilized storage resources, add VStorage capacity.
  For underutilized storage resources, remove VStorage capacity.

- **Reconfigure VM**
  Change network and storage configuration. For example, Turbonomic recommends this action if the VM is configured to use a network that it cannot access.
Supply Chain - Physical Machine

A physical machine (PM or Host) is a server that runs a hypervisor process and hosts a virtual workload. A PM can host VMs that are managed by the given hypervisor. Note that a PM is not necessarily a physical piece of hardware. A VM can be set up as a server that runs a hypervisor, and it can in turn host other VMs within its processing space. However, it’s most usual to use physical hardware as your PMs.

### Synopsis

**Budget:** A PM gains its budget by selling resources to the VMs it hosts. The more VMs running on a PM, the more budget the PM has to purchase storage and datacenter resources. If utilization of a PM is high enough, Turbonomic can recommend that you provision a new PM. If utilization falls off, the PM loses budget. Ultimately, if the budget isn’t enough to pay for the services it consumes, Turbonomic will recommend to suspend or power off the PM.

**Provides:** Host resources for VMs to use:
- Mem (Kbytes)
- CPU (MHz)
- IO (throughput on the I/O bus)
- Net (network throughput)
- Swap (swap rate capacity measured in bytes/sec)
- Ballooning (sharing of memory among hosted VMs)
- CPU Ready Queue (wait time on the queue in ms)

**Conusses:** Datacenter resources (physical space, cooling, etc.) and storage.

**Discovered through:** Turbonomic discovers PMs through hypervisor targets (see Adding and Removing Targets on page 299). For some hypervisor vendors, the PM is the target, and for others the PMs are managed by the specified target.
Monitored Resources

Turbonomic monitors the following resources for a PM:

- **Mem**
  The percentage of the PM’s memory that is reserved or in use, measured in Kbytes.

- **CPU**
  The percentage of the PM’s CPU cycles that are reserved or in use, measured in Kbytes.

- **IO**
  The data rate through the PM’s IO adapters. Charts show the percentage of the PM’s IO capacity that is in use, measured in Kbytes per second.

- **Net**
  The data rate through the PM’s network adapters. Charts show the percentage of the PM’s network throughput capacity that is in use, measured in Kbytes per second.

- **Swap**
  The percentage of the PM’s allocated swap space that is in use, measured in Kbytes.

- **Balloon**
  The sharing of memory among VMs running on the host. Charts show percentage of the PM’s ballooning capacity that is in use, measured in Kbytes.

- **1, 2, 4 CPU Ready**
  The percentage of the PM’s allocated ready queue capacity (measured in Kbytes) that is in use, for 1, 2, and 4 CPU ready queues. Charts show the percentage of wait time for all the VMs on a given host PM.

Actions

Turbonomic recommends the following actions for a PM:

- **Start PM**
  For increased demand on physical resources, start up a suspended PM.

- **Provision PM**
  For increased demand of physical resources, install a new PM in the environment. Turbonomic will then move workload to that host.

- **Suspend PM**
  For underutilized resources on a PM, move existing workload to other hosts and suspend the PM.

- **Terminate (Remove) PM**
  For a PM that has been suspended for a period of time, remove the PM.

**NOTE:** Turbonomic discovers VMware HA configurations in clusters, and considers the reserved resources in its calculations. For tolerated host failures, or a reserved percentage of cluster resources, Turbonomic automatically sets utilization constraints for that cluster (see Utilization Constraints on page 350). If you configure a failover host, Turbonomic reserves that host for HA and will not move VMs to it. You can see a failover icon on the reserved host in the Inventory tree.
Supply Chain - Storage

Storage is represented in Turbonomic as Datastores. A Datastore is a logical grouping of one or more physical storage devices that serve VM storage requirements.

**Synopsis**

<table>
<thead>
<tr>
<th><strong>Budget:</strong></th>
<th>A Datastore gains its budget by selling resources to the VMs it serves. If utilization of a Datastore is high enough, Turbonomic can recommend that you provision a new one.</th>
</tr>
</thead>
</table>
| **Provides:** | Host resources for VMs to use:  
• Storage amount  
• IOPS (storage access operations per second)  
• Latency (capacity for disk latency in ms) |
| **Consumes:** | Disk arrays (or aggregates) — with the Storage Control Module, only |
| **Discovered through:** | Turbonomic discovers Datastores through hypervisor targets (see Adding and Removing Targets on page 299). |
Monitored Resources

Turbonomic monitors the following resources for a datastore:

- **Storage**
  The percentage of the datastore’s capacity (measured in Kbytes) that is in use.

- **IOPS**
  Storage access operations per second. Charts in the user interface show the percentage of allocated IOPS capacity that is used on a datastore.

- **Latency**
  The percentage of allocated latency (measured in ms) that is in use on the datastore. This measures the latency experienced by all VMs and hosts that access the datastore.

Actions

Turbonomic recommends the following actions for a datastore:

- **Start Storage**
  For high utilization of storage resources, start a suspended datastore.

- **Provision Storage**
  For high utilization of storage resources, provision a new datastore.

- **Suspend Storage**
  For low utilization of storage resources, move served VMs to other datastores and suspend this one.

- **Terminate Storage (Remove)**
  For a datastore that has been suspended for a period of time, remove the datastore.

- **Move (only with the Storage Control Module)**
  For high utilization of physical storage, move datastore to a different disk array (aggregate).

- **Resize (only with the Storage Control Module)**
  Increase or decrease the datastore capacity.
A Disk Array (an aggregate) is a data storage system made up of multiple disk drives. For example, a RAID is an aggregate that implements redundancy and other data management features. A disk array provides storage volumes to serve the storage requirements of physical machines. It uses the resources of one storage controller, which manages the disk array operation.

Turbonomic supports disk arrays when you have installed the Storage Control Module license.

### Synopsis

<table>
<thead>
<tr>
<th><strong>Budget:</strong></th>
<th>A disk array gains its budget by selling resources to the datastores it serves. If utilization of a disk array is high enough, Turbonomic can recommend that you provision a new one.</th>
</tr>
</thead>
</table>
| **Provides:** | Storage resources for datastores to use:  
• Storage amount  
• Storage Provisioned  
• IOPS (storage access operations per second)  
• Latency (capacity for disk latency in ms) |
| **Consumes:** | Storage controllers |
| **Discovered through:** | Turbonomic discovers disk arrays through storage controller targets (see "Adding Storage Managers as Targets" in the Target Configuration Guide). |
Monitored Resources

Turbonomic monitors the following resources for a disk array:

- **Storage**
  The percentage utilization of the storage (measured in Kbytes) allocated for the given disk array. Allocated storage is the sum of the aggregated physical storage that the array exposes to the environment.

- **Storage Provisioned**
  The percentage utilization of the storage that was provisioned for this disk array. This encompasses over-provisioning of storage, as well as thin-provisioning on the VMs, deduplication, compression, and other storage optimizations. For example, assume storage over-provisioning of 200% as the only storage optimization. If Storage Utilization was at 100%, then Storage Provisioned would be 50% (half of the over-provisioned storage in use). A more realistic situation would have the current Storage Utilization at 50%, and Storage Provisioned would show a value of 25%.

- **IOPS - Storage Access Operations per Second**
  The percentage utilization of allocated IOPS. The disk array aggregates this value for all its volumes. In other words, all volumes on a given disk array show the same value for this resource.

- **Latency**
  The percentage utilization of allocated latency. The disk array aggregates this value for all its volumes. In other words, all volumes on a given disk array show the same value for this resource.

Actions

Turbonomic recommends the following actions for a disk array:

- **Provision Disk Array**
  For high utilization of the disk array’s storage, provision a new disk array (recommendation, only).

- **Start Disk Array**
  For high utilization of disk array, start a suspended disk array (recommendation, only).

- **Suspend Disk Array**
  For low utilization of the disk array’s storage, move VMs to other datastores and suspend volumes on the disk array (recommendation, only).

- **Move Disk Array (for NetApp Cluster-Mode, only)**
  For high utilization of Storage Controller resources, Turbonomic can move an aggregate to another storage controller. The storage controllers must be running.

  For high IOPS or Latency, a move is always off of the current disk array. All the volumes on a given disk array show the same IOPS and Latency, so moving to a volume on the same array would not fix these issues.

- **Move VM**
  For high utilization of Storage on a volume, Turbonomic can move a VM to another volume. The new volume can be on the current disk array, on some other disk array, or on any other datastore.

  For high IOPS or Latency, a move is always off of the current disk array. All the volumes on a given disk array show the same IOPS and Latency, so moving to a volume on the same array would not fix these issues.

- **Move Datastore**
  To balance utilization of disk array resources, Turbonomic can move a datastore to another array.
Action Automation for NetApp Storage Systems

For NetApp storage systems, the actions Turbonomic can automatically perform depend on the NetApp version you are running, and whether the system is running in cluster mode:

<table>
<thead>
<tr>
<th>Automated Action</th>
<th>7-Mode</th>
<th>Cluster-Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Move VM between datastores, on the same disk array</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Move VM between datastores on different disk arrays</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Move Datastore between disk arrays on the same storage controller</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Move Datastore between disk arrays on different storage controllers</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Resize Storage</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Resize Disk Array</td>
<td>Yes — Resize up, only</td>
<td>Yes — Resize up, only</td>
</tr>
</tbody>
</table>

In addition, for a system running in Cluster-Mode, Turbonomic can recommend moving an aggregate to another storage controller.

Supply Chain - Storage Controller

A Storage Controller is a device that manages one or more disk arrays. The storage controller provides CPU cycles to perform storage management tasks for each disk array it manages.

Turbonomic supports storage controllers when you have installed the Storage Control Module license.
Monitored Resources

Turbonomic monitors the following resources for a storage controller:

- CPU
  The percentage utilization of CPU resources allocated to the storage controller.

- Storage
  The percentage of the storage capacity that is in use. The storage allocated to a storage controller is the total of all the physical space available to aggregates managed by that storage controller.

- IOPS
  Storage access operations per second. Charts show the percentage of allocated IOPS capacity that is used by the aggregates managed by the storage controller.

- Latency
  The percentage of allocated latency (measured in ms) that is in use for this storage controller. This measures the latency experienced by all VMs and hosts that access the managed storage.

Actions

Turbonomic recommends the following actions for a storage controller:

- Provision Storage Controller (recommendation, only)
  For high utilization of the storage controller’s CPU, provision a new storage controller, and then move disk arrays to it.
An IO Module connects the compute resources on a chassis to the fabric domain via the Fabric Interconnect. It provides the servers on the chassis with Net resources. Typical installations provide two IO Modules per chassis.

Turbonomic supports IO Modules when you have installed the Fabric Control Module license.

### Synopsis

<table>
<thead>
<tr>
<th>Budget:</th>
<th>An IO Module gains its budget by selling Net resources to a physical machine.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provides:</td>
<td>Net resources</td>
</tr>
<tr>
<td>Consumes:</td>
<td>Chassis and Fabric Interconnect</td>
</tr>
<tr>
<td>Discovered through:</td>
<td>Turbonomic discovers IO Modules through the fabric managers that use them.</td>
</tr>
</tbody>
</table>

### Monitored Resources

Turbonomic monitors the following resources for an IO Module:

- Net
  - The percentage utilization of the total throughput (storage and network, combined) allocated for the IO Module.

### Actions

Turbonomic does not recommend actions to perform on an IO Module.
Supply Chain - Fabric Interconnect

A Fabric Interconnect connects servers in a computing fabric to the fabric’s network and storage resources. It provides network bandwidth to the servers in the platform.

Turbonomic supports Fabric Interconnects when you have installed the Fabric Control Module license.

**Synopsis**

| Budget: | A Fabric Interconnect gains its budget by selling Net resources to the IO Modules. |
| Provides: | Net resources |
| Consumes: | N/A |
| Discovered through: | Turbonomic discovers Fabric Interconnects through managers of fabric platforms (such as UCS) that use them. For information about fabric manager targets, see "Adding Fabric Managers as Targets" in the Target Configuration Guide. |

**Monitored Resources**

Turbonomic monitors the following resources for Fabric Interconnect:

- **Net**
  The percentage utilization of the total network throughput allocated for the Fabric Interconnect.

**Actions**

Turbonomic recommends the following actions to perform on a Fabric Interconnect:

- **Resize port to increase size.**
A chassis houses the servers that are part of a computing fabric. It provides compute, memory, storage, and bandwidth resources.

### Synopsis

<table>
<thead>
<tr>
<th>Budget:</th>
<th>A Chassis has unlimited budget.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provides:</td>
<td>Chassis resources (physical space, cooling, etc.).</td>
</tr>
<tr>
<td>Consumes:</td>
<td>N/A</td>
</tr>
<tr>
<td>Discovered through:</td>
<td>Turbonomic discovers Chassis through fabric manager targets. For information about fabric manager targets, see &quot;Adding Fabric Managers as Targets&quot; in the Target Configuration Guide</td>
</tr>
</tbody>
</table>

### Monitored Resources

Turbonomic monitors the following resources for the servers in a chassis:

- **Power**
  The percentage of the acceptable range of power consumption that is utilized by this chassis.

- **Cooling**
  The percentage of the acceptable temperature range that is utilized by this chassis. As the chassis temperature nears the high or low running temperature limits, this percentage increases.

### Actions

Turbonomic does not recommend actions for a chassis.
Supply Chain - Domain

A Domain represents the computing fabric network. It provides Network Throughput resources to give the fabric northbound network connectivity.

**Synopsis**

<table>
<thead>
<tr>
<th>Budget:</th>
<th>A Domain has unlimited budget.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provides:</td>
<td>Network Throughput</td>
</tr>
<tr>
<td>Consumes:</td>
<td>N/A</td>
</tr>
<tr>
<td>Discovered through:</td>
<td>Turbonomic discovers Domains through fabric manager targets. For information about fabric manager targets, see “Adding Fabric Managersas Targets” in the Target Configuration Guide.</td>
</tr>
</tbody>
</table>

**Actions**

Turbonomic does not recommend actions to perform on a Domain.
Supply Chain - Datacenter

For Turbonomic, a datacenter is the sum of VMs, PMs, datastores, and network devices that are managed by a given hypervisor target. A datacenter provides compute, memory, storage, and bandwidth resources.

**Synopsis**

<table>
<thead>
<tr>
<th>Budget:</th>
<th>A Datacenter has unlimited budget.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provides:</td>
<td>Datacenter resources (physical space, cooling, etc.).</td>
</tr>
<tr>
<td>Consumes:</td>
<td>N/A</td>
</tr>
<tr>
<td>Discovered through:</td>
<td>Turbonomic discovers Datacenters through hypervisor targets (see Adding and Removing Targets on page 299).</td>
</tr>
</tbody>
</table>

**Monitored Resources**

Turbonomic does not monitor resources directly from the datacenter, but it does monitor the following resources, aggregated for the PMs in a datacenter:

- **Mem**
  The percentage of the PM’s memory that is reserved or in use, measured in Kbytes.

- **CPU**
  The percentage of the PM’s CPU cycles that are reserved or in use, measured in Kbytes.

- **IO**
  The data rate through the PM’s IO adapters. Charts in the user interface show the percentage of the PM’s IO capacity that is in use, measured in Kbytes per second.
Supply Chain Entities

- **Net**
  The data rate through the PM’s network adapters. Charts in the user interface show the percentage of the PM’s network throughput capacity that is in use, measured in Kbytes per second.

- **Swap**
  The percentage of the PM’s allocated swap space that is in use, measured in Kbytes.

- **Balloon**
  The sharing of memory among VMs running on the host. Charts in the user interface show percentage of the PM’s ballooning capacity that is in use, measured in Kbytes.

- **1, 2, 4 CPU Ready**
  The percentage of the PM’s allocated ready queue capacity (measured in Kbytes) that is in use, for 1, 2, and 4 CPU ready queues. Charts in the user interface show the percentage or wait time for all the VMs on a given host PM.

**Actions**

Turbonomic does not recommend actions to perform on a datacenter. Instead, it recommends actions to perform on the devices running in the datacenter.

**Supply Chain - Provider Virtual Datacenter**

**NOTE:** Different targets use different names to refer to Virtual Datacenters. In the Turbonomic supply chain, these entities are all represented by Consumer and Provider VDCs, as follows:
A provider virtual datacenter (vDC) is a collection of physical resources (PMs and datastores) within a cloud stack. The cloud administrator has access to these resources, and defines the datacenter members. A Provider vDC is created to manage resources that will be allocated to external customers through one or more Consumer vDCs.

Turbonomic supports virtual datacenters when you have installed the Cloud Control Module license.

### Monitored Resources

Turbonomic monitors the following resources for a Provider vDC:

- **Mem**
  The percentage of physical machine memory that is reserved or in use, measured in Kbytes.

- **CPU**
  The percentage utilization of CPU resources allocated to the Provider vDC.

- **Storage**
  The percentage usage of storage that is allocated to the Provider vDC.

### Synopsis

| Budget: | A Provider vDC gains its budget by selling resources to the Consumer vDCs that it hosts. If utilization falls off, the datacenter loses budget. Ultimately, if the budget isn’t enough to pay for the services it consumes, Turbonomic will recommend decommissioning the Provider vDC. |
| Provides: | Physical resources such as PMs and datastores to Consumer vDCs. |
| Consumes: | PMs and datastores |
| Discovered through: | Turbonomic discovers vDCs through cloud stack managers such as vCloud Director (see Adding and Removing Targets on page 299). |

### Actions

Turbonomic does not recommend actions to perform on a Provider VDC. Instead, it recommends actions to perform on the devices running in the datacenter.
Supply Chain - Consumer Virtual Datacenter

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

<table>
<thead>
<tr>
<th>Turbonomic</th>
<th>vCloud Director</th>
<th>vCenter Server</th>
<th>VMM</th>
<th>CloudStack</th>
<th>OpenStack</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumer VDC</td>
<td>Organization VDC</td>
<td>Resource Pool (Child)</td>
<td>Tenant or TenantQuota</td>
<td>Accounts</td>
<td>Tenant</td>
</tr>
<tr>
<td>Provider VDC</td>
<td>Provider VDC</td>
<td>Resource Pool (Root)</td>
<td>Cloud</td>
<td>Pod</td>
<td>N/A</td>
</tr>
</tbody>
</table>

A Consumer Virtual Datacenter (vDC) is a collection of resources that are available for external customers to manage workload through the cloud. It is an environment customers can use to store, deploy, and operate virtual systems. Consumer Datacenters use the resources supplied by a Provider Datacenter.

Turbonomic supports virtual datacenters when you have installed the Cloud Control Module license.

**Synopsis**

**Budget:** A Consumer vDC gains its budget as a function of its activity. The higher the utilization of the vDC, the more Turbonomic assumes the vDC is selling its services to a user. If utilization is high enough on a Consumer vDC, Turbonomic can increase resources for the vDC. If utilization falls off, Turbonomic can reduce resource capacity, or ultimately recommend terminating the vDC. Turbonomic can also resize VMs through the Consumer vDC in response to changes in VM utilization.

**Provides:** Resources to host virtual systems.

**Consumes:** Provider vDC

**Discovered through:** Turbonomic discovers vDCs through cloud stack managers such as vCloud Director (see Adding and Removing Targets on page 299).
While users can see some of the physical resources that support the Consumer vDC, consumer-level users cannot modify these physical resources. Users of Consumer vDCs make changes to how the virtual devices are deployed in that environment, but they must ask the Provider vDC administrator to add more physical resources to be used by the Consumer vDC. Likewise, Turbonomic can change resources on the VMs running in the vDC, but it does not make any changes to physical resources through this vDC.

**Monitored Resources**

Turbonomic monitors the following resources for a Consumer vDC:

- **Mem**
  The percentage of physical machine memory that is reserved or in use for this datacenter, measured in Kbytes.

- **CPU**
  The percentage utilization of CPU resources allocated to the datacenter.

- **Storage**
  The percentage usage of storage that is allocated to the Consumer vDC.

**Actions**

Turbonomic recommends the following actions for a Consumer Datacenter:

- **Resize Consumer vDC**
  Resize up to increase memory and CPU.
  Resize down if the datacenter resources are underutilized.

- **Provision Consumer vDC**
  If resize actions are not executed, Turbonomic can recommend provisioning a new datacenter. For example, Consumer Datacenter users who are billed for additional resources might choose not to execute resize up actions. In that case, Turbonomic could recommend provisioning a new Consumer vDC. Note that Turbonomic will only make this recommendation if there are enough resources on the hosting Provider vDC.
A VPod represents a set of consumers that communicate frequently with each other over the network. For example, VMs that host processes for the same distributed application are likely to pass data between each other on a regular basis. VPods provide a way to calculate the cost of network throughput according to where the VPod entities reside in the hardware layer. Turbonomic groups providers into DPods — For more information, see Supply Chain - DPod on page 161.

There are four levels of cost for network flow:

- **Zero cost**
  The consumers use the same provider — For example, VMs that reside on the same host. These consumers have access to infinite network capacity.

- **Low cost**
  The consumers use providers that are under the same switch. Network capacity for these consumers is determined by the capacity of the providers.

- **Medium cost**
  The consumers communicate across switch nodes. Network capacity is the capacity of the uplink, divided by the number of providers sharing it.

- **High cost**
  The consumers communicate across the cloud. Turbonomic calculates a high cost for throughput to reflect the impact to performance you would experience if consumers had cross-cloud dependencies.
Monitored Resources

Turbonomic monitors the following resources for a VPod:

- Flow
  The percentage of network flow capacity that is utilized by the VPod. This is divided into Flow1 (low cost) and Flow2 (medium cost) utilization.

- Mem
  The percentage of providers’ memory that is utilized by the VPod.

- CPU
  The percentage of the providers’ CPU cycles that are utilized by the VPod.

- Storage
  The percentage of the providers’ allocated storage that is utilized by the VPod.

Actions

Turbonomic recommends the following actions for a VPod:

- Move a VPod to different DPods (to providers under a different switch)

In addition, Turbonomic can move a VMs into a VPod to reduce network latency.
A DPod represents a set of closely connected providers — For example a storage controller, its datastores, and the hosts that consume those storage resources. A unified fabric chassis or an Arista switch can also identify the makeup of a DPod. Turbonomic uses DPods as providers for VPods — For more information, see Supply Chain - VPod on page 159.

### Synopsis

<table>
<thead>
<tr>
<th><strong>Budget:</strong></th>
<th>DPods get their budget by selling resources to VPods.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Provides:</strong></td>
<td>Network throughput to VPods.</td>
</tr>
<tr>
<td><strong>Consumes:</strong></td>
<td>Network throughput from underlying hosts.</td>
</tr>
<tr>
<td><strong>Discovered through:</strong></td>
<td>Turbonomic discovers DPods through network flow collectors, and also through supported switches. For information, see &quot;Adding Network Flow Targets&quot; in the Target Configuration Guide.</td>
</tr>
</tbody>
</table>
Monitored Resources

Turbonomic monitors the following resources for a DPod:

- **Flow**
  The percentage of network throughput capacity that is utilized by the DPod.

- **Mem**
  The percentage of underlying host memory that is utilized by the DPod.

- **CPU**
  The percentage of the underlying host CPU cycles that are utilized by the DPod.

- **Storage**
  The percentage of the allocated storage that is utilized by the DPod.

Actions

Turbonomic recommends the following actions for a Zone:

- **Provision a new DPod** — For example, recommend adding a new storage controller, its datastores, and hosts consuming the storage resources

Supply Chain - Zone
A Zone represents an Availability Zone in the Amazon EC2 cloud. A Zone hosts virtual workloads — in theory it can host as many VMs as you want. By managing Zones in the supply chain, Turbonomic can manage a hybrid cloud environment to:

- Start a VM on the cloud so you can suspend workload to free up resources in your enterprise environment
- Suspend a VM running on the cloud when enterprise resources come free, so you can run the workload on the enterprise

### Monitored Resources

Turbonomic monitors the following resources for a Zone:

- **Mem**
  The percentage of the PM’s memory that is reserved or in use, measured in Kbytes.

- **CPU**
  The percentage of the PM’s CPU cycles that are reserved or in use, measured in Kbytes.

- **IO**
  The data rate through the PM’s IO adapters. Charts show the percentage of the PM’s IO capacity that is in use, measured in Kbytes per second.

- **Net**
  The data rate through the PM’s network adapters. Charts show the percentage of the PM’s network throughput capacity that is in use, measured in Kbytes per second.

- **Swap**
  The percentage of the PM’s allocated swap space that is in use, measured in Kbytes.

- **Balloon**
  The sharing of memory among VMs running on the host. Charts show percentage of the PM’s ballooning capacity that is in use, measured in Kbytes.

- **1, 2, 4 CPU Ready**
  The percentage of the PM’s allocated ready queue capacity (measured in Kbytes) that is in use, for 1, 2, and 4 CPU ready queues. Charts show the percentage or wait time for all the VMs on a given host PM.

### Synopsis

<table>
<thead>
<tr>
<th>Budget</th>
<th>Turbonomic assumes a Zone has infinite resources.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provides</td>
<td>Compute and storage resources to VMs.</td>
</tr>
<tr>
<td>Consumes</td>
<td>Region resources.</td>
</tr>
<tr>
<td>Discovered through</td>
<td>Turbonomic discovers Zones through Region targets.</td>
</tr>
</tbody>
</table>
Actions

Turbonomic recommends the following actions for a Zone:

- Start VM on the Zone
- Suspend VM running on the Zone

Supply Chain - Region

A Region represents a region in the Amazon EC2 cloud — it is the target that gives Turbonomic access to manage workload on Amazon cloud services. One region contains multiple Zones.

Synopsis

<table>
<thead>
<tr>
<th>Budget:</th>
<th>Turbonomic assumes a Region has infinite resources.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provides:</td>
<td>Hosting and storage resources to Zones.</td>
</tr>
<tr>
<td>Consumes:</td>
<td>NA</td>
</tr>
<tr>
<td>Discovered through:</td>
<td>Access to cloud service accounts, such as accounts on Amazon AWS, Microsoft Azure, or IBM SoftLayer.</td>
</tr>
</tbody>
</table>
Monitored Resources

Turbonomic does not monitor resources directly from the region, but it does monitor the following resources, aggregated for the Zones in a region:

- Mem
  The percentage of the PM’s memory that is reserved or in use, measured in Kbytes.

- CPU
  The percentage of the PM’s CPU cycles that are reserved or in use, measured in Kbytes.

- IO
  The data rate through the PM’s IO adapters. Charts show the percentage of the PM’s IO capacity that is in use, measured in Kbytes per second.

- Net
  The data rate through the PM’s network adapters. Charts show the percentage of the PM’s network throughput capacity that is in use, measured in Kbytes per second.

- Swap
  The percentage of the PM’s allocated swap space that is in use, measured in Kbytes.

- Balloon
  The sharing of memory among VMs running on the host. Charts show percentage of the PM’s ballooning capacity that is in use, measured in Kbytes.

- 1, 2, 4 CPU Ready
  The percentage of the PM’s allocated ready queue capacity (measured in Kbytes) that is in use, for 1, 2, and 4 CPU ready queues. Charts show the percentage or wait time for all the VMs on a given host PM.

Actions

Turbonomic does not recommend actions for a Region.
The Workload View

The Workload View gives a unique perspective on the distribution of demand and supply throughout your environment. At a glance, you can see how the workload in your environment is utilized, and how the workload demand utilizes the underlying supply of resources. The view displays two panels:

- Current Workload — The current distribution of workload in the environment.
- Expected Improvements — The improvements to workload distribution the environment would achieve if you executed the current set of recommended actions.
The Workload Chart

The Workload Chart plots the supply of resources along X and Y axes, and places groups of workload entities on a grid according to the utilization of the supplied resources. By default, the charts plot physical utilization of host and storage along the X and Y axes. These axes measure either the utilization index value or the percentage of resource capacity that is utilized on the given providers.
The chart is divided into a grid representing utilization of provider resources, and it places rings on that grid. The rings represent workload entities — for example, VMs or Applications. Ring size represents the number of entities in a grid sector. Color shows the severity of the most critical entity in the collection. Position plots the range of average resource utilization for the providers that deliver resources to that collection of entities.

Ring color indicates the utilization of workload resources for all the entities represented by that ring. Note that ring color is a function of the utilization of the workload entities, not the utilization of the provided resources. A workload entity can be critically overutilized, even though it is running on an underutilized provider. Likewise, an entity can be underutilized even though it is running on an overutilized provider. When looking at the colors for a ring, keep in mind that each color means at least one workload entity is in the indicated state, and that the utilization of an entity does not have to match the utilization of the underlying provider in any way.

**Inspecting Chart Data**

The chart display provides an overview of your environment, with limited details. You can select a region of the chart to drill down and display information about the entities that are in that region.

The information panel also includes a list of recommended actions for the currently selected VMs.

**Entities List**

For each entry, the Entities List shows the following information:

- Entity name (VM or Application)
- Utilization Index
- X-Axis provider that hosts the entity, and its Utilization Index
- Y-Axis provider that host the entity, and its Utilization Index
To see where a specific workload entity lines up in the chart, hover over the entry in the list. The current and expected-improvements Workload Charts both display cross-hairs to show the utilization coordinates for that entity. In this way, you can see the utilization in the current environment, and also the utilization it would exhibit if you accepted the existing recommended actions.

Recommended Actions List

The information panel includes an actions list that gives the same information as the Turbonomic To Do list. (For a complete description of To Do lists, see To Do Lists - Maintaining QoS on page 70.)

The list of recommended actions pertains to the selection. To execute actions, select the actions you want and click Execute.
Controlling Workload Chart Display

The Workload Chart includes a list of different plots you can display. For example, you can choose to plot VMs over Host and Storage utilization, or you can plot them over Host utilization and Network Throughput utilization. You can also modify the severity the chart shows (hide all underutilized rings) and the scale used for plotting the supply (percentage of utilized capacity, or Utilization Index). The changes you make affect both the Current Workload and the Expected Improvements charts.

Setting Display of Demand and Supply

By default, the Workload Chart plots groups of VMs as they run on Hosts and Datastores. The VMs represent the demand in your environment, and the Hosts and Datastores supply the resources these VMs require. You can change the chart to plot the workload on a grid that maps out different supplied resources — either providers, or the specific commodities the associated providers deliver.

To change the display, choose a plot from the chart’s drop-down list.

Setting Severity and Scale

The Workload View includes a fly-out panel for Chart Controls. To modify the Workload Chart display, open this fly-out panel and make the settings you want.

![Chart Controls](image)
Setting Workload View Scope

To set the scope of the view, open the Groups fly-out menu and choose a VM group. For example, you can choose a single PM to limit the chart to only the VMs that are running on a specific host.

To reset the scope to show the entire environment, choose a top-level item, such as VM Groups, or Virtual Machines By Network.

![Groups menu showing VM groups]

Setting View Scope
The Deploy View

The deploy View is where you can use Turbonomic intelligent workload management to calculate optimal placement for new VMs, and then actually deploy them in your environment. The view provides tools to create and manage resource reservations, so you can deploy the requested VMs now or in the future.

![Image of Turbonomic deploy view interface]

- **Create/Edit templates**
- **Specify the reservation**
- **Current reservations - deploy, cancel, or edit**
- **Accept or reject the proposed reservation**
- **Future reservations - defined, but not yet reserved**
To deploy VMs in this view, you will perform the following steps:

- **Define a reservation**
  Specify the resource requirements for each VM, and how many VMs of that type you want to deploy

- **Request the resources**
  Turbonomic calculates the resource requirements. If your system has sufficient resources, Turbonomic lists the placement it recommends for each proposed VM.

- **Accept the reservation**
  If you agree with the proposed VM placement, accept the reservation — If you set a future deploy date, this places the reservation in the Reservations list. If you set a deploy date of *today*, this will deploy the VMs immediately.

- **Deploy the reservation**
  As long as the reservation is active, you can deploy it. Turbonomic creates the VMs and places them on hosts in your environment.

This view keeps lists of reservations that are in one of the following states:

- **Current Reservations**
  Turbonomic adds the reserved VMs to your inventory, and calculates their placement as though they are real VMs. In this way, you can see how your environment accommodates the additional workload, and you can run plans that take this reserved workload into account. A reservation remains active until you deploy it, cancel it, or the Deploy Date has passed.

  There’s no guarantee that your environment has enough resources to place all the VMs in your reservation. In that case, Turbonomic calculates placement for the VMs that it can place, and marks the reservation as unfulfilled. For more information, see *Active Reservations* on page 178.

- **Future Reservations**
  If you set a future date for the Reservation Date, this puts the reservation in the Future Reservations list. Turbonomic does not calculate placement at this time — the future reservation saves the definition, and Turbonomic will calculate placement and reserve the VMs at the time of the reservation date.

The following topics describe how to use the Deploy view:

- **Creating Reservations** on page 173
- **Active Reservations** on page 178
- **Future Reservations** on page 181
- **Deploying VMs** on page 182
- **Creating and Editing Templates** on page 184

### Creating Reservations

Reservations set aside resources for anticipated workload — they can be Active or Pending. While a reservation is Active, Turbonomic continually calculates placement for the associated VMs, both in the real-time market and in any plans you might run.
To create a reservation, perform the following steps:

- Define the reservation, including workload to reserve and a deploy-by date
- Request the reservation
- Accept the reservation

If the system has sufficient resources to place the workload, the reservation is *active*. Otherwise, the reservation is *pending*.

It’s important to understand that Turbonomic deploys complete reservations — it cannot deploy a subset of a reservation. If you have a large number of VMs to deploy, but you want flexibility to prioritize some VMs over others, you should create separate reservations for each class of workload. It’s often a good idea to avoid very large reservations, in favor of multiple smaller ones.

**NOTE:** If you define a reservation with a deploy date of *today*, then you will deploy the workload directly — Turbonomic doesn’t create a reservation. Don’t worry, you will have a chance to review the proposed deployment, and accept or reject it.

### Defining a Reservation

The first step for deploying VMs is to define the reservation. This specifies the workload you want to deploy, sets a reservation date, and sets a Deploy Date for the reservation.

**NOTE:** _TERMINOLOGY ISSUE_ — To specify workload, you will select a VM Template to use. Some hypervisors refer to source VMs as templates. Within Turbonomic, templates are files that describe a VM, host, or datastore. For this topic, the word *template* refers to a Turbonomic template. *VM Templates* specify the resources allocated for a VM, and *Deployment Profiles* specify details such as the datacenter or cluster to host the new VM, and the package files (OVF or VHD) for the source VM. The term *source VM* refers to the VM deployment data that is stored on a hypervisor.
To define a reservation:

1. **Name the reservation.**
   Provide a name for the reservation. This provides a base name you can use to identify the reserved VMs in the inventory. For example, the following figure shows reserved VMs for the reservation named DemoStations:

   ![VMs](image)

   - VMs_hp-esx43.corp.vmturbo.com (14):
     - DemoStations_DemoStations_C0
     - DemoStations_DemoStations_C1
     - DemoStations_DemoStations_C2
     - DemoStations_DemoStations_C3

2. **Specify VM Count — how many VMs to deploy with this reservation.**

3. **Set the Reservation Date.**
   This sets when to reserve the VM resources. If the date is in the future, then the reservation definition will be saved in the Future Reservations list. Turbonomic does not calculate placement for future reservations. If you give the current date, the reservation is active, and placed in the Reservations list.

4. **Set the Deploy Date.**
   This sets how long the reservation will remain in the Deploy View. If you have not deployed by this date, and the reservation can be fulfilled, Turbonomic automatically deploys the reservation.
   To deploy the workload directly, set today’s date in this field. Turbonomic will deploy the workload as soon as you accept the proposed deployment (see Accepting a Reservation on page 176).

5. **Choose the VM Template to use for the reserved VMs.**
   VM Templates specify the resources available to the VM, including:
   - VCPUs
   - Virtual Memory
   - Storage
   - Network Throughput
   - IOPS
   - IO Throughput
   Note that you must choose a template that is mapped to a Deployment Profile. When you choose a template, the Deployment Profiles list updates to include the profiles that map to that template.

   To inspect VM Templates, open the Template Catalog and select the template you’re interested in. (For more information about using this dialog box, see Creating VM Templates on page 185.)
   If the VM Template was discovered, its name begins with the IP address of the hypervisor that manages that VM template data. Also, a discovered template is read-only (you cannot edit discovered templates).

6. **Choose the Deployment Profile to use as the basis of your new VMs.**
   The Deployment Profile specifies physical details about how to deploy the VM, including:
   - The path to the VM package files (OVF or VHD) that will be copied to deploy this VM. Note that if the Deployment Profile data was discovered by Turbonomic, then the profile does not show a path to the VM package files. Also, you cannot edit a discovered Deployment Profile.
   - Optional placement constraints (constrain to datacenter or cluster) If the Deployment Profile does not specify a datacenter or cluster, then Turbonomic is free to deploy the VM anywhere in your virtual environment.

   To inspect Deployment Profiles, open the Edit Templates dialog box and select the profile you’re interested in. (For more information about using this dialog box, see Creating Deployment Profiles on page 186.) If the Deployment Profile was discovered, its name begins with the characters DEP- for “Deployment”. A discovered profile is read-only.
Requesting a Reservation

After you have defined the reservation, click **Request**.

If you gave the current date for the reservation, Turbonomic starts to calculate the optimal placement for the VMs you have specified for the reservation. You may have to wait briefly while Turbonomic makes these calculations.

Depending on the size of the workload and the available resources in your environment, the request can have one of two results:

- **Sufficient Resources**
  If your environment has sufficient resources to place all the VMs in the reservation, Turbonomic displays a list of proposed VM placements, one for each VM that you specified. You can accept this reservation, and it will become **active** — it appears in the **Reservations** list with a status icon that shows it as Reserved ( ).

- **Insufficient Resources**
  If your environment doesn't have sufficient resources to place all the VMs, Turbonomic alerts you to that fact. You can close the alert box and accept the reservation, and it will become **unfulfilled** — it appears in the **Reservations** list with a status icon that shows it as Unfulfilled ( ).

If you gave a future date for the reservation, then Turbonomic does not calculate its placement at this time. Instead, the reservation is placed in the **Future Reservations** list with a status icon that shows it as a future reservation ( ). When the Reservation Date arrives, Turbonomic calculates placement for the reservation, and moves it to the **Reservations** list.

Accepting a Reservation

After making the request, you can accept the reservation — whether your environment has sufficient resources or not. If Turbonomic displays a deployment proposal, you can review it to see what the initial placement of the reserved VMs will be. But remember that Turbonomic includes the reserved VMs in its intelligent workload management, so the placement decisions can change before you actually deploy the reservation.

**NOTE:** The deployment proposal is timed — you have five minutes to accept a proposed reservation, or Turbonomic will cancel the proposal. This gives you a chance to confirm the action if you have scheduled the deployment to execute immediately.
If your environment has sufficient resources to deploy the reserved VMs, you will create a Fulfilled Reservation. If you don't have sufficient resources, you will create an Unfulfilled Reservation. For more information, see Active Reservations on page 178.

**NOTE:** When the deploy date is today, Turbonomic deploys the VMs immediately if your system has sufficient resources.
Active Reservations

When you create a reservation with a Reservation Date that is for today (or if the Reservation Date has passed), Turbonomic calculates placement for the reserved VMs and adds an entry to the Reservations list.

<table>
<thead>
<tr>
<th>Select</th>
<th>Reservation Name</th>
<th>VM Count</th>
<th>Reservation Date</th>
<th>Deploy Date</th>
<th>Status</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AllDepts</td>
<td>10000</td>
<td>02/23/2016</td>
<td>03/01/2016</td>
<td>U</td>
<td>Details</td>
</tr>
<tr>
<td></td>
<td>DemoStations</td>
<td>4</td>
<td>02/23/2016</td>
<td>03/02/2016</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>HR_VDIs</td>
<td>5</td>
<td>02/23/2016</td>
<td>04/01/2016</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

While it’s in the Reservations list, a reservation is active — while a reservation is active:

- Turbonomic adds the reserved VMs to your inventory and calculates their placement as though they are real VMs. It manages the placement of the reserved VMs along with the placement of actual workload in your environment.
- If your environment doesn’t have enough resources to place all the reserved workload, the reservation is Unfulfilled. For an unfulfilled reservation, Turbonomic continually tries to place the pending workload — if conditions change in your environment, then Turbonomic will reserve any pending VMs that it can.
- You can see reserved VMs in your inventory, alongside actual workload. This includes the Dashboard, Supply Chain, Workload, and Inventory views.
- You can run plans that take the reserved VMs into account. In addition, plans that are used to generate data in dashboards also include reserved VMs in their calculations.

A reservation remains active until one of the following occurs:

- You select the reservation and deploy it
  When you deploy a reservation, Turbonomic deploys the indicated VMs at the locations currently occupied by the reserved VMs. Before deploying, you can use different Turbonomic views to inspect the placement of the reserved VMs.
• You select the reservation and cancel it
  Canceling a reservation removes the reserved VMs from the market — Turbonomic no longer includes these VMs
  in its workload placement calculations.

• The Deploy Date has passed
  If the reservation is fulfilled, Turbonomic automatically deploys the reservation on the Deploy Date. If the
  reservation is unfulfilled, Turbonomic cancels the reservation.

  **NOTE:** Turbonomic will only deploy a reservation that is completely fulfilled. If the deploy date passes for an
  unfulfilled reservation, or if you select it and click Deploy, then Turbonomic cancels the reservation. If any VMs
  from an unfulfilled reservation were reserved in your environment, they will be removed.

**Reservation Details**

To see details about an active reservation, click the Details button ( ) in the Active Reservations list.

To edit a reservation, select it in the list, and click the Edit button ( ). This displays the **Update Reservation** dialog box. You can use this dialog box to change the reservation’s name or deploy date.

![Update Reservation dialog box](image)

- Change the Reservation Name and Deploy Date
- Template details
- Review host and datastore placement of the reserved VMs

You can also use the Turbonomic user interface to view reserved VMs and drill down to details about them. For exam-
ple, you can see reserved VMs in the Inventory and Supply Chain views:
Placement Calculations

To place reserved VMs on Hosts and Datastores in your environment, Turbonomic measures the VM consumption of the following resources:

- MEM Overprovisioned
- CPU Overprovisioned
- StorageProvisioned

By default, storage overprovisioning is set to 200%, and Mem and CPU overprovisioning is set to 1000%.

These resources measure consumption of overprovisioned capacity for host MEM and CPU, as well as consumption of StorageProvisioned capacity on the datastores. Each reserved VM consumes a fixed amount of these resources, according to the settings in its template. By using the overprovisioned resources, Turbonomic can calculate the placement of reserved VMs even though they don’t consume any actual resources in the environment.

For example, assume a host machine with MEM capacity of 512 GB. By default, MEM overprovisioning is set to 1000%, so the MEM Overprovisioned capacity is five Tb, or 5120 GB. Assume 10 reserved VMs created from a template that assigns it 3072 MB of virtual memory to each VM, and assigns a Mem Consumed Factor of 1 to each VM. In that case, Turbonomic calculates utilization of 30720 MB for the reservation, which is approximately 0.59% of the host’s MEM Overprovisioned capacity.

Note that actual VMs and reserved VMs all use the overprovisioned resource. If the actual VMs start to utilize more memory, the utilization of MEM Overprovisioned will increase on the host. If it increases enough, Turbonomic can move VMs off of that host — it might move the actual VMs, or it might move the reserved VMs. Conversely, if utilization drops it can move more workload onto the host. In this way, the placement of reserved VMs remains up to date, and that placement will be valid when you choose to deploy the reservation.
Unfulfilled Reservations

If Turbonomic can’t place all the VMs defined in your reservation, it places those VMs that it can, and puts the reservation into the **Reservations** list with a status of Unfulfilled ( ![unfulfilled](image). As long as the reservation is active (the deploy date hasn’t passed, and you haven’t canceled the reservation), Turbonomic continues to try and place the pending VMs.

If conditions in your environment have changed, and Turbonomic can place all the VMs for that reservation, it then changes the reservation status ( ![fulfilled](image)). When it’s time to deploy, Turbonomic will deploy all the associated VMs.

If the deploy date comes and Turbonomic has not been able to place all the VMs, then it cancels the reservation. In other words, Turbonomic will not deploy a partial reservation — it’s all or nothing.

Future Reservations

When you specify a future date for the reservation, you create a Future Reservation.

<table>
<thead>
<tr>
<th>Select</th>
<th>Reservation Name</th>
<th>VM Count</th>
<th>Reservation Date</th>
<th>Deploy Date</th>
<th>Status</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="check" /></td>
<td>HR_VDI</td>
<td>5</td>
<td>03/05/2016</td>
<td>05/07/2016</td>
<td><img src="image" alt="unfulfilled" /></td>
<td><img src="image" alt="details" /></td>
</tr>
</tbody>
</table>

This is a way to define a reservation and defer the time that Turbonomic will calculate the placement of the reservation’s VMs. Instead of calculating the placement, Turbonomic places the reservation in the **Future Reservations** list.

The Reservation Date shows the date when you want Turbonomic to calculate placement and reserve resources for the workload. At that time, Turbonomic will move the reservation into the **Reservations** list.
Deploying VMs

To deploy VMs, you first create a reservation. When you request a reservation, Turbonomic calculates the optimal placement for the reserved VMs. You can then accept the proposed placement to create an active reservation. For more information about reservations, see:

- Creating Reservations on page 173
- Active Reservations on page 178

Turbonomic provides three ways to deploy VMs in a fulfilled reservation:

- Wait for the Deploy Date, so Turbonomic will deploy the reservation automatically
- Select an active reservation and click Deploy
- Create a reservation with a deploy date of today

NOTE: Turbonomic can only deploy a reservation that is in the fulfilled state, with the Fulfilled status icon ( ).

Manually Deploying an Active Reservation

To deploy VMs from an active reservation, select the reservation in the list, and click Deploy. Turbonomic then deploys VMs to the locations that are current for the associated reserved VMs.

For information about active reservations, see Active Reservations on page 178.
Deploying VMs Today

When you define a reservation with a deploy date of today, Turbonomic calculates a deployment proposal. If you then accept the proposal, Turbonomic immediately deploys the VMs to the locations that are described in the proposal.

If you agree with the proposed VM deployment, click **Deploy** to create the VMs. You may have to wait a few minutes while Turbonomic performs the deployment actions.

If for some reason you log out of Turbonomic, the deployment action completes anyway. When you log in again, Turbonomic displays an alert telling you that you logged out while a deployment was pending.
Creating and Editing Templates

To define a reservation, you specify the workload by choosing:

- A VM template
  The VM template specifies the resources required for each VM you will deploy.

- A Deployment Profile
  The Deployment Profile specifies deployment details such as the source VM package (the OVF or VHD files) and optional placement constraints.

Turbonomic creates a number of VM Templates automatically as it discovers source VM data on the target hypervisors. These templates are read-only — you cannot edit them because they reflect data that is specified in your environment. Turbonomic also discovers associated Deployment Profiles that correspond with the discovered templates (also read-only).

You can create your own VM Templates and Deployment Profiles, and use them to deploy VMs. In this way, you can plan for and deploy VMs with different configurations than any VMs currently defined in your environment.

The following sections describe:

- Creating VM Templates on page 185
- Creating Deployment Profiles on page 186
- Discovered Deployment Data on page 187
Creating VM Templates

VM Templates describe the resource allocation that you want to provide for a class of VMs. When deploying VMs, Turbonomic uses the values that are specified in a chosen VM template. VM templates specify:

- **VCPUs**
  The virtual CPUs assigned to the VM.

- **Virtual Memory**
  The memory allocation for the VM, in MB. Note that you should never allocate less than is required for the guest OS.

- **Storage**
  The amount of disk storage assigned to the VM, in GB.

- **Network Throughput Used**
  The amount of the host’s network throughput to assign to the VM, in MB/s.
The values you set for these resources determine the configuration of any VMs you deploy using this template.

To create a VM Template:
1. Click the Create/Edit icon ( ) to open the dialog box.
2. In the dialog box, click the Add icon for the VM Templates list.
   To edit an existing template, select the template and click the Edit icon. Note that you can only edit user-created templates.
3. In the fields that appear, enter settings for the VM Template.
   The Template Name and Vendor fields help identify the template for future use.
4. Click Apply when you’re done.

Creating Deployment Profiles

A Deployment Profile specifies the physical files that will be copied to deploy the VM, as well as optional placement limitations.

NOTE: In many cases it’s best to let Turbonomic choose where to place the VMs you deploy. However, if you want to limit deployment to a specific datacenter or cluster, you can use a Deployment Profile to specify these constraints. If you are creating a profile for VMs in a Hyper-V environment, you should always select a Hyper-V datacenter or cluster for the profile.

Before creating the profile, you should know:

• The path to the VM package files (OVF or VHD) that will be copied to create the VM
• Optionally, the name of the datacenter or cluster that you want to deploy the VMs to

To create a Deployment Profile:
1. Click the Create/Edit icon ( ) to open the dialog box.
2. In the dialog box, click the Add icon for the Deployment Profiles list.
3. In the fields that appear, provide the settings for the Deployment Profile.
4. Click Apply when you’re done.
Discovered Deployment Data

Many hypervisor technologies support the use of source VMs as files that can be cloned, and the clones can be deployed as running VMs. For example, XenServer and CloudStack require the use of such source VMs to deploy new running VMs in their environments. When it performs discovery, Turbonomic identifies the source VM data on each hypervisor, and builds a corresponding set of VM Templates and Deployment Profiles.

**NOTE:** Hyper-V targets do not include discovered VM Templates and Deployment Profiles. You must create these files to deploy VMs in a Hyper-V environment. In the Deployment Profile, you must specify a Hyper-V datacenter, or a cluster that is a member of a Hyper-V datacenter.

For discovered VM Templates and Deployment Profiles, Turbonomic uses the following naming conventions:

- **VM Template** — These names begin with the IP address of the hypervisor that stores them
- **Deployment Profile** — These names begin with the characters `DEP` for “Deployment”, and if they match a discovered template, the profile name mirrors the template’s name
To view the settings for a discovered template or profile, open the template editor and select the item you want to inspect. The editor shows the template or profile in a dimmed view.

You cannot edit a discovered VM Template or Deployment Profile. This is to preserve the integrity of the template and profile in relation to the source VM data.
The Plan View

The Plan View runs simulations for what-if scenarios that explore possibilities such as:

- Optimal workload distribution across existing resources
- Changing hardware supply
- Impact of downsizing, or removing resources
- Optimal workload distribution to meet historical peaks demands
- Projected infrastructure requirements
To run these scenarios, Turbonomic creates a snapshot copy of your real-time market. It then uses the Economic Scheduling Engine to perform analysis on that snapshot market. You can modify the snapshot market by changing the workload, adding or removing hardware resources, or eliminating constraints such as cluster boundaries or placement policies.

As it runs a planning scenario, Turbonomic continuously analyzes the snapshot market until it arrives at the optimal conditions that market can achieve. When it reaches that point, the Economic Scheduling Engine cannot find better prices for any of the resources demanded by the workload — the scenario stops running, and it displays the results as the desired state. The display includes the resulting workload distribution across hosts and datastores, as well as the actions the scenario executed to achieve the desired result.

For example, assume you run a plan that adds virtual machines to a cluster. The plan runs analysis, where each entity in the supply chain shops for the resources it needs, always looking for a better price — looking for those resources from less-utilized suppliers. This analysis continues until all the resources are provided at the best possible price.

The results might show that you can add more workload to your environment, even if you reduce compute resources by suspending physical machines. The recommended actions would then indicate which hosts you can take offline, and how to distribute your virtual machines among the remaining hosts.

To run plans, open the Plan View, start a new plan, then configure and run the plan. Plan setup includes the following:

**Scope**
- Limit the physical devices that are included in the planning scenario—for example, limit to a given cluster. See Setting Plan Scope on page 206.

**Projection**
- Enable Projection Planning, then specify the end date and the frequency for a projection plan. A projection plan reiterates its runs to calculate requirements into the future. For each time period you specify, a plan runs to add workload or perform the specified changes on top of the previously run results. This shows how your environment will change over time.

**Demand**
- Specify workload parameters for the plan—add or remove VMs, to change load, or demand in your environment. See Specifying the Plan Resources on page 209.

**Supply**
- Specify resource parameters for the plan—add or remove hosts or datastores, to change supply in your environment. See Specifying the Plan Resources on page 209.

**Baseline**
- Specify baseline utilization statistics for the plan. The baseline types you can set are:
  - Historical
  - High-Demand
  - Percentage Increase
  For more information, see Set Baseline from History on page 220.

**Advanced Settings**
- Specify advanced parameters for utilization, VM Constraints, and Workload Placement. See Setting Advanced Options on page 223.

Run the plan. The plan can recognize existing constraints (clusters, network/storage constraints, and workload placement policies), or it can disable the constraints before running (Ignore constraints). While a plan is running, the Stop button appears. You can stop a running plan if necessary. See Running Plans on page 201.
Use Cases

The Plan View is where you create What-If scenarios that are especially useful for system architects, system administrators, and capacity planners.

System architects can use the Plan View to investigate how to expand the physical and virtual inventory to the best effect. A scenario can indicate how much new hardware to add, how to distribute VMs among clusters of hosts, and whether components of the proposed network will be over- or under-utilized.

System administrators can use the Plan View to answer immediate questions. If you expect a surge in utilization or demand, you can run a scenario to explore how to deploy new VMs that perform specific functions.

The following sections show example scenarios that can address these use cases:

- Increasing Virtual Load under Existing Constraints on page 191
- Decommission a Cluster or Datacenter on page 196

Increasing Virtual Load under Existing Constraints

Assume you want to determine the load distribution if you add more VMs to your environment. To do this, you would create a Workload Distribution scenario that adds the new VMs, and then determines the best way to run existing and new load on your physical hosts and datastores.

Your environment already has its physical systems assigned to clusters and resource pools. As you add VMs to the environment, you want to respect these constraints. When thinking about this scenario, imagine asking, “What would happen if I add ten VMs running Web servers, and ten VMs running database servers? How can I optimally deploy these VMs in my current environment?”

To plan out the best way to add these VMs to your inventory, you can create a Workload Distribution scenario that:

- Specifies how many VMs to add
- Uses an existing Web server VM as a model for your new Web server VMs
- Uses an existing database VM as a model for your new database VMs
The following steps show how to create such a scenario in the Plan view:

1. **Start a New plan to add VMs.**

   Click the **NEW** button ( ) to open the Plan Wizard, and choose the **Added VMs** scenario. This clears the loaded plan so you can specify a new plan based on your current environment.

   ![Create a new scenario](image)

2. **Define the scope of the plan.**

   By default, a plan loads a snapshot of your complete environment. Setting scope to the plan limits the processing to only those parts of the environment that interest you for this scenario. When you’re done, click **Next**.
3. **Edit the load for your plan.**

For this plan you will add 10 VMs to your environment. Use the Wizard to choose the VMs to add.

- Specify the properties of the VMs that you will add

  For this scenario, you will add copies of existing VMs to your load. Copying existing VMs is just one way to specify the properties of your new VMs. Expand a VM group and select the VM you want, set the number of copies to 5, then click **Add**.
• Now select another VM to copy, and add 5 more VMs to your load
  Be sure to click **Add** after you have selected the new VM to copy.

4. **Now that you have defined the new load, close the Wizard and run the plan.**

   Click the run button to see the planning results (Run). For information about run options, see **Running Plans** on page 201.

   Before running the plan, you should verify the setup to make sure it is as you intended:
Note that you can make more changes to the plan before running it. For example, to plan for a recurring peak load you can run the scenario against a load that occurred in the past. Or you can change the supply of physical hosts. After making these other changes, you would then click Run to execute the plan.

5. **When Turbonomic is finished running the plan, it displays the results.**

Click the View Arrows until you display the results bar chart. For information about this Results view, see One-time Plan Results on page 230.

Note that in this case the plan recommends suspending two hosts.
Decommission a Cluster or Datacenter

Assume you want to decommission one datacenter, and move all its workload to a different datacenter. Does the target datacenter have enough physical resources to support the workload you plan to move? Where should that workload be placed? How can you calculate the effect such a change would have on your overall infrastructure?

You can set up a scenario to simulate this change for you, and show the most desirable workload distribution in the target datacenter. In addition, the scenario can generate a PDF report that describes the final environment and lists the actions that the plan took to achieve that result. You can run such a scenario to simulate decommissioning an entire datacenter, or a given cluster.

To calculate this information, create a plan that:

- Limits the plan scope to two datacenters (or clusters) — the one you will decommission, and the one that will take on the extra workload
- Eliminates all the hardware from the decommissioned datacenter
- Calculates workload placement across datacenter (or cluster) boundaries
- Does not provision new hardware to support the workload

When you run it, the plan will move the workload from the closed down datacenter onto the one that is still in service. If that datacenter has enough resources to support the workload, the plan lists all the actions you can take to achieve the desired results. If the datacenter doesn’t have enough resources to support the workload, the plan lists the VMs that could not be placed.
The following steps show how to create and run such a plan:

1. **Start a new plan.**
   This clears the plan so you can specify a new plan based on your current environment. For this plan, you will create a scenario without using the Plan Wizard. To start a new plan, click to edit the scope — editing scope always starts a new plan.
2. **Set the plan scope**
   For this use case you will close down one datacenter and move its workload to another one that will remain in service. To set up this scenario, set the plan’s scope to include just these two datacenters.

Expand **PM Groups > Physical Machines by Datacenter** and select two datacenters - the one you will decommission, and the one to take on the extra workload.

For multiple selections, use **Ctrl-Click**

When you have selected the datacenters you want, click **OK**.

3. **Decommission the datacenter.**
   Modify the plan’s supply (click **Supply**).

Expand **Plan Host** and choose **Remove Hosts**.
NOTE: This use case can serve to decommission datacenters or clusters. To be thorough for decommissioning a datacenter, you can repeat this step for storage to remove the datacenter’s datastores. However, when decommissioning a cluster, you should not remove the cluster’s datastores — it’s likely that datastores are shared across clusters.

4. **Disable hardware provisioning.**

To make sure the plan places the stranded workload on just the existing hardware in your remaining datacenter, you must disable hardware provisioning.

Expand the **Physical Machines** group and select the datacenter to decommission. Click **Remove**, then close the dialog box.

Edit the Advanced Settings (click **Edit**) to disable hardware provisioning.
Display the **Action Settings** tab. Disable the options for **Allow Host Provisioning** and **Allow Datastore Provisioning**. Then click **Apply**.

When you’re done, close the dialog box.

5. **Run the plan.**

   To enable moving workload across datacenters and clusters, be sure to enable **Ignore constraints** before you run the plan ( ). In this mode, the plan can move your stranded workload to the in-service datacenter.

   After a successful run, you can review the results in the Plan view. The results will tell you whether the workload from the decommissioned datacenter can run on the datacenter that is still in service. For information about this Results view, see **One-time Plan Results** on page 230.
Running Plans

Plans are an excellent way to compare hypothetical conditions against the current conditions of your environment. There are a number of ways you can set up a plan (see Plan Setup on page 205). This section describes how to run plans, no matter what changes you have made in the plan setup.

By default, a plan incorporates all the constraints (cluster, storage, and network) and workload placement policies that are in effect in your environment. You can run a plan in two modes with respect to these constraints:

- **Respect Constraints:**
  The plan incorporates all the constraints. For example, in this mode the plan will not give resources from one cluster to a VM that is constrained to another cluster.

- **Disable Constraints:**
  The plan disables all the constraints before running. For example, in this mode the plan results can include:
  - Moving VMs to hardware that is in a different cluster
  - Moving VMs to hardware that uses different storage
  - Changes that cross datacenter boundaries
  - Changes that violate enabled workload placement policies

To run a plan:

1. **Decide whether you want to load a saved plan to run, or create a new plan.**
   Remember that a plan is a snapshot of your environment stored in memory as a static market. Before you begin setup, you should always start with a new plan. When you clear a currently loaded plan, Turbonomic gives you the option to save it or delete it.
   - **Start New Plan with the Plan Wizard**
     To start a new plan, click the **New Plan** icon. This clears the current plan, and then opens the Plan wizard. Use the wizard to set up your new plan. Note that you can always make changes after you finish with the wizard.
   - **Clear the current plan, and set new parameters**
     To clear a plan that’s in memory, set a new scope in the Plan view (see Setting Plan Scope on page 206. Changing plan scope always clears the current plan and begins with a new snapshot of the market.

2. **Load a Saved Plan**
   To load a saved plan, click the **Load Saved Plan** icon and choose the plan you want. When you load and run a saved plan, it starts from the current date, based on the current state of your environment.

For more information, see Plan Setup on page 205.
3. **Run the plan**

   Run the plan, either with or without constraints.

   - [ ] **Ignore constraints**
   - **Run**

   Note that you can always **Stop** a running plan if necessary.

   ![Running plan, please stand by..](image)

   Stop the plan, finish pending calculations that result from plan analysis, and display results

   ![Stop](image)

   Stop the plan without finishing calculations or displaying results

After running a plan, you can review the results according to the type of plan you have run.

**Running a Plan on the Current Environment**

By default, a new plan mirrors your current environment. It is often instructive to run a plan on your current environment, without making any changes to the plan setup. The results will show how much you can improve your current workload distribution, and whether you should suspend or provision underlying infrastructure to provide a supply that meets the current demand.

If your environment is very large, you can scope the plan to specific clusters or groups and run against those. For information about scoping a plan, see [Setting Plan Scope](#) on page 206.

The following image shows the results of clicking **Run** to run an unmodified plan on the current environment. The results show that the plan suggests you can decommission 24 hosts. This indicates that your environment is overprovisioned, and you can save money by consolidating resources.
In the next image you can see the results of clicking the checkbox to run an unmodified plan on the same environment, but without respecting constraints such as cluster boundaries or placement rules. In this case the results show that you can decommission 30 hosts and still satisfy the current workload. This indicates the impact that cluster boundaries and other constraints have on the workload placement options that are available to you.
The Plan View

Changes:

**Virtual Machine (Active & Reserved)**
- Initial: 50
- Desired: 60
- Plan Execution: Resize actions: 31

**Hosts**
- Initial: 37
- Desired: 7
- Plan Execution: Suspended 30
Plan setup defines the workload, resources, and settings that you want to use when calculating results. A plan begins as a snapshot of your current environment, loading a static version of your real-time market into memory. As you modify the plan setup, you actually modify the plan market.

For example, you can set the plan’s scope, add more hardware resources (change supply), or increase the workload (change demand). These changes are reflected in the plan market, so Turbonomic can use the Economic Scheduling Engine to calculate the results that can come from the planned changes.

**NOTE:** When you create a new plan, it begins as a snapshot of your current environment. You can run the scenario against a new and unmodified plan, and it will give you results for your current environment. This is a way to get an initial overview of your environment. To do this, simply run a new plan.

To create a plan, you specify its properties and then run it. The Plan Setup panel includes tools for these settings.
The following sections describe the steps for plan creation:

- Setting Plan Scope on page 206
- Enabling Projection on page 208
- Specifying the Plan Resources on page 209
- Setting the Plan Baseline on page 218
- Setting Advanced Options on page 223

**Setting Plan Scope**

Plan scope determines which devices in the environment will be included in the plan. For example, if you scope the plan to your Development cluster, the current environment for your plan would only include PMs in the Development cluster, the VMs hosted by those machines, and datastores that support those machines. Likewise, the target results would only correspond to those machines.

Note that you can only set scope to a new plan. If you have a defined plan resident in memory, setting scope opens the Save Plan dialog box where you can choose to cancel, save the current plan, or discard the current plan before you start the new plan. Changing scope requires that you start a new plan after:

- You have opened a saved plan
- You have run a plan
- You have made any changes in Plan Setup
The plan determines scope differently, depending on the type of entity you base it on:

- **Scope by VM**
  Limits the plan to the physical hosts that those VMs are able to run on. Likewise, the plan includes all the datastores that are available to the VMs in your scope.

- **Scope by PM**
  Limits the plan to those physical hosts. For datastores, Turbonomic identifies all the VMs that can run on the hosts in your scope, and identifies all the datastores that are available for those VMs.

- **Scope by Storage**
  The plan includes the VMs that can run on those datastores, and the physical hosts that those VMs are able to run on.

- **Scope by Provider Virtual Datacenter**
  Limits the plan to the VMs on the virtual datacenters — For those VMs, the scope operates similarly to scope by VM.

**NOTE:** When setting scope for a plan, you can choose multiple groups. However, you should be sure to choose groups of the same type. For example, you should not scope by PM and VM groups for the same plan.

Edit the plan’s scope in the **Configure** panel. This opens the **Define Plan Scope** dialog box.
Ctrl-click to select multiple items in the list. Click **OK** to set the scope to the current plan. You can see the scope for the current plan in the **Configure** panel.

![Configure panel with selected clusters]

### Enabling Projection

Projection plans calculate infrastructure requirements into the future, so your environment can accommodate changes to workload requirements over time. In a single plan you can specify the scope of the plan, how far into the future to project, and by what increments of time. For example, you can project the requirements of a specific data-center one year into the future, showing how requirements change at one-month intervals.

When you run a projection plan, Turbonomic executes the plan iteratively for each time period you’re projecting for. For example, assume you set up a projection plan as follows:

- Project for three months at one-month intervals
- Set a 15% increase of workload as the baseline
- Specify Demand settings to:
  - Add VMs based on previous month
  - Add 10 copies of a specific VM every month

When you run this plan, it will execute three steps, one for each one-month interval. For each step, the plan will:
- Increase the current workload by 15%, add the same VMs that were added the month before the plan was run, and add 10 copies of the specified VM.

Enable projection in the **Configure** panel. This opens the **Projection** dialog box where you can enable or disable projection, and set up the projection time periods.
The start date for projection is always now — the time that you run the plan. In other words, the plan loads your current environment into memory when you click the Run button.

End Date specifies how far into the future you will project, and Monthly Frequency specifies how much time to assign each projection step. Frequency is always a factor of the number of months in the projection time range. For example:

- 6-month range: divisible by 1, 2, 3, and 6
- 9-month range: divisible by 1, 3, and 9
- 11-month range: divisible by 1 and 11

## Specifying the Plan Resources

The plan workload is determined by the set of VMs that are deployed in your environment, compared to the PMs and datastores that provide resources to them. In other words, plan workload is determined by the plan’s supply and demand.

The more VMs you have for a given number of PMs and datastores, the greater the load will be on these physical devices. With a plan you can add or remove VMs to change the demand. You can also add or remove PMs and datastores to change the supply. Then you can run the plan to see what the results would be.

For example, you can define a plan that adds VMs to the same set of PMs and datastores. Or you can upgrade your physical hosts so they have more CPU or memory resources, and see how that would affect the way your environment supports the current crop of VMs.

To set the plan’s workload, modify the plan’s Demand or Supply. For more information, see:

- Demand on page 210
- Supply on page 215
- Creating Templates on page 216
**Demand**

Workload is the set of VMs in your environment, compared to the physical resources — the hosts and datastores. Demand settings have to do with adding or removing VMs within the scope of the plan.

For projection plans, many of these settings include a choice of when to add or remove the specified VMs. You can choose to make the change:

- **Now**
  Add or remove the specified VMs as part of the first iteration of the projection.

- **Monthly**
  Add or remove the specified VMs repeatedly, for every month in the projection.

- **Month/Year**
  Add or remove the VMs once for a specific month that falls within the projection time range.

For example, the following image shows a Month/Year setting to make the change on February of 2015:
You can change demand in the following ways:

- **Add VMs based on previous month**
  For every month in the projection, the plan adds copies of the VMs that were added to your environment in the month previous to running the plan. In other words, the projection assumes you will add these VMs regularly each month.

- **Include Reserved VMs**
  If you have any reservations set up in the Deploy view, the plan will include these VMs. If the plan period is before the reservation deploy date, the plan handles the reservation as reserved VM resources. When the plan period reaches the deploy date, the plan treats the reserved workload as fully deployed VMs. For more information about reservations, see The Deploy View on page 172.

- **Copy VMs**
  Add copies of existing VMs to your plan. See Copy VMs on page 212.

- **Copy Using Templates**
  Add VMs to the plan, based on VM templates. See Copy VM Using Template on page 213.

- **Remove VMs**
  Select the VMs you want to remove from the plan. See Remove VMs on page 214.

- **Change Resource Utilization**
  Select a group of VMs and increase or decrease their workload by a given percent. See Change Resource Utilization on page 214.

You can also create templates for add operations. For more information, see Creating Templates on page 216.
Copy VMs

Select a VM to serve as a model of what you want to add, then specify how many copies of that VM you want to add to the environment.

1. Choose the Copy VMs action.
2. Navigate the list of VMs to choose which one to copy.
3. Specify the number of copies to add, then click Add.
   The list of items will include a folder called New Entities. You can expand that folder to see the items you have added.

You can repeat these steps — select another item to copy, specify the number of copies, then click Add. New additions will appear in the New Entities folder.

4. When you have finished adding items to the plan’s workload, close the dialog box.
Copy VM Using Template

Select a template to serve as a model of what you want to add, then specify how many copies of that templated VM you want to add to the environment. You can also choose to create a new template or edit an existing template (see Creating Templates on page 216).

1. Choose the Copy VM Using Template action.
2. Choose the template you want to use.
   Note that in the above example, the templates with IP addresses have been discovered on the indicated hypervisors. Templates without IP addresses in their names have been created within Turbonomic. You can use either type of template in a plan.
3. Specify the number of copies to add, then click Add.
4. When you have finished adding items to the plan’s workload, close the dialog box.
Remove VMs

Select the VMs you want to remove from your environment.

1. Choose the Remove VMs action.
2. Navigate the list to choose which VMs you will remove. You can select individual VMs, or groups of VMs.
3. Click Remove.
4. When you have finished removing VMs, close the dialog box.

Change Resource Utilization

Use this to see what will happen if the VMs in your environment were to consume a different amount of resources. For example, you can set the scope of your plan to a production cluster, increase the load by 20%, and run a plan. This is the same as saying, “What would happen if all the VMs in my production cluster saw a 20% increase in their consumption of host memory and CPU cycles?”

This option is for VMs, only. Select the VMs you want to modify, and raise or lower the resource utilization by percentage points.
1. Choose the Change Resource Utilization action.

2. Navigate the list of VMs to choose which ones you will change. You can select individual VMs, or groups of VMs. Ctrl-click to select multiple items.

3. Click Change Load.

4. When you have finished changing VMs in the plan’s load, close the dialog box.
   - Click Close to close the dialog box. Use this option if you want to make more changes to the plan, or if you want to save the plan before you run it.
   - Click Close and Run to close the dialog box and run the plan immediately.

**Supply**

Workload is the set of VMs in your environment, compared to the physical resources — the hosts and datastores. Supply settings have to do with adding or removing hosts and datastores within the scope of the plan.
For projection plans, these settings include a choice of when to add or remove the specified physical resources. You can choose to make the change:

- **Now**
  Add or remove the specified supply as part of the first iteration of the plan.

- **Month/Year**
  Add or remove the specified supply once for a specific month that falls within the projection time range.

For example, the following image shows a Month/Year setting to make the change on February of 2015:

![Month/Year Image]

You can change supply in the following ways:

- **Add copies of hosts or storage**
  Choose the Add action, navigate to the host or datastore you want to copy, and then specify the number of hosts or datastores to add.

- **Add host or storage using template**
  Choose the Add Using Template action, select the template you want to add copies of, and then specify the number of hosts or datastores to add. You can also choose to create a new template or edit an existing template (see Creating Templates on page 216).

- **Replace host or storage using template**
  First choose the Replace Using Template action, and navigate to the host or datastore you want to replace. Then specify the template you want to use. You can also choose to create a new template or edit an existing template (see Creating Templates on page 216).

- **Remove host or storage**
  Choose the Remove action, navigate to the host or datastore you want to remove, then click **Remove**.

### Creating Templates

When you specify the load for a plan, you can use templates to define the items you will add to the load.

To create a new template while you’re setting up a plan:

1. **Modify the Demand or the Supply.**
   Open the plan’s **Demand** or **Supply** dialog box.

2. **Choose one of the template actions:**
   - Copy Using Template
   - Add Using Template
   - Replace Using Template

3. **When you choose a template to use, scroll the dropdown list to select Add New Template.**

4. **Specify your template settings and click Create Profile.**

To edit an existing template, perform the above steps to choose a template action. Then select an existing template and click the **Edit** icon. Then change the template settings and click **Update Template**. If you want to delete the template, click the **Delete** icon.
Note that when you create a new template or edit a template, the Modify Load dialog box expands to display the template settings. The available settings are different, depending on the type of item the template is for.

**Template Settings for VMs**

These settings identify a VM type, and specify the resources that VM type will consume.

For VCPU, Turbonomic assigns 75% of the physical CPU resources to the VM. For example, if you specify 1 VCPU for this VM type, Turbonomic assigns 75% capacity of a CPU on the machine that hosts the VM. This ensures that the host machine has CPU capacity to perform infrastructure tasks.

For VMEM and VStorage, Turbonomic assigns 100% of the physical resources that you specify here.
**Template Settings for Hosts**

These settings identify a PM type, and specify the resources it can provide. For plans, scenarios use the Price entry to calculate costs or savings when adding or removing host machines.

<table>
<thead>
<tr>
<th>Choose template name:</th>
<th>Dell R415</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vendor:</td>
<td>Dell</td>
</tr>
<tr>
<td>Model:</td>
<td>R415</td>
</tr>
<tr>
<td>Description:</td>
<td>Dell Poweredge R415</td>
</tr>
<tr>
<td>Price:</td>
<td>1000</td>
</tr>
<tr>
<td>CPU cores of 2662.4 [Mhz]</td>
<td></td>
</tr>
<tr>
<td>Memory capacity [MB]:</td>
<td>131072</td>
</tr>
<tr>
<td>Network Throughput [MB/s]:</td>
<td>1000</td>
</tr>
<tr>
<td>IO Throughput [MB/s]:</td>
<td>1000</td>
</tr>
</tbody>
</table>

**Template Settings for Datastores**

These settings identify a type of data store, and specify the resources it can provide.

<table>
<thead>
<tr>
<th>Choose template name:</th>
<th>Medium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price:</td>
<td>5000</td>
</tr>
<tr>
<td>Storage capacity [GB]:</td>
<td>4</td>
</tr>
<tr>
<td>IOPS:</td>
<td>5000</td>
</tr>
</tbody>
</table>

**Setting the Plan Baseline**

The plan baseline is the set of utilization statistics that a planning scenario uses to calculate target or projected results. You can use the current statistics, or you can choose statistics from a past period. For example, if utilization typically peaks at a certain time of the day, or a certain day of the week, you can choose that moment as your baseline.
Edit the plan's scope in the **Configure** panel. This opens the **Select Baseline** dialog box.

![Configure panel](image)

You can set the following types of baselines:

- **Baseline from history**
  
  Choose a moment in the past to serve as the plan baseline (see Set Baseline from History on page 220).

- **High Demand Baseline**
  
  Choose different past utilization peaks per cluster (see Set High Demand Baseline on page 221).

- **Increased Utilization Percent**
  
  Specify a percentage by which to increase or decrease the current utilization (see Increase Utilization by Percent on page 222).

![Select Baseline dialog box](image)
Set Baseline from History

Use this dialog box to set up the baseline of utilization metrics for your plan. You can set this up to:

- **Use the metrics that are current to your environment**
  This setting runs the plan against the current state of your environment. You can set up the plan to add or remove entities, or otherwise affect the plan calculations. But the utilization metrics will be based on the current state of the plan. If you run the same plan multiple times, each run begins with a fresh view of your inventory.

- **Use metrics that are based on utilization**
  This loads the utilization statistics from a previous time period into the plan. Use this to run the plan against utilization that you experienced in the past. For example, assume a peak utilization period for the month before the winter holidays. During the holidays you want to plan to add new capacity that can better handle that peak. You would set the baseline to the utilization you saw during that pre-holiday peak.

If you enable the **Use current inventory** option, the plan sets historical utilization metrics to the inventory that is current in your environment. Also, each run of the plan will start with a fresh view of your inventory.

If you disable this option, the plan uses the inventory that was current when you first ran the plan. Subsequent runs accumulate results on top of that original run of the plan.

To set the baseline, click Historic Baseline icon ( ). Then click a data point to choose the moment you want.

After you click a data point, the dialog box displays the statistics for utilization on the environment’s physical hosts.
When you are satisfied with the baseline settings, click **Apply Baseline**.

**Set High Demand Baseline**

High Demand Baseline loads peak utilization values per cluster into the plan. For each cluster in the plan’s scope, you can choose from the peak loads the scope has experienced in the past. In this way, you can set up a plan to run against the true peak workloads for each cluster.

**NOTE:** The High-Demand baseline is not just a snapshot of utilization at different times in the past. For each cluster in this baseline, the plan will recreate the workload that cluster experienced at that time. If the cluster had different VMs running in it, then Turbonomic uses its historical data to represent the VMs that were in the workload at that time.

To set the baseline, click the High Demand icon ( ). The dialog box lists each cluster in the plan’s scope — for each cluster, a drop-down list shows peak utilizations, showing the date and the average price (calculated from the Utilization Index) for that cluster. For each cluster, choose the peak utilization you want to plan against.
Note that when you select a high-demand period for a cluster, if that workload included more VMs than are currently in your environment, the plan adds those VMs to the scenario and you will see a net increase in the number of VMs in your plan. On the other hand, if the workload had fewer VMs than your current environment, you might see a net decrease in the number of VMs in your plan.

Increase Utilization by Percent

Setting baseline by increasing utilization by percent is a way to globally increase the workload for the full scope of your plan. When you set an increase percentage for a Projection plan, the projection runs for as many periods as you set — for each projection run, the planning scenario increases the workload by the specified percentage.

To set this baseline, click the Increase Utilization by Percent icon ( ), and enter the percentage by which you want to increase the workload.
Setting Advanced Options

For a given plan, you can make the following advanced settings:

- **Utilization Levels** on page 223 (for Physical Hosts, Datastores, and Desired State)
- **VM Constraints** on page 224
- **Workload Placement** on page 226
- **Action Settings** on page 227

**Utilization Levels**

Max Host and Max Storage utilization levels specify the percentage of a physical resource that you want to make available in the given plan. By default, hosts and datastores have utilization set to 100%. For a given plan, you can set the utilization to a lower value.

For example, assume you have one data store that you want to share evenly for two clusters of VMs. Also assume that you are creating a plan for one of those clusters. In that case, you can set the datastores to 50% utilization. This saves storage resources for the other cluster that will use this storage.
To set utilization:

1. Click the Advanced Options icon ( ) to open the advanced Planning Options dialog box.
2. Display the Set Utilization tab.
3. Choose which type of device to modify:
   - Max Host Utilization
   - Storage Utilization
4. Navigate the list to select the device you want to modify.
5. Specify the percentage you want, then click Set Max Level.

**VM Constraints**

By default, VMs are constrained to the cluster, network group, or storage group that their hosts belong to. When you run a plan, Turbonomic does not consider moving VMs to physical hosts outside of the current cluster if they are constrained by cluster. But if you disable the Cluster constraint for a VM, then the planning scenario can evaluate the results of hosting that VM on any other physical machine in your environment. If the best results come from moving that VM to a different cluster, then the scenario will show that result.
To set constraints:

1. Click the Advanced Options icon ( ) to open the advanced Planning Options dialog box.
2. Display the VM Constraints tab.
3. Navigate the list to select the VMs you want to modify.
4. Choose the types of constraints to set:
   - All
   - Cluster
   - Network
   - Storage
5. Specify whether to enable or disable the constraints.
6. Click Apply.
Workload Placement

In this tab you can enable or disable imported placement policies or Turbonomic placement policies for the VMs in your plan. The tab shows the workload placement policies that are currently defined for your environment. You can also click the Plus or Minus icons to create new Turbonomic placement policies from this tab. For more information about these policies and how to manage them, see Workload Placement Segments on page 336 in the Policy view.

Click the Plus or X icons to create or delete Turbonomic placement policies.

To set enable or disable placement policies:

1. Click the Advanced Options icon ( ) to open the advanced Planning Options dialog box.
2. Display the Workload Placement tab.
3. Navigate the list to select the policies you want to enable, then click Enable Rule.
Action Settings

In this tab you can enable or disable:

- **The provisioning and suspension of hardware**
  By default, when you run a plan Turbonomic can provision or suspend hosts and storage within that plan. This means that if Turbonomic sees that you would get better results by adding or removing hardware, the plan will recommend that you perform those actions, and the plan will reflect the results you would get by performing those actions.

  There are reasons to run a plan with hardware provisioning and suspension disabled. For example, you might want to run a scenario to see how much workload you can add to your current environment. To do that you would:
  - Add workload to the environment
  - Disable provisioning for hosts and storage
  - Run the plan and review the results
  This is not simply looking at how much more workload you can place on specific hosts. The plan will redistribute the workload to get the best possible results. After running the plan you may find that you can add more workload than you initially thought — without adding any new hardware.

- **Resizing of VMs**
  By default, plans calculate resize options for VMs. If the resources are available, and increasing resources would reduce the percentage of capacity utilized, the plan will recommend resizing a VM. However, for some applications you might prefer to deploy a new VM as a response to performance bottlenecks in an application. In that case, you can disable resizing of VMs.

  **NOTE:** Turbonomic includes settings to specify the desired state in your environment. It is unusual to change these settings, but if you have changed them from the defaults, you should not disable hardware provisioning or suspension. If you do, then plan results may not be satisfactory. For more information about these settings, see Desired State on page 351.
**Provisioning and Suspension for a Plan Subset**

Assume you want to plan how many new hosts you need to support increased workloads, and assume you want to only provision a specific type of host. If you enable provisioning for all the hosts in the plan’s scope, then if the plan wants to provision new hosts it can choose from any hosts within that scope. This is true even if you have a cluster of hosts that you never want the plan to copy.

If you choose Group in the Action Settings tab, then you can select a specific group or cluster and specify overrides to the provisioning and suspension settings. Note that you should select a group that is within the scope of the plan, otherwise this setting will have no effect on your plan.

In this example, Allow Provisioning is disabled for the selected cluster. This means the plan will not copy hosts from that cluster when provisioning new hosts.

Be sure to click **Apply** when you're done.
Plan Results

After running a plan, the results show you the optimal placement of the entities in the plan. By reviewing the results you can learn about:

- **Optimal workload distribution**
  You can see whether you have enough supply to satisfy the planned-for demand. A plan could show that you can consolidate workload on fewer hosts or datastores. The plan results show the optimal distribution of supply and demand, compared with the current workload distribution.

- **A summary of changes**
  If the plan proposes changes to your environment, you can see these changes summarized in a list — How many hosts or datastores you should add or remove, and how the count of VMs has changed.

- **A list of actions**
  The plan’s To Do list shows all the actions the plan took to arrive at the final desired state.

The plan displays two types of results views — One for Projection Plans, and another for One-time Plans. The following sections describe these different views.
One-time Plan Results

This view provides an overview of the current workload compared to the desired results, as calculated by the plan. The results are from a single run of the plan over a snapshot of your current environment.

Plan Workload Distribution

The Plan Workload Distribution pane shows the plan results as Workload Charts for before and after running the plan. The display is similar to what you see in the Workload View (see The Workload View on page 166). However, you should be aware of the following distinctions:
### Plan View

The charts show states in the plan market — a simulation of market analysis performed on a snapshot of your environment from a moment in time.

### Workload View

The charts show states of the real-time market. Both views use the same analysis, but the Workload View shows charts based on your current environment, as it changes in real time.

#### Current Chart

This shows the state of your environment as it is represented by the plan settings, including:

- Scope
- Demand
- Supply
- Baseline

#### Desired Chart

This shows the results of the plan, after it has executed actions and can make no more improvements to the simulated environment.

#### Desired Chart

This shows the results you would see in your real-time environment if you were to execute all the actions that are currently recommended.

---

### Plan Improvements

The **Plan Improvements** pane charts the current results. You can filter the view to chart different entity types (Host, Storage, or VM) and different resource types (utilization index, memory, CPU utilization, input/output, network utilization, or VMs per host).

The desired results display as a green plot. The desired result is laid over a bar chart of the current resource distribution. If a bar is grayed, that means the planning scenario recommends you suspend that device. If the chart shows no bar to correspond with a desired result data point, this indicates that the plan has added a new device to meet the plan’s requirements.

For a different view of the same data, click **Side by Side View** at the top-right of the panel. You can customize the display to chart different metrics, and you can chart by average or peak values.
Summary of Changes

The **Summary of Changes** pane shows the current and desired numbers of VMs, hosts, and datastores. It includes a total savings/cost at the top of the pane. This value is calculated from the costs you assign to resources. For example, you can assign a cost when you create a host template (see Creating Templates on page 216).

To Do List

The To Do list shows actions that the plan used to achieve the desired results. These actions can range from adding more storage or physical machines to your environment, to moving or changing the configuration of virtual machines. Each action includes a tooltip that displays a full description.

This list includes all the actions the plan used to achieve the desired results, but you should not necessarily execute all of them as they are listed here. Remember that a plan runs on a static representation of your environment. Because the plan market is static, the Economic Scheduling Engine can the plan market until it reaches a conclusion. The real-time market is dynamic — demand changes as you execute actions, and the environment can always be improved.

The planning scenario shows how your environment would develop and change under different conditions. The best way to achieve those results is to change the conditions in the real-time environment and let Turbonomic recommend the actions you should take there.
Projection Plan Results

The Projection Results view shows the requirements for your environment that the plan calculates when you enable projection. The charts show data points that correspond with the start date of the plan, and the intervals you specified — monthly, every 2 months, every three months, etc.

Utilization Summary Charts

These charts plot the utilization of host and storage resources over the time span of the projection.
Additional Resources Panel

This panel lists the resources that will be added to your environment over time. For example, if you set the plan to add VMs every month, those additions appear in this panel.

<table>
<thead>
<tr>
<th>Time Periods</th>
<th>Virtual Machine</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 2015</td>
<td>+5</td>
</tr>
<tr>
<td>May 2015</td>
<td>+5</td>
</tr>
<tr>
<td>July 2015</td>
<td>+5</td>
</tr>
</tbody>
</table>

Provisioning Projections

These panels show the projected workload and projected resource requirements for hosts and storage. The green line indicates the current capacity, and the bars indicate the projected values.
The Inventory View

The Inventory View is where you go to observe the full virtual infrastructure. Here you can see the health of your entire virtual environment from a single view. You can identify bottlenecks and other resource and performance anomalies, and assess your overall workload distribution.

You can also see To Do lists with recommended actions to improve performance in your environment. For more information, see To Do Lists - Maintaining QoS on page 70.

Inventory View
Inventory Charts

With the Inventory View you can see information about all the items in your environment, starting from a global summary and drilling down to information about a specific item. As you select items in the Inventory or Groups flyouts, the view updates to show information about the selected item in charts on the right. These charts can display historical data for up to 60 days (see Utilization History on page 69).

Chart panels in the Inventory view include tools you can use to:

- Maximize/minimize
- Customize display
- Export content to XML
- Display a legend
- Display tooltips

For more information, see Standard Panel Controls on page 52.

The Inventory Flyout Panel

The Inventory flyout shows all the resources, services, and commodities Turbonomic has discovered for your environment. As you browse this tree and select an item, your selection sets the scope for the Inventory View. For any inventory item you select (any tree item except “Summary”), you can export the current view as a PDF report.
Exporting the view to a PDF report

The Inventory flyout displays a tree that you can use to explore the following in your environment:

- Virtual Applications on page 238
- Applications on page 240
- Virtual Machines on page 247
- Physical Machines on page 251
- Storage on page 255
- Disk Arrays on page 258
- Storage Controllers on page 262
- Fabric Interconnects on page 265
- Chassis on page 268
- IO Modules on page 271
- Datacenters on page 279
- Provider Virtual Datacenters on page 281
- Consumer Virtual Datacenters on page 285
Virtual Applications

A virtual application is the client’s point of contact to request services from an application that is managed by a load balancer. Each virtual application has one or more running applications bound to it. The load balancer passes requests to these bound applications. Note that Turbonomic discovers running applications, but you must bind these to the virtual applications that are in a load balancer as part of your load balancer configuration. For more information about applications and application discovery, see Applications on page 240 and "ApplicationDiscovery" in the Target Configuration Guide.

When you select Virtual Applications in the Inventory tree, the Inventory view displays the following panels:

- Virtual Applications Utilization Chart
  The percentage of allocated transaction capacity the virtual applications are using. To see a history of usage for a virtual application, click the associated bar.

  To choose which metrics to plot or change the chart sort order, edit the chart . Utilization Index shows a measure of the utilization of resources. The more equal the Utilization Index values are for your applications, the more evenly distributed their loads.

- Virtual Applications Utilization Trend
  The percentage of maximum and average transactions over time.

- To Do list
  Recommended actions for Virtual Applications

- Usage for Virtual Applications
  A tabular display of the percentage of transaction capacity that is used by each virtual application.
Virtual Applications Summary

In the Inventory tree, the Applications branch includes a hierarchy similar to the following figure.

Virtual Applications Hierarchy
Underneath Virtual Applications, the list shows the application service types. These service types are defined on the load balancer — Turbonomic discovers the service types through each load balancer that is registered as a target. For each service type, the panels show charts for the current service type:

- **Virtual Applications Utilization Chart**
  The percentage of transaction capacity used by virtual applications of this service type. To see a history of usage, click the associated bar.

- **Virtual Applications Utilization Trend**
  The percentage of maximum and average transactions over time.

- **Virtual Applications To Do list**

- **Usage for Virtual Applications**
  A tabular display of the percentage of transaction capacity that is utilized, for virtual applications of this service type.

When you expand a Service Type item, the Inventory tree lists the individual virtual applications within that service type. Each virtual application consumes the running applications that are managed by the load balancer.

## Applications

Turbonomic discovers and monitors applications running on VMs in your environment. By default, Turbonomic discovers the following applications:

<table>
<thead>
<tr>
<th>Application Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSASS</td>
<td>Microsoft Active Directory services</td>
</tr>
<tr>
<td>IIS</td>
<td>Microsoft Internet Information Services</td>
</tr>
<tr>
<td>XenDesktop</td>
<td>Citrix XenDesktop</td>
</tr>
<tr>
<td>VMView</td>
<td>VMware View</td>
</tr>
<tr>
<td>MSSQL</td>
<td>Microsoft SQL Server</td>
</tr>
<tr>
<td>SharePoint</td>
<td>Microsoft Sharepoint Server</td>
</tr>
<tr>
<td>Guest Load</td>
<td>The resources that Turbonomic has not assigned to any specific application (for more information, see Guest Load on page 243)</td>
</tr>
</tbody>
</table>

In addition, your installation of Turbonomic might be configured to discover other applications running in your environment. For more information, see "ApplicationDiscovery" in the Target Configuration Guide.
Applications Summary

When you select Applications or an applications group in the Inventory tree, the Inventory view displays the following panels:

- **Applications Utilization Chart**
  The percentage of VMEM, VCPU and transaction capacity the applications are using. To see a history of usage for a given metric, click the associated bar.

  To choose the metrics to plot or change the chart sort order, edit the chart. Note that Utilization Index shows a measure of the utilization of resources. The more equal the Utilization Index values are for your applications, the more evenly distributed their loads.

- **Applications Utilization Trend**
  The consumption of commodities over time. Click the radio buttons to choose which statistics to show in the chart. You can show averages for all resources, or average and max for individual resources.

- **To Do list — Recommended Actions for Applications**

- **Usage for Applications**
  A tabular display of VCPU and VMEM usage for the VMs that support your applications.

In the Inventory tree, the Applications branch includes a hierarchy similar to the following figure.
Applications Hierarchy

When you expand an Applications item, the Inventory tree lists application groups and individual applications within each group. If you select an application group, the view displays a set of panels showing information about all the applications in that group. If you select an individual application, the view displays a set of panels devoted to the specific application.

These panels show:

- **Application Utilization Chart**
  The percentage of VMEM, VCPU and transaction capacity the application uses.

- **Application Resources**
  A grid showing the resources the application sells (for applications, NA) and the VM resources the application consumes.

- **Related Datastore Utilization**
  The percentage of allocated storage resources the selected application is using.

- **Recommended Actions for the Application**

- **Related Virtual Machine Utilization**
  The percentage of allocated VM resources the selected application is using.

- **Related Physical Machine Utilization**
  The percentage of allocated host resources the selected application is using.
Panels for an individual application

Guest Load

The Apps_GuestLoad item is a special entry in the Applications hierarchy. This item tracks the resources that Turbonomic has not assigned to any specific application. This can occur for the following reasons:

- You do not have the licenses required to support Application monitoring. In this case, Turbonomic lists all the consumed VM resources in the Apps_GuestLoad entry—this is the only entry under Applications.
- Turbonomic cannot discover some applications. In this case, Turbonomic displays entries for the applications it has discovered, and lists the VM resources that are not accounted for under Apps_GuestLoad.
- VM resources are devoted to infrastructure, and not part of any application. Turbonomic lists these resources under Apps_GuestLoad, and provides entries for the applications it has discovered.
Application Servers

If you have the Application Control Module installed, you can specify application servers as targets (see "Adding Application Servers as Targets" in the Target Configuration Guide). When you select an individual application server, the Inventory View displays panels for that application server. These panels show:

- **Resources**
  A table showing the resources the application server provides and the resources it consumes from the hosting VM.

- **Utilization**
  A chart showing the utilization of the provided resources over time.

- **To Do**
  The actions recommended for the selected application server
Database Servers

If you have the Application Control Module installed, you can specify database servers as targets (see "Adding Database Servers as Targets" in the Target Configuration Guide). When you select an individual database server, the Inventory View displays panels for that application server. These panels show:

- **Resources**
  A table showing the resources the application server provides and the resources it consumes from the hosting VM.

- **Utilization**
  A chart showing the utilization of the provided resources over time.

- **To Do**
  The actions recommended for the selected application server

Panels for a single database server
Containers

When you select Containers in the Inventory tree, the view displays the following panels:

- **Containers Utilization Chart**
  The percentages of Memory and CPU capacity that are used by the containers. To see a history of usage per container, click the associated bar.

  To choose the metrics to plot or change the chart sort order, edit the chart. Note that Utilization Index shows a measure of the utilization of resources.

- **Containers Utilization Trend**
  The consumption of allocated commodities over time.

- **Recommended actions for Containers**

- **Usage for Containers**
  A tabular display of resource usage by the containers.

Containers

In the Inventory tree, the Containers branch includes a hierarchy similar to the following figure.
Containers Hierarchy

When you expand the Containers item, the Inventory tree lists the individual containers in your environment. If you select an individual item, the data display is similar to the above figure, but for that single container.

Virtual Machines

When you select Virtual Machines in the Inventory tree, the Inventory view displays information about virtual machines, grouped by the physical machines they run on. The view lists VMs in these groups because the number of VMs in your environment can be very large. Grouping them by their physical machines makes the amount of data in each panel easier to view and understand.
For each Virtual Machines item (the collection of VMs on a host), the Inventory view displays the following panels:

- **Virtual Machines Utilization Chart**
  The percentage of CPU and memory capacity used by groups of virtual machines. To see a history of usage for a group, click the associated bar.
  
  To choose the metrics to plot or change the chart sort order, edit the chart. Note that Utilization Index shows a measure of the utilization of resources. The more equal the Utilization Index values are for your applications, the more evenly distributed their loads.

- **Virtual Machines Utilization Trend**
  The consumption of commodities over time. Click the radio buttons to show VCPU or VMEM statistics.

- **Recommended actions for Virtual Machines**

- **Usage for Virtual Machines**
  A tabular display of usage of resources such as CPU and memory for the VMs in your environment.

---

**Virtual Machines**

In the Inventory tree, the Virtual Machines branch includes a hierarchy similar to the following figure.
Virtual Machines Hierarchy

When you expand the Virtual Machines item, the Index tree lists the individual VM Groups by the names of their physical machines. If you select an individual VM group, the view displays a set of panels similar to the following figure. Note that the Utilization bar chart shows bars for each VM in the group.
Virtual Machines — One Group of VMs

When you expand a VM group, the Index tree lists the individual VMs. If you select an individual VM, the view displays a set of panels similar to the following.

These panels show:

- **VM Utilization Chart**
  The percentage of allocated virtual resources in use on the VM.

- **VM Resources**
  A grid showing the resources the VM sells to applications, and the physical host and storage resources the VM consumes. For descriptions of these resources and their measurement, see Resource Descriptions on page 23.

- **Related Datastore Utilization**
  The percentage of allocated storage resources the selected VM is using.

- **To Do List**
  Recommended Actions for the VM.

- **Audit Log**
  A list of actions performed on the selected VM.

- **Related Physical Machine Utilization**
  The percentage of allocated host resources the selected VM is using.
Virtual Machines — Individual VM

From the Navigation Tree you can expand each VM to show the following:

- Composed Of
- Consumes
- Hosts

Physical Machines

When you select Physical Machines in the Inventory tree, the Inventory view displays the following panels:

- Physical Machines Utilization Chart
  The percentage of physical machine CPU and memory commodities that are used within your environment. To see a history of usage per machine, click the associated bar.

  To choose the metrics to plot or change the chart sort order, edit the chart. Note that Utilization Index shows a measure of the utilization of resources. The more equal the Utilization Index values are for your applications, the more evenly distributed their loads.
• Physical Machines Utilization Trend
  The consumption of commodities over time. Click the radio buttons to show memory, CPU, IO, or network throughput statistics.

• Recommended actions for Physical Machines

• Usage for Physical Machines
  A tabular display of resource usage for the physical machines in your environment.
In the Inventory tree, the Physical Machines branch includes a hierarchy similar to the following figure.

Physical Machines Hierarchy

The Inventory tree shows the Physical Machines category, clusters of physical machines, and the member physical machines of each cluster. If you select an individual machine, the view displays a set of panels similar to the following.
Physical Machines: — Individual Physical Machine

These panels show:

- **PM Utilization Chart**
  The percentage of allocated resources in use on the PM.

- **Related Virtual Machine Consumption**
  The percentage of allocated physical resources the hosted VMs are using.

- **To Do List**
  Recommended Actions for the PM.

- **Resources**
  A grid showing the resources the PM sells to VMs, and the resources the PM consumes. For descriptions of these resources and their measurement, see Resource Descriptions on page 23.

- **Related Datastore Utilization**
  The percentage of allocated storage resources the selected PM is using.

You can expand each physical machine to show the following:

- **Composed Of**
- **Consumes**
- **Hosts**
Storage

The Storage item shows statistics for storage that is accessed by the virtual infrastructure. When you select Storage in the Inventory tree, the Inventory view displays the following panels:

- **Storage Utilization Chart**
  The percentage of storage amount and storage IOPS capacity that are in use. To see a history of usage per storage device, click the associated bar.

  To choose the metrics to plot or change the chart sort order, edit the chart. Note that Utilization Index shows a measure of the utilization of resources. The more equal the Utilization Index values are for your applications, the more evenly distributed their loads.

- **Storage Utilization Trend**
  The consumption of commodities over time.

- **Recommended actions for Storage**

- **Usage for Storage**
  A tabular display of storage amount and storage IOPS and other usage for the storage devices in your environment.
In the Inventory tree, the Storage branch includes a hierarchy similar to the following figure.

**Storage Hierarchy**

The Inventory tree shows the Storage category, storage clusters, and the member datastores of each cluster. If you select an individual datastore, the Inventory view displays a set of panels similar to the following.
Data Stores — Individual Data Store

These panels show:

- **Storage Utilization Chart**
  The percentage of allocated resources the in use on the datastore.

- **Related Virtual Machine Consumption**
  The percentage of allocated storage resources the hosted VMs are using.

- **To Do List**
  Recommended Actions for the datastore.

- **Resources**
  A grid showing the resources the datastore sells, and the resources the datastore consumes. For descriptions of these resources and their measurement, see Resource Descriptions on page 23.

When you expand a data store item, the view shows the following:

- **Consumes**
- **Hosts**
Disk Arrays

The Disk Arrays item shows statistics for physical storage volumes that are managed by a disk array. When you select Disk Arrays in the Inventory tree, the Inventory view displays the following panels:

- **Disk Array Utilization Chart**
  The percentage of allocated storage resources that are in use on each group of disk arrays. To see a history of usage per disk array group, click the associated bar.
  
  To choose the metrics to plot or change the chart sort order, edit the chart. Note that Utilization Index shows a measure of the utilization of resources. The more equal the Utilization Index values are for your applications, the more evenly distributed their loads.

- **Disk Array Utilization Trend**
  The consumption of storage commodities over time.

- **Recommended actions for Disk Arrays**

- **Usage for Disk Arrays**
  A tabular display of storage amount and storage IOPS and other usage for the volumes in the disk arrays.
In the Inventory tree, the Disk Arrays branch includes a hierarchy similar to the following figure.

![Disk Array Hierarchy](image)

**Disk Array Hierarchy**

When you expand the Disk Arrays entry, the Inventory tree lists groups of disk array, with the grouping determined by the storage controllers in your environment. If you select an individual group, the Inventory view displays a set of panels similar to the following.
Disk Arrays — Disk Array Group

These panels show:

- **Disk Array Utilization Chart**
  The percentage of allocated resources in use on the selected group, charted for each aggregate.

- **Disk Array Utilization Trend**
  The consumption of commodities over time.

- **To Do List**
  Recommended Actions for the aggregates in the group.

- **Usage for the group**
  A tabular display of storage amount and storage IOPS and other usage for aggregates in the disk array group.

When you expand a disk array group, the tree lists the member aggregates. If you select an individual aggregate, the Inventory view displays a set of panels similar to the following.
Disk Arrays — Individual Aggregate

These panels show:

- **Aggregate Utilization Chart**
  The percentage of allocated resources in use on the aggregate.

- **Related Storage Utilization**
  The percentage of allocated resources in use on each volume in the aggregate.

- **To Do List**
  Recommended Actions for the aggregate.

- **Resources**
  A grid showing the resources the aggregate sells, and the resources it consumes. For descriptions of these resources and their measurement, see Resource Descriptions on page 23.

- **Related Storage Controller Utilization**
  The percentage of allocated resources on the Storage Controller the selected VM is using.

When you expand an aggregate item, the view shows the following:

- **Consumes**
- **Hosts**
Storage Controllers

The Storage Controllers item shows statistics for the storage controllers that manage disk arrays in your environment. When you select Storage Controllers in the Inventory tree, the Inventory view displays the following panels:

- **Storage Controller Utilization**
  The percentage of storage, Latency capacity and CPU capacity that are used in the environment, over time. To see a history of usage per storage controller, click the associated bar.

  To choose the metrics to plot or change the chart sort order, edit the chart. Note that Utilization Index shows a measure of the utilization of resources. The more equal the Utilization Index values are for your applications, the more evenly distributed their loads.

- **Storage Controller Utilization Trend**
  The consumption of commodities over time.

- **Recommended actions for Storage Controllers**

- **Usage for Storage Controllers**
  A tabular display of storage amount and storage IOPS and other usage for the volumes in the disk arrays.
In the Inventory tree, the Storage Controllers branch includes a hierarchy similar to the following figure.

**Storage Controller Hierarchy**

When you expand the Storage Controllers entry, the Inventory tree lists the individual storage controllers in your environment. If you select an individual storage controller, the Inventory view displays a set of panels similar to the following.
Storage Controllers — Individual Storage Controller

These panels show:

- **Storage Controller Utilization Chart**
  The percentage of allocated resources in use on the Storage Controller.

- **Related Disk Array Utilization**
  The percentage of allocated resources in use on each aggregate managed by the Storage Controller.

- **To Do List**
  Recommended Actions for the Storage Controller.

- **Resources**
  A grid showing the resources the Storage Controller sells, and the resources it consumes. For descriptions of these resources and their measurement, see Resource Descriptions on page 23.

When you expand an aggregate item, the view shows the following:

- **ComposedOf**
- **Hosts**
Fabric Interconnects

The Fabric Interconnects item shows statistics for the interconnects that connect the network to storage fabrics in your environment. When you select Fabric Interconnects in the Inventory tree, the Inventory view displays the following panels:

- **Fabric Interconnect Utilization Chart**
  The percentage of allocated network resources that are in use. To see a history of usage per Fabric Interconnect, click the associated bar.

  To choose the metrics to plot or change the chart sort order, edit the chart. Note that Utilization Index shows a measure of the utilization of resources. The more equal the Utilization Index values are for your applications, the more evenly distributed their loads.

- **Fabric Interconnects Trend**
  The consumption of commodities over time.

Fabric Interconnects
• Recommended actions for Fabric Interconnects
• Usage for Fabric Interconnects
  A tabular display of network usage for the chassis served by the IO Modules.

In the Inventory tree, the Fabric Interconnects branch includes a hierarchy similar to the following figure.

**Fabric Interconnects Hierarchy**

When you expand the Fabric Interconnects entry, the Inventory tree lists the individual interconnect pairs in your environment. When you expand an interconnect pair, the tree lists the member A and B Fabric Interconnects. If you select an individual Fabric Interconnect, the Inventory view displays a set of panels similar to the following.
Individual Fabric Interconnect

These panels show:

- **Ports**
  A grid showing the utilization and capacity of the Northbound and Southbound ports in the Fabric Interconnect.

- **Utilization**
  A trend over time of Net utilization of all the ports in the Fabric Interconnect.

- **Related Blade Consumption**
  The percentage of allocated Net resources the served IO Modules are using.

- **To Do List**
  Recommended Actions for the Fabric Interconnect.

When you expand a single Fabric Interconnect item, the view shows the following:

- **Hosts**
Chassis

The Chassis item shows Power and Cooling statistics for the chassis that house blade servers in the fabric domains of your environment. When you select Chassis in the Inventory tree, the Inventory view displays the following panels:

- **Chassis Utilization Chart**
  The percentage of allocated Power and Cooling resources that are in use. To see a history of usage per domain, click the associated bar.

  To choose the metrics to plot or change the chart sort order, edit the chart. Note that Utilization Index shows a measure of the utilization of resources. The more equal the Utilization Index values are for your applications, the more evenly distributed their loads.

- **Chassis Trend**
  The consumption of commodities over time.

Chassis
- Recommended actions for Chassis
- Usage for Chassis

A tabular display of Power and Cooling usage for the chassis in your environment.

In the Inventory tree, the Chassis branch includes a hierarchy similar to the following figure.

**Chassis Hierarchy**

When you expand the Chassis entry, the Inventory tree lists the domains in your environment that contain chassis. If you select an individual domain, the Inventory view displays information for the chassis in that domain. When you expand a domain, the tree lists the individual chassis. When you select a chassis, the view shows panels similar to the following:
Individual Chassis

These panels show:

- **Chassis Utilization**
  A trend over time of Power and Cooling utilization.

- **Related Blade Consumption**
  The percentage of allocated Power and Cooling the housed blades are using.

- **To Do List**
  Recommended Actions for the chassis.

- **Resources**
  A grid showing the resources the chassis sells, and the resources it consumes. For descriptions of these resources and their measurement, see Resource Descriptions on page 23.

- **Related IO Module Consumption**
  The percentage of allocated Power and Cooling the chassis IO Modules are using.

When you expand a chassis item, the view shows the following:

- **Hosts**
IO Modules

The IO Modules item shows statistics for the switches that provide network connectivity to blade chassis in your environment. When you select IO Modules in the Inventory tree, the Inventory view displays the following panels:

- **IO Modules Utilization Chart**
  The percentage of allocated network resources that are in use. To see a history of usage per switch, click the associated bar.

  To choose the metrics to plot or change the chart sort order, edit the chart \[\text{edit chart}\]. Note that Utilization Index shows a measure of the utilization of resources. The more equal the Utilization Index values are for your applications, the more evenly distributed their loads.

- **IO Modules Trend**
  The consumption of commodities over time.

IO Modules
The Inventory View

- Recommended actions for IO Modules
- Usage for IO Modules
  
  A tabular display of network usage for the chassis served by the IO Modules.

In the Inventory tree, the IO Modules branch includes a hierarchy similar to the following figure.

### IO Module Hierarchy

When you expand the IO Modules entry, the Inventory tree lists the IO Modules per chassis. When you expand an entry for a chassis, the tree lists the IO modules that are installed on that chassis. If you select an individual IO Module, the Inventory view displays a set of panels similar to the following.
IO Modules — Individual Switch

These panels show:

- **Ports**
  A grid showing the utilization and capacity of the Northbound and Southbound ports in the IO Module.

- **Utilization**
  A trend over time of Net utilization of all the ports in the IO Module.

- **Related Blade Consumption**
  The percentage of allocated Net resources the served blades are using.

- **To Do List**
  Recommended Actions for the IO Module.

When you expand an IO Module item, the view shows the following:

- **Consumes**
- **Hosts**
VPods

When you select VPods in the Inventory tree, the view displays the following panels:

- **VPods Utilization Chart**
  The percentages of Memory, CPU, and Storage capacity that are used by the VPods. To see a history of usage per VPod, click the associated bar.

  To choose the metrics to plot or change the chart sort order, edit the chart.

- **VPods Utilization Trend**
  The consumption of allocated commodities over time.

- **Recommended actions for VPods**
- **Usage for VPods**
  A tabular display of resource usage by the VPods.

VPods

In the Inventory tree, the VPods branch includes a hierarchy similar to the following figure.
When you expand the VPods item, the Inventory tree lists the individual VPods in your environment. If you select an individual item, the view displays a set of panels devoted to the specific VPod.

These panels show:

- **VPod Utilization Chart**
  The percentage of Mem, CPU, Storage, and Flow capacity this VPod uses.

- **Related Virtual Machine Utilization**
  The consumption of resources, per VM.

- **DPod Utilization**
  The status of resource utilization on the DPod that hosts this VPod.

- **Recommended Actions for the VPod**

- **VPod Resources**
  A grid showing the resources the VPod sells and the DPod resources the VPod consumes.
Panels for an individual VPod

DPods

When you select DPods in the Inventory tree, the view displays the following panels:

- **DPods Utilization Chart**
  The percentages of Memory, CPU, and Storage capacity that are used by the DPods. To see a history of usage per DPod, click the associated bar.

  To choose the metrics to plot or change the chart sort order, edit the chart.

- **DPods Utilization Trend**
  The consumption of allocated commodities over time.

- **Recommended actions for DPods**

- **Usage for DPods**
  A tabular display of resource usage by the DPods.
DPods

In the Inventory tree, the DPods branch includes a hierarchy similar to the following figure.
DPods Hierarchy

When you expand the DPods item, the Inventory tree lists the individual DPods in your environment. If you select an individual item, the view displays a set of panels devoted to the specific DPod.

These panels show:

- **DPod Utilization Chart**
  The percentage of Mem, CPU, Storage, and Flow capacity this DPod uses.

- **Provider Physical Machine Utilization**
  For the physical machines in the DPod, the percentage utilization of capacity for Mem, CPU, IO and Net.

- **Provider Datastore Utilization**
  For the datastores in the DPod, the percentage utilization of capacity for Storage, IOPS, and Latency.

- **Consumer Virtual Pods Utilization**
  The consumption of Mem, CPU, Storage, and Flow capacity by the hosted VPods.

- **Recommended Actions for the VPod**

- **DPod Resources**
  A grid showing the resources the DPod sells, and the host and datastore resources the DPod consumes.
Panels for an individual DPod

Datacenters

When you select Datacenters in the Inventory tree, the view displays the following panels:

- Data Centers Utilization Chart
  The percentages of Space, Power, and Cooling capacity that are used within your environment. To see a history of usage per data center, click the associated bar.

  To choose the metrics to plot or change the chart sort order, edit the chart. Note that Utilization Index shows a measure of the utilization of resources. The more equal the Utilization Index values are for your applications, the more evenly distributed their loads.

- Physical Machines by Data Center Utilization Trend
  The consumption of commodities over time.

- Recommended actions for Data Centers

- Usage for Physical Machines by Data Center
  A tabular display of usage for the data centers in your environment.
Data Centers

In the Inventory tree, the Datacenters branch includes a hierarchy similar to the following figure.
Data Centers Hierarchy

When you expand the Data Centers item, the Inventory tree lists the individual data centers in your environment. If you select an individual data center, the data display is similar to the above figure, but for that single data center. The UI chart shows consumption by each PM in the datacenter. For each individual data center, the Inventory tree shows the following:

- Consists Of
- Hosts

Provider Virtual Datacenters

Provider Virtual Datacenters expose the resources that you will deliver to customer organizations. Provider Virtual Data Centers are managed by cloud stacks such as vCloud Director.
**NOTE:** Different targets use different names to refer to Virtual Datacenters. In the Turbonomic supply chain, these entities are all represented by Consumer and Provider VDCs, as follows:

<table>
<thead>
<tr>
<th>Turbonomic</th>
<th>vCloud Director</th>
<th>vCenter Server</th>
<th>VMM</th>
<th>CloudStack</th>
<th>OpenStack</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumer VDC</td>
<td>Organization VDC</td>
<td>Resource Pool (Child)</td>
<td>Tenant or TenantQuota</td>
<td>Accounts</td>
<td>Tenant</td>
</tr>
<tr>
<td>Provider VDC</td>
<td>Provider VDC</td>
<td>Resource Pool (Root)</td>
<td>Cloud</td>
<td>Pod</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Provider Virtual Data Centers**

When you select Provider Virtual Data Centers in the Inventory tree, the Inventory view displays the following panels:

- Provider Virtual Data Centers Utilization Chart
  The percentage of allocated memory, CPU, and storage resources that are used by Provider VDCs. To see a history of usage per data center, click the associated bar.

  To choose the metrics to plot or change the chart sort order, edit the chart. Note that Utilization Index shows a measure of the utilization of resources. The more equal the Utilization Index values are for your applications, the more evenly distributed their loads.
• Provider Virtual Data Centers Utilization Trend
  The consumption of allocated commodities over time. Click the radio buttons to show memory, CPU, or storage statistics.

• Recommended actions for Provider Virtual Data Centers

• Usage for Provider Virtual Data Center
  A tabular display of usage for the data centers in your environment.

In the Inventory tree, the Provider Virtual Datacenters branch includes a hierarchy similar to the following figure.

![Inventory tree](image)

Provider Virtual Datacenters Hierarchy

When you expand the Provider Virtual Datacenters item, the Inventory tree lists the individual Provider VDCs in your environment. If you select an individual Provider VDC, the Inventory view displays a set of panels similar to the following.
Individual Provider Virtual Data Center

These panels show:

- **Provider VDC Utilization Chart**
  The percentage utilization over time of memory, CPU, and storage commodities that are allocated to this VDC.

- **Provider Physical Machine Utilization**
  The percentage utilization of resources on the physical machines that serve as hosts for this VDC.

- **Provider Datastore Utilization**
  The percentage utilization of resources on the datastores that service this VDC.

- **Recommended Actions for the Provider VDC**

- **Provider vDC Resources**
  A grid showing the resources the Provider vDC sells, and the resources it consumes. For descriptions of these resources and their measurement, see Resource Descriptions on page 23.

- **Consumer Virtual Data Center Utilization**
  The percentage of resource capacity on the Provider VDC that is utilized by the hosted Consumer VDC.

If you expand an individual Provider VDC, the Inventory view shows the following:

- **Consumes**
- **Hosts**
Consumer Virtual Datacenters

Consumer Virtual Datacenters expose the resources that are allocated to specific customer organizations. Consumer Virtual Datacenters are managed by cloud stacks such as vCloud Director.

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

<table>
<thead>
<tr>
<th></th>
<th>Turbonomic</th>
<th>vCloud Director</th>
<th>vCenter Server</th>
<th>VMM</th>
<th>CloudStack</th>
<th>OpenStack</th>
</tr>
</thead>
<tbody>
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<td>Consumer VDC</td>
<td>Organization VDC</td>
<td>Resource Pool (Child)</td>
<td>Tenant or TenantQuota</td>
<td>Accounts</td>
<td>Tenant</td>
<td></td>
</tr>
<tr>
<td>Provider VDC</td>
<td>Provider VDC</td>
<td>Resource Pool (Root)</td>
<td>Cloud</td>
<td>Pod</td>
<td>N/A</td>
<td></td>
</tr>
</tbody>
</table>

Consumer Virtual Data Centers
When you select Consumer Virtual Datacenters in the Inventory tree, the Inventory view displays the following panels:

- **Consumer Virtual Datacenters Utilization Chart**
  The percentage of allocated memory, CPU, and storage resources that are used by your Consumer VDCs. To see a history of usage per data center, click the associated bar.

  To choose the metrics to plot or change the chart sort order, edit the chart. Note that Utilization Index shows a measure of the utilization of resources. The more equal the Utilization Index values are for your applications, the more evenly distributed their loads.

- **Consumer Virtual Datacenters Utilization Trend**
  The consumption of allocated commodities over time. Click the radio buttons to show memory, CPU, or storage statistics.

- **Recommended actions for Consumer Virtual Datacenters**
- **Usage for Consumer Virtual Datacenter**
  A tabular display of usage for the Consumer vDCs in your environment.

In the Inventory tree, the Consumer Virtual Datacenters branch includes a hierarchy similar to the following figure.
When you expand the Consumer Virtual Datacenters item, the Inventory tree lists the individual Consumer VDCs in your environment. If you select an individual Consumer VDC, the Inventory view displays a set of panels similar to the following.

These panels show:

- **Consumer VDCs Utilization Chart**
  The percentage utilization over time of memory, CPU, and storage commodities that are allocated to this VDCs.

- **Related Virtual Machine Consumption**
  For each VM on this VDC, the percentage utilization of resources.

- **Provider Virtual Datacenter Utilization**
  The percentage of the host Provider VDC resources that are utilized by this Consumer VDC.

- **Recommended Actions for the Consumer VDC**
- **Consumer vDC Resources**
  A grid showing the resources the Consumer vDC sells, and the resources it consumes. For descriptions of these resources and their measurement, see Resource Descriptions on page 23.

If you expand an individual Consumer vDC, the Inventory list shows the following:

- Consumes
- Hosts
The Admin View

The Admin view provides settings to manage Turbonomic sessions and perform other administrative tasks. In this view you assign the target servers Turbonomic will connect to as it manages your environment. You can also use the Admin view to manage user accounts on Turbonomic, manage how Turbonomic retains system metrics and other data, manage custom groups, and perform maintenance tasks such as managing configuration files or refresh intervals.

The Configuration panel of the Admin view includes the following accordion buttons for specific administrative tasks:

- **User Authentication Configuration** on page 288
  Create and manage user accounts for the Turbonomic.

- **Configuring Targets** on page 297
  Use these tools to specify the list of servers Turbonomic will connect to as it monitors your environment.

- **License Configuration** on page 302
  Apply license keys to activate Turbonomic features.

- **Maintenance** on page 303
  Perform general tasks such as managing configuration files or refresh intervals.

User Authentication Configuration

As an administrator, you specify accounts that grant users specific access to Turbonomic. The following topics describe how to work with user accounts:

- **Creating User and Group Accounts** on page 289 — Accounts can be for individual users, or members of Active Directory groups
- **User Authentication** on page 291 — Accounts can use Active Directory or locally stored credentials
- **Account Privileges** on page 293 — Accounts include type and role to specify access to Turbonomic features
- **Account Scope** on page 295 — Limits which devices in the environment the user can access
Creating User and Group Accounts

Turbonomic supports individual user accounts, and Active Directory group accounts.

Individual User Accounts

User accounts determine the following for a given user login:

- **User credentials**
  Credentials can be stored locally on the Turbonomic server, or they can be managed by Active Directory.

- **Type**
  User type is a way to set up an account for third-party users or service provider customers (see Account Type on page 294).

- **Role**
  The user’s role determines access to Turbonomic features (see Account Role on page 295).

- **Scope**
  The user’s scope determines how much of the environment this user can manage via Turbonomic (see Account Scope on page 295).

- **Authentication Type**
  Either local (credentials stored on the Turbonomic server) or Active Directory (see Active Directory Authentication on page 292).
To create a new user account, click **Add**, and provide the required information. When you’re finished, click **Create**.

When creating a user account that is managed by Active Directory, you must specify the user name and the Active Directory domain. You can use the following formats for a user name:

- `mydomain\theuser`
- `theuser@mydomain.com`

When the user logs in, he or she must use the same format that you specified for the account. For this reason, we suggest that you use the same format for all user accounts that are managed by Active Directory. (For information about Active Directory settings, see Active Directory Authentication on page 292.)

To edit or delete a user account, select the user in the list. Then make changes and click **Update**, or to remove the user you can click **Delete**.

**Active Directory Group Accounts**

Group accounts use Active Directory groups to manage user authentication. You can specify role and scope for the group, and any member of the AD group can log into Turbonomic with those privileges. To log in via AD groups, a user must enter a valid User Principal Name (UPN).
NOTE: To log in via a group account, Turbonomic must have an Active Directory domain already specified in the Active Directory Settings form. For information about Active Directory settings, see Active Directory Authentication on page 292.

User Authentication Configuration

User/Group Administration

Click Group to create an AD Group account

MyAdGroup

Add Delete

Groupname

Group Role observer

Scope

Define Scope Update Create Cancel

To create a new user account, click Add, and provide the required information. When you’re finished, click Create.

To edit or delete a user account, select the user in the list. Then make changes and click Update, or to remove the user you can click Delete.

User Authentication

Turbonomic supports the following types of authentication:

- Local — Turbonomic stores user credentials on its local server
- Active Directory — Turbonomic authenticates the user via credentials that are managed by Active Directory
Local Authentication

Local authentication is for individual users. Turbonomic stores the account credentials locally on its server. To create a local account, open the User Configuration panel in the Admin view, and click Add in the User/Group Administration form. Then provide the required information and click Create. The form should appear similar to the following figure:

User/Group Administration

- Create an account for an individual user
- Provide the account username and password
- Select Local authentication

Active Directory Authentication

Active Directory (AD) authentication uses credentials that are managed by an Active Directory server. To create an account that uses AD, you must already have specified the AD domain or server that Turbonomic will use. Then you can specify AD authentication for individual users, or for AD groups.

NOTE: When you specify Active Directory domain and server, those settings are global to the Turbonomic server. All AD users will log into the server via those specifications. If you change the AD domain or server, then those changes will affect all subsequent AD user logins.

To specify the Active Directory domain and server that Turbonomic will use, open the User Configuration panel in the Admin view, and provide the required information. If you change any of the fields in this form, be sure to click Apply. The form should appear similar to the following figure.
Active Directory Settings

The Active Directory domain this Operations Manager appliance will use to perform AD authentication. If you specify only a domain, then authentication will use any AD servers in that domain. To use Active Directory Groups, you must specify a domain.

**Active Directory Domain**

The Active Directory server this Operations Manager appliance will use to perform AD authentication. This setting is optional. If you specify an AD server, then authentication will only use that AD server.

**Active Directory Server**

- Secure
- Apply

You can specify Active Directory Settings to get the following results:

<table>
<thead>
<tr>
<th>Result</th>
<th>Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disable AD authentication</td>
<td>Specify no domain and no server.</td>
</tr>
<tr>
<td>AD authentication via any AD server on a domain</td>
<td>Specify an AD domain and do not specify an AD server. Authentication will use any AD server accessible from that domain.</td>
</tr>
<tr>
<td>AD authentication via a specific AD server</td>
<td>Specify an AD server, and optionally specify an AD domain.</td>
</tr>
<tr>
<td>Enable AD Group authentication</td>
<td>To enable groups, you must specify an AD domain. Authentication will use any AD server accessible from that domain. The domain is necessary for Active Directory to find a user via the User Principal Name (UPN). You can optionally specify an AD server.</td>
</tr>
<tr>
<td>Disable AD Group authentication, but enable AD for single users</td>
<td>Specify an AD server, but do not specify an AD domain.</td>
</tr>
<tr>
<td>Use a secure connection when communicating with AD servers</td>
<td>Turn on the Secure option. This enables a secure connection to the AD servers you have configured. The AD Domain must be configured to use LDAPS, and you must import a certificate into the Turbonomic server. For more information, see the Turbonomic Support Knowledge Base articles for Setting Up VMTurbo To Communicate To Secure LDAP.</td>
</tr>
</tbody>
</table>

Account Privileges

Turbonomic accounts includes the **Role** and **Type** settings to specify access privileges. You can use these to set up different types of user accounts. For example, the same Turbonomic server can support users who:

- Perform Turbonomic administration tasks
- Modify the virtual environment
- Use Turbonomic to monitor the environment
- Access small parts of the environment as Service Provider clients

By combining Role and Type in a user account, you can set up access privileges that support these and other users’ needs.
Account Type

Account type provides a way to limit account privileges so users can see only virtual resources. This is useful for service providers who want their customers to use Turbonomic, but don’t want to expose information about any physical resources in the environment. In this way, a service provider can use Turbonomic to give customers a window into the resources they have purchased, but not expose information the service provider would rather keep private.

Turbonomic provides the following user account types:

- **Dedicated — Unlimited user type**
  
  A user who is focused on the overall virtual environment, or who is an administrator of the Turbonomic server. For example, a service provider would set up dedicated accounts for its IT staff.

  A dedicated user can have any of the user roles in Turbonomic.

  When you create a dedicated user account, you can optionally specify a scope.

- **Shared — Limited user type**
  
  A user who is focused on a subset of the virtual environment. For example, a service provider would create a shared account for a customer who has purchased a set virtual of resources. This user can only see virtual infrastructure in the user interface. In addition, the To Do list only shows actions for virtual infrastructure. For example, a shared user will not see resize actions for a physical machine.

  When you create a shared user account, you must also specify a scope to limit the inventory that the shared user can access.

  Note that a shared user can only have an Observer or Advisor role. An advisor can see the To Do list, but cannot perform any actions via Turbonomic. In addition, a shared user only has access to the Inventory view.
### Account Role

Role determines what Turbonomic features the user can access. You can set a role for individual accounts as well as group accounts. For group accounts, any member of the group who logs in with this account will assume the given role.

You can choose from the following:

- **Observer**
  The user can use the Dashboard, Inventory, Supply Chain, and Reports views. This is the most restrictive role.

- **Advisor**
  The user can use the Dashboard, Inventory, Supply Chain, Reports, and Plan views, but cannot accept recommended actions.

- **Automator**
  The user can use all the views except Admin and Policy. This user can accept recommended actions, but cannot perform administrative tasks.

- **Administrator**
  The user can use all Turbonomic views.

### Account Scope

When creating an account, you can define a scope for that user. The scope limits what the user can monitor. For example, assume you have created a group that contains only the physical machines that support this user’s VMs or applications. You can then set the user’s scope to that group. When the user logs in, Turbonomic will only display information about those machines, and resources associated with them such as hosted VMs and data storage that they use. In the figure below, the scope is set to the VMs on a specific network. The user’s account can only access resources associated with that network.

Note that dedicated customers can work with physical resources, but shared customers are restricted from working with the physical infrastructure. In the figure below, the account is for a shared user.
NOTE: If you want to use custom groups to set the scope, you must create the groups first, and then assign them to the user account. For more information, see "GroupManagement" in the Target Configuration Guide.
Configuring Targets

**NOTE:** This section describes how to add targets in the Turbonomic user interface. For details about the different targets, see "TargetConfiguration" in the Target Configuration Guide.

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

Target Configuration displays an Environment Summary panel and a list of current targets. The environment summary shows the count of different kinds of entities (PMs, VMs, data stores, Datacenters, network nodes, etc.) in your environment.
You can assign instances of the following technologies as Turbonomic 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 — 6.0 running with ESX 3.x, 4.x, 5.x, and 6.x

- **Cloud Managers**
  - CloudStack 3.0.2 — 4.1
  - 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, and kilo
  - Amazon AWS
  - 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 7.x and 8.0.x

- **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

- **Microsoft Applications**
  - Microsoft Exchange

- **Load Balancers**
  - Citrix NetScaler

- **Storage Managers**
  - NetApp Storage Systems running Data ONTAP version 8 or later
  - EMC VNX Series Storage Systems (for version details, see the [EMC VNX Support KB article](https://support.emc.com/home)
  - Pure Storage FlashArray
  - HP 3PAR StoreServ
  - Nutanix
  - Dell Compellent

- **Fabric Managers**
  - Cisco UCS 2.0 and higher

- **Network Flow Collectors**
  - NetFlow/sFlow: NFDUMP — Turbonomic provides an OVA download with NFDUMP preconfigured for NetFlow and sFlow collection
  - Arista EOS+

- **Turbonomic Targets**
  To configure an aggregated deployment of Turbonomic, you can assign Turbonomic servers as targets. The versions of target instances must match the version of the aggregating instance.
Adding and Removing Targets

The target services your Turbonomic installation will manage appear in the Target Configuration list. You can add, remove, and edit entries in this list. Note that the service user account for each target must provide privileges that support the Turbonomic activities you want to perform. For example, the following vCenter privileges correspond to activities Turbonomic can perform:

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

When you add a target to Turbonomic, you must specify the credentials for a service user account that is appropriate for the actions you want Turbonomic to perform.

Adding Targets

To add a target service, click the **Add** button (Add), provide the requested information, then add the target to the list of pending targets. When you have configured the pending targets you want, click **Apply** to validate those targets, set them to Turbonomic, and start a new run of 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
When you are finished adding entries to the **Pending Targets** list, click **Apply** to add these targets to your Turbonomic installation. Turbonomic validates these targets immediately, and begins to discover the entities they manage.

**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**.
Target Discovery

To manage a target’s entities Turbonomic must discover these entities. Discovery is a process that uses the target’s management protocol (REST API, SMI-s, etc.) to query the target for:

- Entities managed by the target
- Utilization of resources by each entity
- Relationships between entities — the resources one entity provides to another, and the resources one entity consumes from another

When you first add a target, Turbonomic automatically validates the target to ensure it has a good connection. It then automatically runs discovery on that target. As a result, Turbonomic adds the target’s entities to the market and includes those entities in analysis. You can see the discovered entities in various views and dashboards in the Turbonomic user interface.

After the initial discovery, Turbonomic periodically runs incremental discovery on each target to account for changes in the topology (new entities added, or entities removed) and changes in the state of entities (for example, suspended or put into maintenance mode).

You might occasionally need to rediscover the entities for a target. This directs Turbonomic to run full discovery for the given target. For example, if Turbonomic lost communications with the target for a period of time, it’s a good idea to run a full discovery.

To rediscover targets, navigate to Admin > Target Configuration. You can run full discovery:

- On all targets
  Do not select any items in the targets list, and click Rediscover All.

- On selected targets
  Select the targets you want to rediscover. The button changes to Rediscover Selected — Click it to rediscover only the selected targets. Note that you can filter the targets list by target type.
License Configuration

Turbonomic provides a range of capabilities, from observing your environment, to planning resource management, to the automation of load balancing. The user interface presents these capabilities via different views and tools. The following table lists the main Turbonomic features for each edition of the product. The Virtual Health Monitor edition features do not require licensing, but all other features do.

To activate features outside of the Virtual Health Monitor edition, you must purchase licenses from Turbonomic. When you purchase a new product, Turbonomic sends the license key to you in an e-mail message.

To activate a license, Click License Configuration to display the form. Copy the license key and paste it into the text box, and then click Save. TheLicensed Product list shows the features you currently have licensed.
Maintenance

The Maintenance panel provides tools to load configuration files onto your Turbonomic installation, set the monitoring interval, export data for technical support, and check for Turbonomic updates. Many of tools are for advanced users. You should contact Turbonomic technical support before you use them.
Proactive Support automatically generates a ticket for your support account when the Turbonomic server encounters issues with:

- Low heap space
- Low swap space
- Low disk space
- Health Check issues

To avoid security concerns, Proactive Support only responds to notification events that show critical states for the conditions in the above list. This feature does not inspect your Turbonomic installation to forward any statistics or metrics.

Proactive Support is Opt-In — Turn on the Enable Proactive Support check box and provide your support credentials. By default, Proactive Support is disabled.

If your environment requires an HTTP proxy to access the web, you can configure proxy access here.
SMTP Relay

Use this to enable e-mailing Turbonomic reports to subscribers through your e-mail SMTP relay.

Export State

If you are experiencing problems with Turbonomic, your support engineer might request that you export diagnostic data. You can export the data and then send it to the support engineer as requested.

Software Updates

Use this to check whether Turbonomic has released updates to the Turbonomic software, and apply them when appropriate. Note that this will apply the most recent update that is available.
Server Start Time

**Server start time:**  Tue Oct 27 16:57:13 UTC 2015

This shows when the server was last started.

Configuration Files

To help with diagnosis of some issues, a support engineer might want you to load configuration files into your Turbonomic server. You should only use these controls while working with a Turbonomic support engineer.

Logging Levels

You can set the level of logging for different components of the Turbonomic server. You should be aware that setting more verbose logging levels increases the disk space required to store the log files.
Extra Configuration Tasks

The following configuration tasks might be useful in your virtual environment:

- Turbonomic Backup Procedures on page 307
- Configuring Management Continuity on page 311
- P2V - Planning Migration from Physical to Virtual on page 318
- Custom Branding of Turbonomic on page 321

Turbonomic Backup Procedures

Turbonomic anticipates trouble-free use of Turbonomic, but in most environments a regular backup schedule is recommended. You should be able to incorporate Turbonomic backups in your schedule with minimal impact on your regular backup procedures.

Turbonomic is a real-time management and control application that performs the bulk of its analysis on in-memory data. Unlike many other products, Turbonomic does not store operations-critical data about your environment on the file system or in a database. As a result, backups do not require the space necessary to store a complete listing of all the resources in your environment. The following describes the data that must be included in a backup:

- Turbonomic historical database
  Turbonomic uses data stored in a database data to chart past values, perform projections, provide baselines for plans, and display historical data in reports. This information is useful but not necessary for operation. Turbonomic performs workload management as soon as it discovers your topology, and does not rely on this information for operation.

- Retained reports
  Turbonomic retains the reports that you generate on demand, as well as reports that you have scheduled to be generated regularly.

- Configuration files
  Configuration files define user accounts, policies, groups, target configurations, licensing, and other data that describes your installation.

Turbonomic includes a script that you can execute to run a backup. You can also create a backup by saving a snapshot of the Turbonomic virtual machine, or by including Turbonomic in scheduled runs of a VM backup agent.

Backup and Restore Via the Turbonomic Backup Script

The supplied backup and restore scripts perform backups of the critical Turbonomic data — the historical database, retained reports, and configuration files.

**NOTE:** You can execute backups with no interruption to Turbonomic processing. However, restore operations require the server to restart. The restore command restarts the Turbonomic server as part of its execution.
**Backing Up Turbonomic**

To perform a backup, open the advanced update page and choose the type of backup to perform.

- **Navigate to** [HTTP://<appliance_IP>/update.html](HTTP://<appliance_IP>/update.html)
  Enter your username and password, then Ctrl-Click (or Command-Click on the Macintosh) the **Authenticate** button.
  This opens the advanced update page.

- In the form, choose **Full Backup** or **Configuration Backup**, then click **Download**
  This creates a backup file and downloads it to your local machine. **Full Backup** backs up the historical database, retained reports, and the configuration files. **Configuration Backup** only backs up the configuration files.
• Save a copy of the backup file to a safe location
  You should save copies of the backups in case the Turbonomic virtual machine fails and cannot be recovered. In that case, you can use the saved copy to restore to a new installation of the appliance.

**Restoring Turbonomic Backups**

**NOTE:** The version of Turbonomic to which you restore the backup must be the same as the version that generated the backup file.

To restore a backup to a Turbonomic installation:

• Navigate to HTTP://<appliance_IP>/update.html
• Enter your username and password, then Ctrl-Click (or Command-Click on the Macintosh) the **Authenticate** button.
  This opens the advanced update page.

• In the form, choose a Full Restore from Backup, then click **Choose File**
  This opens a file chooser dialog where you can choose the backup file you created in the steps above. When you choose this file, the current Turbonomic server restores the backed up data — the newly installed Turbonomic will now have your configuration and database data.
- Verify that the backup was successful

  Log into the new Turbonomic user interface and confirm that the migration is complete and successful. Check your data in the following views:

  - Admin view — check configuration data such as license, user accounts, and target configurations
  - Policy view — check your custom groups under Group Management, as well as any placement policies you have created under Workload Placement
  - Inventory view — check that the date slider on the information panels can show historical data
To restore a backup if the Turbonomic server has failed and cannot be recovered:

- Download a new server from the Turbonomic web site, and deploy it
  This server should be the same version as the version that you used to create the backup file you will restore.

- Navigate to HTTP://<appliance_IP>/update.html
- Enter your username and password, then Ctrl-Click (or Command-Click on the Macintosh) the Authenticate button.
  This opens the advanced update page.

- In the form, choose a Full Restore from Backup, then click Choose File
  This opens a file chooser dialog where you can choose the backup file you created in the steps above. When you choose this file, the current Turbonomic server restores the backed up data — the newly installed Turbonomic will now have your configuration and database data.

- Choose your most recent backup file to upload

**Backups Via Virtual Machine Snapshots**

It's common to back up critical virtual machines by creating regular snapshots. If this is the method you prefer, you can include Turbonomic servers in your snapshot schedule. These backups will include all the information that is necessary to restore Turbonomic to its original state.

**Using VM Backup Agents**

If you use VM backup agents to back up your environment, you can include the Turbonomic server in that backup schedule. We have not tested specific backup agents, but we are not aware of any reported issues with their use.

**Configuring Management Continuity**

Turbonomic runs as a VM server on the major VM platforms that are on the market today. These platforms include High Availability (HA) utilities you can use for many situations. In addition, you can use network monitoring utilities to check on the status of the Turbonomic server, and respond in the event of server failure. These techniques cover different faults, and offer different approaches to recovery.

This section describes recommended techniques for maintaining continuous workload management with Turbonomic for the following situations:

- Host Failure
- Storage Failure
- Turbonomic Server Failure
- Site Failure (Disaster Recovery)
Recovering from Host Failure

You can install Turbonomic on the following VM platforms:

- VMware vCenter 4.1 — 5.x
- RHEV-M (RedHat Enterprise Virtualization Manager) versions 3.x
- Microsoft Hyper-V 2008 and 2012
- Citrix XenServer 5.6 — 6.1

These platforms support HA that responds to host failure and VM failure. In either case, if you install Turbonomic in a cluster that meets the requirements for the platform’s HA, then you can expect HA in the event of these types of failure. For example, if the host that is running the Turbonomic virtual machine fails, the platform HA will move the VM to a different host in the same cluster. After the move, the VM can start up (if necessary) and run with no impact to stored data or configuration.

Recovering from Storage Failure

Turbonomic is a real-time management and control application that performs the bulk of its analysis on in-memory data. It stores historical data, configuration data, and saved reports on disk. Loss of this data can affect some processing; for example, Turbonomic uses historical data to generate projections.

To guard against possible storage failure, you can use an installed storage replication technology to maintain a mirror of the Turbonomic server files on another datastore. If the datastore for the Turbonomic VM fails, use the recovery services that are provided by the storage replication technology.

Recovering from Turbonomic Server Failure

For the unlikely event that the Turbonomic server itself fails, you must implement your own HA procedure to capture that failure, and then execute a response. The following sections describe different ways to achieve this.

NOTE: Do not allow two Turbonomic servers to perform automation on the same targets at the same time. You should disable Automatic Restart for your Turbonomic VM to ensure this situation never occurs.

Manual Restart

The simplest response to Turbonomic failure is to manually restart the server. You should correct the problem that caused failure as soon as possible. For example, you might need to allocate more memory to the hosting VM, or change the database retention policies. If you cannot resolve the problem, contact Turbonomic technical support for assistance.

VM HA from the VM Platform

Some VM platforms offer VM-level HA. If the platform detects guest OS failure it resets the VM to recover normal operation. You should be aware that this level of HA responds to the guest OS, but not necessarily to the application running on the OS. It’s possible that the Turbonomic VM can fail without triggering VM HA.
Active/Passive Redundancy

To automate your response to a Turbonomic server failure, Turbonomic recommends the following deployment:

- Deploy a network utility that tracks connectivity of the Turbonomic server, and can post a notification if the server goes down
- Deploy a primary/secondary pair of Turbonomic servers
  Deploy each Turbonomic VM on a different host. You should use workload placement policies to ensure these VMs never run on the same host.

The hosts should be in the same cluster and have access to the same shared datastores. Also, the two installations of Turbonomic must be for the same version, and they should be installed on the same virtual platform. For example, if the primary installation is on VMware Systems, then the secondary installation should also run on VMware Systems.

- Run the pair in active/passive modes
  Set up the primary Turbonomic installation to manage your environment, including automatic execution of recommended actions. Set up the second installation to manage the same targets as the primary, but do not automate execution of any actions. You can leave this secondary installation powered on and running in standby mode, or powered off.

- Execute regular backups of the primary, active Turbonomic VM
  Turbonomic includes a script you can run regularly to backup the server’s database, configuration, and any saved reports. Save the backup data in a location that is visible to the secondary installation.

  To ensure coverage, you should automate running the backup script at regular intervals. (The steps to perform backup and restore are included below.)

When you receive a notification that the primary Turbonomic VM has gone down, put the secondary VM in active service. To automate this, you should implement a script that can perform the necessary actions. You put the secondary VM in service as follows:

- Ensure the primary VM is actually shut down
  It is important that you do not have both the primary and secondary Turbonomic servers performing automation on the same targets at the same time.

- Update the secondary Turbonomic server’s data
  The secondary installation should match the latest primary server’s data as much as possible. Use the Turbonomic restore script to bring the backup data from the primary server into the secondary server. You can choose to update the full set of server data, or just the configuration data. (The steps to perform backup and restore are included below.)

  The secondary Turbonomic server is now configured to perform workload management the same as the primary server did. This includes automation of recommended actions.

- Put the secondary installation in service
  If the Turbonomic VM is in standby or is powered down, put it into full service.

- Treat the now-running Turbonomic VM as primary (active), and the shut down VM as secondary (passive)
  You must ensure that the now-secondary VM is configured so that it will not automate any recommended actions.

**NOTE:** Do not allow two Turbonomic servers to perform automation on the same targets at the same time. When switching to the secondary Turbonomic VM, you must be sure that the primary VM is powered off.
Disaster Recovery — Site Failure

In the case of failure of a production site, your recovery management system should move the affected VMs to a separate DR site. Turbonomic is not a critical application in itself, but it is important to maintain your site with optimal workload distribution. This is true of a production site as well as a DR site. You can deploy Turbonomic on the DR site to take over management of recovered VMs as they are moved to the DR site. To do this:

- Install Turbonomic VMs on the DR site to match instances running on your production site
- For the DR instances of Turbonomic, ensure that they do not automate any actions
- On the DR site, configure the Turbonomic servers to monitor the targets on the DR site and the production site. For example, assume the production site has a single vCenter Server as a target for a single Turbonomic server, and the DR site has a single vCenter Server to manage recovered VMs. The Turbonomic server on the DR site should have both vCenter Server instances (production and DR) as targets.

As the production site goes down, your DR system will migrate VMs to the DR site. As this occurs, the DR instances of Turbonomic will discover these VMs and manage workload distribution on the DR site.

When you recognize that the production site has gone down, put the Turbonomic servers on the DR site into active service. To do this, change the actions configuration to automate whichever actions were automated on the production site.

**NOTE:** Before you bring the production site back up and move the recovered VMs back onto it, you should turn off automation for the Turbonomic servers running on the DR site. It is important that you never have two Turbonomic servers automating actions for the same targets.

Turbonomic Backup Procedures

Turbonomic anticipates trouble-free use of Turbonomic, but in most environments a regular backup schedule is recommended. You should be able to incorporate Turbonomic backups in your schedule with minimal impact on your regular backup procedures.

Turbonomic is a real-time management and control application that performs the bulk of its analysis on in-memory data. Unlike many other products, Turbonomic does not store operations-critical data about your environment on the file system or in a database. As a result, backups do not require the space necessary to store a complete listing of all the resources in your environment. The following describes the data that must be included in a backup:

- **Turbonomic historical database**
  Turbonomic uses data stored in a database data to chart past values, perform projections, provide baselines for plans, and display historical data in reports. This information is useful but not necessary for operation. Turbonomic performs workload management as soon as it discovers your topology, and does not rely on this information for operation.

- **Retained reports**
  Turbonomic retains the reports that you generate on demand, as well as reports that you have scheduled to be generated regularly.

- **Configuration files**
  Configuration files define user accounts, policies, groups, target configurations, licensing, and other data that describes your installation.

Turbonomic includes a script that you can execute to run a backup. You can also create a backup by saving a snapshot of the Turbonomic virtual machine, or by including Turbonomic in scheduled runs of a VM backup agent.
Backup and Restore Via the Turbonomic Backup Script

The supplied backup and restore scripts perform backups of the critical Turbonomic data — the historical database, retained reports, and configuration files.

**NOTE:** You can execute backups with no interruption to Turbonomic processing. However, restore operations require the server to restart. The restore command restarts the Turbonomic server as part of its execution.

Backing Up Turbonomic

To perform a backup, open the advanced update page and choose the type of backup to perform.

- **Navigate to** `HTTP://<appliance_IP>/update.html`
- **Enter your username and password**, then Ctrl-Click (or Command-Click on the Macintosh) the **Authenticate** button. This opens the advanced update page.

- In the form, choose **Full Backup** or **Configuration Backup**, then click **Download**
  This creates a backup file and downloads it to your local machine. **Full Backup** backs up the historical database, retained reports, and the configuration files. **Configuration Backup** only backs up the configuration files.
Save a copy of the backup file to a safe location
You should save copies of the backups in case the Turbonomic virtual machine fails and cannot be recovered. In that case, you can use the saved copy to restore to a new installation of the appliance.

Restoring Turbonomic Backups

NOTE: The version of Turbonomic to which you restore the backup must be the same as the version that generated the backup file.
To restore a backup to a Turbonomic installation:

- **Navigate to** `HTTP://<appliance_IP>/update.html`
- Enter your username and password, then Ctrl-Click (or Command-Click on the Macintosh) the **Authenticate** button. This opens the advanced update page.
- In the form, choose a Full Restore from Backup, then click **Choose File**
  
  This opens a file chooser dialog where you can choose the backup file you created in the steps above. When you choose this file, the current Turbonomic server restores the backed up data — the newly installed Turbonomic will now have your configuration and database data.
• Verify that the backup was successful

Log into the new Turbonomic user interface and confirm that the migration is complete and successful. Check your data in the following views:

- Admin view — check configuration data such as license, user accounts, and target configurations
- Policy view — check your custom groups under Group Management, as well as any placement policies you have created under Workload Placement
- Inventory view — check that the date slider on the information panels can show historical data

To restore a backup if the Turbonomic server has failed and cannot be recovered:

• Download a new server from the Turbonomic web site, and deploy it
  This server should be the same version as the version that you used to create the backup file you will restore.

• Navigate to HTTP://<appliance_IP>/update.html
• Enter your username and password, then Ctrl-Click (or Command-Click on the Macintosh) the Authenticate button.
  This opens the advanced update page.

• In the form, choose a Full Restore from Backup, then click Choose File
  This opens a file chooser dialog where you can choose the backup file you created in the steps above. When you choose this file, the current Turbonomic server restores the backed up data — the newly installed Turbonomic will now have your configuration and database data.

• Choose your most recent backup file to upload

**Backups Via Virtual Machine Snapshots**

It’s common to back up critical virtual machines by creating regular snapshots. If this is the method you prefer, you can include Turbonomic servers in your snapshot schedule. These backups will include all the information that is necessary to restore Turbonomic to its original state.

**Using VM Backup Agents**

If you use VM backup agents to back up your environment, you can include the Turbonomic server in that backup schedule. We have not tested specific backup agents, but we are not aware of any reported issues with their use.

**P2V - Planning Migration from Physical to Virtual**

You can use the Turbonomic to Plan View to simulate migration from a physical environment to a virtual environment. To set up the planning scenario, you first identify how many virtual machines to deploy, and what hardware you need to serve the virtual environment. You can perform your own analysis to build up such a listing, or you can use existing services and utilities to generate a listing.

Once you have a list of the devices you need in your environment, use Plan View to calculate the distribution of workload and resources that will give you optimal performance. The simulation suggests deployments that assure QoS while making sure to utilize system resources as fully and efficiently as possible.
When you execute P2V, Turbonomic creates a planning scenario that contains only the devices in your listing. It then uses the Economic Scheduling Engine to calculate the best placement of VMs among the physical hosts and datastores. The Plan View generates a To Do list of recommended actions to achieve this target deployment. When it’s completed, you can view the results:

- As a plan in the Plan View of Turbonomic
- As a PDF report
- As an XML file listing recommended actions

### Running a P2V Plan

To run a P2V plan:

1. **Generate a CSV listing of virtual and physical devices**
   This listing includes the physical and virtual devices for your environment, plus their capacities and resource requirements. You can generate the listing in a number of ways. You can turn to a vendor to analyze your current physical environment and generate a listing for you. Or you can perform your own analysis to generate the listing. Once you have a list of physical and virtual devices, you must convert that data into a CSV file with the appropriate fields for each device. For a listing of the required fields and field order, see CSV Field Order on page 320.

2. **Load the listing and run the plan**
   To access P2V planning, navigate your browser to the following URL: `<TurbonomicAddress>/plan.html` This opens the P2V page where you can provide the following:

   **VMTurbo P2V**

   ![P2V Planning](image)

   The login credentials you give must be for a user account with a role that has access to the Turbonomic Plan View. To run the plan, click **Plan P2V**.

3. **View the results**
   You can view results in the Plan View. Log into Turbonomic with the same credentials you used to run the P2V plan, then navigate to the Plan View.
   When the plan is finished, the web page displays two links:
   - **Generate Report**
     Direct Turbonomic to generate a PDF report outlining the plan results.
   - **View Action Plan**
     Display the list of recommended actions as XML.

   To return to the original P2V page, click the browser’s **Back** button.
CSV Field Order

The following table lists the fields in the CSV file. For each type of device you will add, some fields have mandatory values, while the others are optional (you can leave the field blank). The table lists the mandatory fields for each device type with an X. You can provide values for the unmarked fields, but they are not mandatory.

<table>
<thead>
<tr>
<th>Index</th>
<th>Field</th>
<th>Description</th>
<th>VM</th>
<th>PM</th>
<th>Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Type</td>
<td>The type of device — Can be one of VirtualMachine, PhysicalMachine, or Storage</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1</td>
<td>Instances</td>
<td>Number of instances to create</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>DataCenter</td>
<td>Name of the datacenter that houses the device</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Cluster</td>
<td>Name of the cluster the device belongs to</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Network</td>
<td>Name of the network the device runs on</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Datastore</td>
<td>Name of the datastore that services the device</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Host</td>
<td>For a VM, the host physical machine</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>System Name</td>
<td>The name for this device.</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>8</td>
<td>Vendor</td>
<td>The vendor name for this device</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Model</td>
<td>The model for this device</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Description</td>
<td>A string describing this device</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Price</td>
<td>The price for this device</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>CPU Count</td>
<td>The number of VCPUs on the VM, or cores on the PM</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Speed</td>
<td>CPU capacity for a VM, or a PM (MHz)</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Mem Size</td>
<td>The VMEM capacity for this VM, or MEM capacity for this PM (MB)</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Storage Size</td>
<td>Size of the datastore or vStorage for VMs (GB)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Network Interface Count</td>
<td>The number of network interfaces for this device</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Network Speed</td>
<td>The data rate of the network serving this device (Kbytes/sec)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Network Throughput</td>
<td>The network throughput for the interface(s) on this physical machine (Kbytes/sec)</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Num I/O</td>
<td>Number of I/O adapters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>I/O speed</td>
<td>Data rate through the host’s IO adapter, (Kbytes/sec)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>I/O Throughput Size</td>
<td>Throughput bandwidth for this PM’s I/O adapter (Kbytes/sec)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Rack Units</td>
<td>Number of rack slots this physical device takes up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Weight</td>
<td>Weight of this physical device (lbs)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Power</td>
<td>Power consumption of this physical device (W)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Thermal</td>
<td>Heat generated by this physical device (BTU/hr)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Custom Branding of Turbonomic

Third-party distributors and service providers might want to customize the company brand name for Turbonomic. You can change the logos that appear in generated reports and in the GUI, so the product will present your brand’s logo.

When you re-brand Turbonomic:

- You create images for your custom logos
- You create one or more custom Turbonomic startup pages to display custom logos
- The product GUI displays your custom logo images
- Generated reports display your logo, and your copyright statement

To re-brand the product, you will upload a ZIP archive that contains custom html files, and a set of logo image files. Turbonomic then copies the files into the proper locations. In addition, the Turbonomic installation stores a copy of your re-branding files so that your brand will remain even after executing a product update.

Re-Branding Turbonomic

To re-brand Turbonomic:

1. **Create image files for your logos and copyright statement.**

   Create the following files:
   - `logo-<Brand_Name>.jpg` (where `<BrandName>` is a custom name you use to identify your brand) — Used in the top-left of the main Turbonomic GUI. This image file must be 128 pixels wide by 46 pixels high. User interface display will have unpredictable results if you use a different sized image.
   - `logo_login<BrandName>.png` (where `<BrandName>` is a custom name you use to identify your brand) — Used in the login screen. This image file must be 150 pixels wide by 35 pixels high. Display of the login screen will have unpredictable results if you use a different sized image.
2. **Download the default re-branding package.**

You will use this package as a template for creating your own re-branding package.

Navigate to [HTTP://<appliance_IP>/update.html](http://<appliance_IP>/update.html).

Provide a username/password for an administrator account, choose **Download Existing Branding**, then click **Download**. This downloads the file `branding.zip`. Save this file in your working directory. You should change the file name — for example, save it as `branding_default.zip`.

**NOTE:** You get the default package only from a Turbonomic instance that has not already been re-branded. Be sure to save this default package for future reference.
3. Unzip the re-branding package and add your images to the file tree.
You should see the following directory structure — replace the files indicated below in bold with your files:

```
...\srv\reports\images\copyright.jpg
...\srv\reports\images\logo.png
...\srv\www\htdocs\com.vmturbo.UI\assets\images\logo-<BrandName>.jpg
...\srv\www\htdocs\com.vmturbo.UI\assets\images\logo_login.png
```

4. Rename the UIMain.html file

```
...\srv\www\htdocs\com.vmturbo.UI\UIMain.html
```

This file presents the Turbonomic user interface, along with the branding logo. When your users launch your GUI, the URL they execute will terminate in this filename. For that reason, you should give a filename that represents your brand. For example, if you rename the file to UIMain_MyCompany.html, the URL customers execute will be HTTP://<Appliance_Address>/com.vmturbo.UI/UIMain_MyCompany.html.

Note that you can make several copies of this file, each with a different name, and each to use a different logo. In that case, you would:

- Create a different version of logo-<BrandName>.jpg for each version of UIMain_<MyCompany>_.html, and store each one in
  ```
  ...\srv\www\htdocs\com.vmturbo.UI\assets\images
  ```
- Give different customers the appropriate URLs, depending on which of these UIMain.html files you want them to open

5. Edit the UIMain.html title element

Edit this file to set the text that displays in the browser window’s title bar. Search for the <title> element, and make your changes. For example, change

```
<title>Turbonomic - Converge, Control, Prevent</title>
```

to

```
<title>MyCompany - Converge, Control, Prevent</title>
```

6. Specify the main banner logo for this customized UIMain.html file

The logos are specified as a Flash variables. Search the file for the following statement:

```
var flashvars = {};
```

Immediately after this line, add or edit `flashvars.appImageFileName` to specify the path to your custom logo as follows:

```
flashvars.appImageFileName = "assets/images/logo-<BrandName>.jpg";
```

Assuming a logo file named logo-MyCompany.jpg, the resulting edit should appear as follows:

```
var flashvars = {};
flashvars.appImageFileName = "assets/images/logo-MyCompany.jpg";
```

7. Specify the login logo for this customized UIMain.html file

Immediately after the line you just added, add or edit `flashvars.appImageLoginFileName` to specify the path to your custom logo as follows:

```
flashvars.appImageLoginFileName = "assets/images/logo_login<BrandName>.png";
```

Assuming a login logo file named logo_loginMyCompany.png, the resulting set of Flash variables should appear as follows:

```
var flashvars = {};
flashvars.appImageFileName = "assets/images/logo-MyCompany.jpg";
flashvars.appImageLoginFileName = "assets/images/logo_loginMyCompany.png";
```
8. Save the file tree as a re-branding package
   The re-branding file tree that you have modified begins at the srv directory. Save this directory and all of its 
   contents as a ZIP file named branding.zip.
   Be careful not to overwrite the original branding package that you downloaded from a default instance of Turbo-
   nomic.

9. Upload your custom re-branding package
   - Navigate to HTTP://<appliance_IP>/update.html and choose Upload New Branding
   - Provide a username/password for an administrator account
   - Select the Upload New Branding option
   - Click Choose File and select the ZIP file you just created. Note: The file must be named branding.zip.
   - Click Upload
   This uploads the package to the installation. Turbonomic deploys these files so it can use the logos and copyright 
   image that you provided. In addition, it stores the package so your brand will persist after you update to later 
   versions of Turbonomic.

10. Save your branding packages for later reference.
    You should save the default branding package and your custom branding package, in case you need either of the 
    sets of files at a later date.

**Delivering the Re-Branded GUI**

To deliver your branded GUI to your customers, have them execute the URL that calls your custom version of 
UIMain.html. For example, have your customers navigate to:

HTTP://<Appliance_Address>/com.vmturbo.UI/UIMain_MyCompany.html

**Updating Turbonomic**

When you update Turbonomic, the updated version will still use your custom branding.

In some cases, an update includes changes to the UIMain.html file. In this case, your customized file will not include 
these changes. For your custom brand to use the latest changes in UIMain.html, you must recreate your custom UIM-
ain.html files, based on the new version.
The Policy View

The Policy view provides settings to control how the Turbonomic analyzes resource allocation, how it displays resource status, and how it recommends or performs actions. This view opens the Policy Editor that you can use to:

- Navigate to policy categories
- Specify the scope of your settings You can make global settings, or make settings for groups of machines or applications.
- Enter setting values and apply your changes

To set a policy, you first select a category, and then navigate the Scope tree to set the scope of the policy change. The editor then displays the settings you can change. To edit a field you click in it and enter a value. When you have made the changes you want, be sure to click Apply Setting Changes.
For example, you can direct Turbonomic to automatically resize all VMs on a specific datastore. To do this, you would make a selection similar to the following figure, set the Resize value, and apply the change.

Policy Scope Set to VMs on a Specific Datastore

Before you make policy settings, you should understand the scope of these settings, and how Turbonomic chooses among competing settings. For more information, see Policy Scope on page 326.

For information about policy categories, and the effects of their individual settings, see Policy Categories on page 330.

Policy Scope

Policy scope determines which resources will be affected by the settings you make. Scope can be either:

- **Global Settings** on page 326: Base settings for each category that apply by default to all resources
- **Group Overrides** on page 327: Settings you apply to specific groups of resources

Global Settings

To make global settings, select a category, and if necessary select a resource type. The following image shows global settings for actions on Hosts.
Global Policy Settings

These are the base settings for all the resources in your inventory. The settings you make on groups and individual resources will override these global settings.

Group Overrides

You can make settings to groups of resources that override the global settings for the resource type. (For information about defining custom groups, see "GroupManagement" in the Target Configuration Guide.) As you make these settings, you should be aware of issues that can arise with:

- Conflicting Settings on page 327
- Top-level Groups on page 329

Conflicting Settings

You can set overrides on any groups listed in the Profiles view. However, it’s possible that individual machines or applications are in more than one group (see the following illustration).
Same VM in Two Groups

In this case, you could set different overrides for the two groups, which can then conflict with each other in the same resource instance. For example, assume the following settings for VM Resizing:

- The Global setting is Manual
- The override for VMs_Beta\Cluster-1 (in Virtual Machines by Cluster) is Automated
- The override for VMs_dv VM Network (in Virtual Machines by Network) is Recommend

In this case, two different settings will be associated with the VM named Fedora 12. In all such conflicts, Turbonomic uses a tie-breaker to resolves the conflict. In the case of actions, the tie-breaker uses the most conservative setting. Following this example, any Resize actions for Fedora 12 will be of type Recommend, because that is the most conservative of the settings for this VM.

The documentation for each policy category describes the tie-breaker for that category.

**NOTE:** Tie-breakers only apply among override settings. For example, even if a global action setting is more conservative than its override, the override takes precedence. But among two or more overrides for the same setting, the tie-breaker comes into effect.

You can navigate to any instance in the scope tree, see its effective setting, and also see where that has been set. For example, the following figure shows that the action mode for Resize on Fedora 12 is Recommend, and it was set in the VMs_dv VM Network group.
Scope: VirtualMachine

Parameter: Fedora 12

Action Mode Settings

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Value</th>
<th>Defined In</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td>Manual</td>
<td>Global</td>
</tr>
<tr>
<td>Move</td>
<td>Manual</td>
<td>Global</td>
</tr>
<tr>
<td>Suspend</td>
<td>Manual</td>
<td>Global</td>
</tr>
<tr>
<td>Terminate</td>
<td></td>
<td>Global</td>
</tr>
<tr>
<td>Add Provider</td>
<td>Recommend</td>
<td>Global</td>
</tr>
<tr>
<td>Change</td>
<td>Recommend</td>
<td>Global</td>
</tr>
<tr>
<td>Remove Provider</td>
<td>Recommend</td>
<td>Global</td>
</tr>
<tr>
<td>Reconfigure</td>
<td>Recommend</td>
<td>Global</td>
</tr>
</tbody>
</table>

Resize: Recommend

Top-level Groups for Actions

Viewing the Effective Setting for a VM

Top-level Groups

Within each policy category, the editor displays resources in groups. The following figure shows groups for actions on VMs.
Notice that each category has top-level groups. For example, the Action category sets policies for actions on VMs, hosts, datastores, and virtual datacenters. For VM actions the scope tree shows:

- Virtual Machines
- Virtual Machines by Cluster
- Virtual Machines by Network
- Virtual Machines by Storage

Each of these is a top-level group. Beneath each top level you can see the individual groups that contain the resources. It’s likely that most individual resources belong to all of the top-level groups. For example, it’s likely that a single VM belongs to Virtual Machines by Cluster and to Virtual Machines by Datacenter.

You should not make settings to the top-level groups. You could make a top-level setting that always wins a tie-breaker, and so all the lower-level settings would never take effect. If you set overrides to a top-level group after lower-level settings were already made, you could inadvertently make all the lower-level settings ineffective.

**NOTE:** If you want to make settings to all resources (all PMs or all VMs, for example), then you should make global settings (see Global Settings on page 326). You should not make settings in a top-level group.

**Policy Categories**

You can specify the following categories of policies on this installation of Turbonomic:

- "GroupManagement" in the Target Configuration Guide: Custom groups you define to manage resources—You can use groups to manage how Turbonomic uses policy settings
- Workload Placement Segments on page 336: Imported and user-created workload placement policies that restrict how Turbonomic calculates workload distribution
- Analysis on page 343 — Constraints that Turbonomic can use to determine whether a resource is operating optimally
- Action Modes on page 354 — How Turbonomic handles the execution of actions in the To Do list (automatic, manual, recommend, or disable)
- Application Priority on page 369 — Mission critical or normal
- Discovery Policies on page 370 — How to discover Windows applications, and how to recognize vCenter tags
- Infrastructure Cost on page 377 — Group hardware devices by cost so you can use those criteria for placement policies
- Email and Trap Notification on page 382 — Notification policies for Turbonomic events
- Retention Configuration on page 385 — Policies to retain historical data
- General Settings on page 386 — Policies to set the currency symbol that appears in plans
Group Management

Groups assemble collections of resources for Turbonomic to monitor and manage. When using the Navigation Panel, or when or setting scope, you can select groups to focus on those specific resources. For example, if you have a number of VMs devoted to a single customer, you can create a group of just those VMs. When running a planning scenario you can set the scope to work with just that group.

Turbonomic ships with some groups already defined. With Group Management you can also create your own groups. Turbonomic supports two custom-grouping methods:

- **By criteria** — You create dynamic groups that are defined by specific search criteria. You can group services according to naming conventions (all VM names that start with “ny”), resource characteristics (all physical machines with four CPUs), or other criteria such as time zone or number of CPUs You can create a group with as many as three separate criteria.
  These groups are dynamic because Turbonomic updates the group as conditions changes.

- **By manual selection** — You create static groups by selecting the specific group members.

When working with groups you can:

- Create new groups — click the **PLUS** icon
- Edit an existing group — select a group and make changes to its properties
- Delete an existing group — select a group and click the **X** icon
Creating a Group

To create a group:

1. **Click the Plus icon.**
   
   This opens a New Group entry in the list of groups.

2. **Name the group.**
   
   Edit the name of the New Group entry, and then press Return. This displays the Group Configuration form. For example, create **My Sample Group**.
3. Choose the type of entities for this group.

![My Sample Group: Group Configuration](image)

A given group contains entities of the same type — Specify that type here.

4. Choose a grouping method.

![My Sample Group: Group Configuration](image)

If you group by criteria, you will create a dynamic group — The group will contain all the items that match your search criteria. As Turbonomic discovers new entities that match your criteria, it will add the entities to the group.

If you manually select entities, you will create a static group. You search for specific entities and add specific matches to the Custom group content list.

5. Specify your search criteria.

Click the Add Filter button (Add filter) to create each search criterion you want to use. One group can use up to three filters.

For a search criterion, choose the entity attribute to search for. Then choose the matching criterion. For example, you can search for all VMs with a name that matches a given string (Note that .)

The search field accepts regular expressions. For help on regular expression syntax, click the QUESTION MARK button.

Turbonomic treats multiple search filters as AND criteria — A search will find the entities that match all the criteria you specify in the filters. For example, you can search for all VMs that match a given string, AND that have more than one VCPU.
When you have entered your search criteria, click **Find matches** to see what entities your search specifies.
If you enabled the **Manually Select** grouping method to create a static group, you can drag items from the match list to the **Custom group content** list.

If you enabled the **Group Entities By Criteria** grouping method to create a dynamic group, these items will be the members of your group.

6. **Save the group settings.**
   
   When you’re satisfied with the group setup, click **Apply Member Changes** to save the group.
**Editing a Group**

To edit a group, select the item in the My Groups list and change its settings. Then click **Apply Member Changes**.

To rename a group, double-click the group name in the My Groups list. Then type the new name and click **Return**.

**Workload Placement Segments**

For planning and optimization, Turbonomic recommends actions to place workload from applications, VMs, physical machines, datastores, and disk arrays. Turbonomic can recommend these actions, or execute them automatically. When calculating workload placement, Turbonomic respects cluster boundaries, networks, and provisioned data stores. These boundaries impose segments on the market view that Turbonomic uses to model your virtual infrastructure.
In finance a market segment divides the market according to the criteria different groups of people use when they buy or sell goods and services. Likewise in the Turbonomic market, a workload placement segment uses criteria to focus the buying and selling of resources within specific groups of entities. It gives you finer control over how Turbonomic calculates moves. When managing segments you can:

- **Importing Workload Placement Policies** on page 337 — Review the placement policies that Turbonomic has discovered. These are policies that have been defined in your environment, outside of Turbonomic.
- **Creating Workload Placement Segments** on page 338 — that restrict workload placement according to specific rules

**NOTE:** You can enable or disable any imported policy or created workload placement segment. You can view the constraints that affect any given entity in the Inventory view. For more information, see [Viewing Entity Constraints](#) on page 64.

### Importing Workload Placement Policies

The hypervisors that you set as targets can include placement policies of their own. Turbonomic imports these placement policies, and you can choose to enable or disable them. By default, Turbonomic enables imported placement policies. (For information about target hypervisors, see [Configuring Targets](#) on page 297.)

For example, VCenter servers can include Distributed Resource Scheduler (DRS) rules that determine placement of VMs among physical hosts. In Turbonomic, you can specify whether to enable or disable each DRS rule.

To see the list of imported placement policies for your environment, expand the Imported Placement Policies folder. To enable or disable a policy, select it in the list and modify its settings.

![Policy Editor](image)

**Enable/disable the imported policy**

**Enabling an Imported Placement Policy**
Creating Workload Placement Segments

You can create Workload Placement Segments to further control how Turbonomic calculates the placement of entities within your environment. For example, you can create market segments that have these kinds of effects:

- Restrict the number of VMs that can use a given datastore
- Limit VM mobility by restricting a collection of VMs to a specified cluster or group of hosts
- Expand VM mobility by merging a number of clusters — this enables placement of VMs that crosses traditional cluster boundaries
- Implement system redundancy by specifying that certain VMs always run on different hosts
- Restrict placement of Physical Machines to specific fabric chassis
- Keep workload running on hosts that have the required licenses

After you have created a market segment you can always edit it, enable it, or disable it (see Editing Workload Placement Segments on page 343).

Creating Workload Placement Segments

To create market segments, identify a consumer group and then specify which provider groups can serve those consumers. Consumer groups can be made up of the following types of entities: Applications, VMs, PMs, datastores, and disk arrays. You can create the following types of market segments:

- **Place** — Determine which entities use specific providers
  For example, the VMs in a consumer group can only run on a PM that is in the provider group. You can limit the number of consumers that can run on a single provider — for PMs in the provider group, only 2 instances of VMs in the consumer group can run on the same host. Or no more than the specified number of VMs can use the same storage device.

- **Don’t Place** — Consumers must never run on specific providers
  For example, the VMs in a consumer group can never run on a PM that is in the provider group. You can use such a segment to reserve specialized hardware for certain workloads.

- **Merge** — Merge clusters into a single provider group (requires the Cloud Control Module license)
  For example, you can merge three PM clusters in a single provider group. This enables Turbonomic to move workload from a host in one of the clusters to a host in any of the merged clusters.

To create a segment, click the Plus icon (+) to display the Segment Editor. You can then use the editor to create a segment of the type you want.

**Place**

These segments control where workload can be placed. For example, you can specify that a VM will only be placed on a PM that is a member of a specific cluster. Or you could specify that any applications in a specific group can only be placed on a datastore that is a member of a specific group.
To create a Place segment, first turn on the **Place** radio button, and give the segment a name. Then make the following settings:

- **Type**
  Choose the type of consumer entities for this segment. The type can be:
  - **Application**: To set which VM groups can host the applications
  - **Virtual Machine**: To set which PM or datastore groups can host the VMs
  - **Physical Machine**: To set which datacenter or fabric chassis can host the PMs
  - **Storage**: To set which disk arrays can manage the datastore
  - **Disk Array**: To set which storage controllers can manage the disk array

- **Consumer Group**
  The group or cluster that contains entities of the type you chose. For a Place segment, you can choose a single group or cluster. To customize the list of consumer entities, you can create a custom group.

- **Provider Group**
  The group or cluster of entities that will provide resources to the consumer entities. For a Place segment, you can choose a single group or cluster. To customize the list of provider entities, you can create a custom group.

- **Limit workload entities to placement group**
  This option enables the Place segment to limit consumer placement to the items in the provider group.

  If you disable this option, the segment can still limit the number of workload items to place on any provider, without limiting availability to the provider group.

- **Limit the number of workload entities per placement entity**
  Limit how many instances of the specified consumer entities can be placed on a single provider. A common use for this is to specify that only one instance of a given application can ever be placed on a host PM.

When you have made the settings you want, click **Create**.
Don’t Place

These segments identify groups or clusters that will never host the consumer entities. For example, you can specify that a VM will never be placed on a PM that is a member of a specific cluster. Or you can specify that a set of non-critical applications will never be placed on specialized hardware, as a way to ensure availability for critical applications.

To create a Don’t Place segment, first turn on the Don’t Place radio button, and give the segment a name. Then make the following settings:

- **Type**
  Choose the type of consumer entities for this segment. The type can be:
  - **Application**: To set which VM groups can host the applications
  - **Virtual Machine**: To set which PM or datastore groups can host the VMs
  - **Physical Machine**: To set which datacenter or fabric chassis can host the PMs
  - **Storage**: To set which disk arrays can manage the datastore
  - **Disk Array**: To set which storage controllers can manage the disk array

- **Consumer Group**
  The group or cluster that contains entities of the type you chose. For a Don’t Place segment, you can choose a single group or cluster. To customize the list of consumer entities, you can create a custom group.

- **Provider Group**
  The group or cluster of entities that will not provide resources to the consumer entities. For a Don’t Place segment, you can choose a single group or cluster. To customize the list of provider entities, you can create a custom group.

When you have made the settings you want, click **Create**.

**Merge**

If you have the Cloud Control Module license, you can create Merge segments. These segments merge multiple clusters into a single logical group for the purpose of workload placement. For example, your environment might divide hosts into clusters according to hardware vendor, or by some other criteria. Workload placement typically does not
cross such cluster boundaries. However, there might be no technical reason to apply these boundaries to workload placement. By creating a larger pool of provider resources, Turbonomic has even more opportunities to increase efficiency in your environment.

**NOTE:** With the exception of Cross-vCenter vMotion (see below), the clusters you place in a Merge segment must be members of the same datacenter.

To create a Merge segment, first turn on the **Merge** radio button, and give the segment a name. Then make the following settings:

- **Type**
  Choose the type of provider entities for this segment. The type can be:
  - **Host Cluster:** To merge clusters of Physical Machines
  - **Storage Cluster:** To merge clusters of datastores
- **Provider Group**
  The clusters this segment will merge.

When you have made the settings you want, click **Create**.

Turbonomic shows the following icons for Merge segments:

- 🔄 When the segment is enabled
- 🔄 When the segment is disabled

**Cross-vCenter vMotion**

Versions of VMware vCenter Server 6.0 and later support cross-vCenter migration. To enable this feature in Turbonomic, create a Merge placement segment that includes clusters managed by the different vCenter Server instances. For example, the following image shows a selection of clusters that merge the Demo41 datacenter with the Development41 datacenter. If you create a Merge placement segment with this scope, then VMs can move from one datacenter to the other.
To use cross-vCenter vMotion in Turbonomic, the vCenter Servers must meet the following requirements:

- The vCenter Server instances and ESXi hosts must run version 6.0 or later
- You must have an Enterprise Plus license
- The vCenter Server instances must be in Enhanced Link Mode, and they must be time-synchronized
- Turbonomic cannot execute vMotion from a cluster that uses standard switches (VSS) to a cluster that uses distributed switches (VDS)
**Editing Workload Placement Segments**

You can edit segments, and you can enable or disable them. Select the segment and make your changes.

---

**Policy Editor**

**Category:**
- Group Management
- Workload Placement
- Analysis
- Action
- Application Priority
- Discovery
- Infrastructure Cost
- Cluster Capacity
- Email / Trap Notification
- Retention
- General Settings

**Workload Placement Policies**

- Imported Placement Policies
- VMTurbo Segments
- Keep VMs Off Host

**Segment name:** Keep VMs Off Host

VMs of group VMs_Datacenter-9\Q52:ESXDC9DS1 must not run on Host of group: PMs_Datacenter-9\Cluster-1

Enable/disable the segment

Open the Segment Editor to change settings

---

**Analysis**

As Turbonomic gathers metrics, it compares the metric values against specified constraint and capacity settings to determine whether a metric exhibits a problem, how to recommend a problem resolution, and so on. Turbonomic maintains analysis settings for Host and Storage devices.

The following figure shows override settings for all NAS storage devices. To make settings for all storage devices in the environment, you should make global settings for Analysis > Host or Analysis > Storage (see Global Settings on page 326).
Tie-break Results

When the same resource instance has conflicting settings, the most conservative setting wins:

<table>
<thead>
<tr>
<th>Setting type:</th>
<th>Most conservative is:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utilization, throughput, and upper bounds</td>
<td>Lowest value</td>
</tr>
<tr>
<td>Latency and lower bounds</td>
<td>Highest value</td>
</tr>
</tbody>
</table>

How Turbonomic Responds to Analysis Settings

Turbonomic compares utilization metrics in your environment to the operational constraints you specify. It uses that comparison to trigger problem notifications and to classify the problems. The values you set here specify maximum values for each metric. Based on those settings, Turbonomic classifies these metrics as follows:

<table>
<thead>
<tr>
<th>If the value is:</th>
<th>The classification is:</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than 80% of the constraint setting</td>
<td>Critically overutilized</td>
</tr>
<tr>
<td>Between 60% and 80% of the setting</td>
<td>Overutilized</td>
</tr>
<tr>
<td>Between 10% and 5% of the setting</td>
<td>Under utilized</td>
</tr>
<tr>
<td>Less than 5% of the setting</td>
<td>Critically under utilized</td>
</tr>
</tbody>
</table>
Application Server Settings

Turbonomic tracks utilization of resources for applications that are managed by the Application Control Module. To access capacity settings for these resources, choose **Analysis > Application Server** from the **Category** tree, and then choose a group of application servers from the Applications list, or from your custom groups.

The default values for these capacity settings are as follows:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auto Set Transactions Capacity</td>
<td>Disabled</td>
</tr>
<tr>
<td>Connection Capacity</td>
<td>10000</td>
</tr>
<tr>
<td>Response Time Capacity (ms)</td>
<td>60000</td>
</tr>
<tr>
<td>SLA Capacity</td>
<td>100000000</td>
</tr>
<tr>
<td>Threads Capacity</td>
<td>500</td>
</tr>
<tr>
<td>Transactions Capacity</td>
<td>10</td>
</tr>
</tbody>
</table>
Transactions

This resource measures the number of transactions per second. Excess transactions indicate a heavy load on the application server, and usually means you should provision a new instance. You can set the transaction capacity, or direct Turbonomic to automatically set it.

- **Transaction Capacity**
  If you know the rate of transactions your applications can maintain, then you can set it here. The value that you set indicates when Turbonomic considers utilization to be 100%. The default value is 10 — if an application experiences 10 transactions per second or more, Turbonomic sets the utilization index for this resource to 100%.

- **Auto Set Transaction Capacity**
  If you enable this setting, Turbonomic adjusts the transaction capacity to the upper limit your application server experiences. For example, if the Transaction Capacity is set to 10, and the application server experiences 15 transactions per second, then the utilization of this resource would be 150%. However, if you enable Auto Set Transaction Capacity, then Turbonomic would increase the capacity to 15, and show utilization at 100%.

Response Time

Response time capacity determines the upper limit for acceptable response time in your applications, in milliseconds. Very high response time can be a result of excess load on the application. For excess response time, Turbonomic can recommend to provision another application instance.

Turbonomic maps Response Time utilization to QoS. This means that the higher the response time, the greater the utilization of QoS. QoS indicates the risk the application has for meeting its requirements. As QoS utilization increases, Turbonomic gives the affected application more priority. In cases of resource contention, other things being equal, the application with higher QoS utilization will win.

SLA Capacity

This sets how much the given application can be at risk for meeting its QoS requirements. The higher the risk, the more priority the application has to get resources from the underlying providers.

---

**NOTE:** Measurement of QoS against the capacity set for SLA requires instrumentation to monitor QoS-related metrics, or integration of third-party monitoring systems with Turbonomic. If you have such monitoring, then you can provide values for SLA in relation to the scale of your monitoring. Otherwise, you should leave this setting at the default. Also note that this SLA setting does not impact the mapping of Response Time consumption to QoS measurements in applications.

---

Connection Capacity

Connection capacity determines the upper limit for concurrent connections to the application. Excess connections can indicate the need to provision a new instance.
**Threads Capacity**

For most types of applications and servers managed by the Application Control Module (ACM), Turbonomic discovers the thread pool capacity on the server, and uses that in utilization calculations. For this release, the following types of supported ACM targets do not provide thread pool data that Turbonomic can use:

- Microsoft Exchange Server

For entities of this type, you can select a group of these entities and specify the thread pool capacity. Turbonomic assumes a default capacity of 500 threads, which is according to best practices in the field.

**Load Balancer Settings**

To manage load balancers, Turbonomic tracks transactions that occur on the virtual applications (vservers) each load balancer manages. You can set the capacity of transactions per second as a policy for virtual applications. Turbonomic will list transaction utilization as a percentage of the capacity you set.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Application Transaction Capacity</td>
<td>1000</td>
</tr>
</tbody>
</table>

**Operational Settings**

These settings affect overall Turbonomic processing for the hosts and workloads in your environment.

Global operational settings include the following items:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ignore High Availability</td>
<td>Off — Turbonomic discovers and manages HA policies.</td>
</tr>
<tr>
<td>Ignore Hyperthreading</td>
<td>Off — Turbonomic calculates extra CPU capacity when it detects hyperthreaded sockets.</td>
</tr>
</tbody>
</table>

In addition, you can make settings for:

- [Hardware Costs](#) on page 348
- [Reporting Upper and Lower Bounds](#) on page 348
- [Resize Recommendation Settings](#) on page 348
- [Utilization Constraints](#) on page 350
- [Advanced](#) on page 350
Hardware Costs

For planning and reporting, Turbonomic uses these values to estimate the cost of changes to your hardware inventory. The following table shows the default settings for hardware cost:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of CPU per unit</td>
<td>200</td>
</tr>
<tr>
<td>Cost of memory per GB</td>
<td>50</td>
</tr>
<tr>
<td>Cost of storage per TB</td>
<td>50</td>
</tr>
<tr>
<td>Host Hardware Cost</td>
<td>9000</td>
</tr>
</tbody>
</table>

Reporting Upper and Lower Bounds

The following table shows the default settings for operational constraint values that some reports use to assign virtual machines to categories that show them as overutilized or underutilized. For example, with a VMem lower bound of 10, if utilization falls below 10% then the report will categorize this as an underutilized VM.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCPU Utilization Lower Bound</td>
<td>10</td>
</tr>
<tr>
<td>VCPU Utilization Upper Bound</td>
<td>85</td>
</tr>
<tr>
<td>VMem Utilization Lower Bound</td>
<td>10</td>
</tr>
<tr>
<td>VMem Utilization Upper Bound</td>
<td>85</td>
</tr>
<tr>
<td>VStorage Utilization Lower Bound</td>
<td>10</td>
</tr>
<tr>
<td>VStorage Utilization Upper Bound</td>
<td>85</td>
</tr>
</tbody>
</table>

Resize Recommendation Settings

When Turbonomic recommends changes to virtual resources, it uses increments as it calculates how much to raise or lower the given value, and a Rate of Resize to specify how many increments to apply in a single resize action.

**NOTE:** For CloudStack environments, resize is determined by templates. Resize Increments have no effect. However, Rate of Resize can affect which template Turbonomic will use for a resize operation. Assume an environment with small, medium, and large templates, and a VM that is set to small needs to be resized to large. If the Rate of Resize is set to Low, Turbonomic might try the medium template first. However, if the setting is High, then Turbonomic will probably use the large template for the initial resize operation.

Resize Increments

The increments specify how many units to add or subtract when resizing the given resource allocation for a VM. For example, it makes sense to change VMem by steps of 1024 MB at a time, but for VStorage it’s better to make changes by 0.5 GB steps.
The following table shows the default settings for the Resize increments:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increment constant for VMem [MB]</td>
<td>1024</td>
</tr>
<tr>
<td>Increment constant for VCPU [MHz]</td>
<td>1800</td>
</tr>
<tr>
<td>Increment constant for VStorage [GB]</td>
<td>999999</td>
</tr>
<tr>
<td>Increment constant for Heap [MB]</td>
<td>100</td>
</tr>
<tr>
<td>Increment constant for VDC MEM Allocation [MB]</td>
<td>1</td>
</tr>
<tr>
<td>Increment constant for VDC CPU Allocation [MHz]</td>
<td>1</td>
</tr>
<tr>
<td>Increment constant for VDC Storage Allocation [GB]</td>
<td>1</td>
</tr>
<tr>
<td>Increment constant for Storage Amount [GB]</td>
<td>100</td>
</tr>
</tbody>
</table>

For resize increments, you should consider the following:

- For VMem, you should not set the increment value to be lower than what is necessary for the VM to operate. If the VMem increment is too low, then it’s possible that Turbonomic would allocate insufficient VMem for the machine to operate. For a VM that is under utilized, Turbonomic will reduce VMem by the increment amount, but it will not leave a VM with zero VMem. For example, if you set this to 1024, then Turbonomic cannot reduce the VMem to less than 1024 MB.
- For VCPU, the increment affects resize of VCPU limits and reservations in MHz, and it also affects the addition/removal of cores for VCPU capacity on a VM. For limits and reservations, Turbonomic recommends changes in terms of the specified resize increment. For example, assume the increment is 1800 MHz and you have reserved 3000 MHz for a VM. Turbonomic could recommend to reduce the reservation by 1800, down to 1200 MHz.
- For VCPUs, Turbonomic can only resize allocation one core at a time. This means a resize is to the nearest core count that matches or exceeds the resize increment. Assume the cores all have a clock speed of 2000 MHz. If the resize increment is 1800 MHz, then a resize up will recommend to add one more core at 2000 MHz.
- For VStorage, the default setting is very high to disable resize actions. This is usually preferred because VStorage resize requires that you reformat the storage.

**Rate of Resize**

When resizing resources for a VM, Turbonomic calculates the optimal values for VMem, VCPU and VStorage. But it does not necessarily make a change to that value in one action. Turbonomic uses the Rate of Resize setting to determine how to make the change in a single action, as follows:

- **Low**
  Change the value by one increment, only. For example, if the resize action calls for increasing VMem, and the increment is set at 1024, Turbonomic increases VMem by 1024 MB.
- **Medium**
  Change the value to be halfway between the current value, and the optimal value. For example, if the current VMem is 2 GB and the optimal VMem is 8 GB, then Turbonomic will raise VMem to 5 GB (or as close to that as the increment constant will allow).
- **High**
  Change the value to be the optimal value. For example, if the current VMem is 2 GB and the optimal VMem is 8 GB, then Turbonomic will raise VMem to 8 GB (or as close to that as the increment constant will allow).

The default setting for Rate of Resize is **Medium**.
**Utilization Constraints**

Utilization constraints affect the actions Turbonomic recommends as it manages your environment. Turbonomic recommends actions that avoid using these resources beyond the given settings.

The following table shows the default settings for utilization constraints on physical machines.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collection Time Utilization</td>
<td>10</td>
</tr>
<tr>
<td>CPU Overprovisioned Percentage</td>
<td>1000</td>
</tr>
<tr>
<td>Heap Utilization</td>
<td>80</td>
</tr>
<tr>
<td>Host CPU Utilization</td>
<td>100</td>
</tr>
<tr>
<td>Host IO Throughput</td>
<td>20</td>
</tr>
<tr>
<td>Host Memory Utilization</td>
<td>100</td>
</tr>
<tr>
<td>Host Net Throughput</td>
<td>20</td>
</tr>
<tr>
<td>Host Ready Queue Utilization</td>
<td>100</td>
</tr>
<tr>
<td>Host Swapping Utilization</td>
<td>20</td>
</tr>
<tr>
<td>Mem Overprovisioned Percentage</td>
<td>1000</td>
</tr>
<tr>
<td>Storage Amount Utilization</td>
<td>100</td>
</tr>
<tr>
<td>Storage Controller CPU Utilization</td>
<td>100</td>
</tr>
<tr>
<td>Storage IOPS Utilization</td>
<td>100</td>
</tr>
<tr>
<td>Storage Latency Utilization</td>
<td>100</td>
</tr>
<tr>
<td>Switch Net Throughput</td>
<td>70</td>
</tr>
</tbody>
</table>

**Advanced**

The advanced settings adjust the overall analysis performed by the Economic Scheduling Engine. They adjust how Turbonomic calculates recommended actions, as well as the desired state Turbonomic will try to achieve for your environment.

**Price**

Weights for peaks and averages specify the degree to which historic peak and average metric values will affect calculations. These settings are a way to tune the Economic Scheduling Engine’s response to events in the environment. A higher weight for historic peaks or averages reduces the impact of current peaks or averages.

For example, assume you have applications that use 100% CPU for short transient events. To reduce the impact of these transients, you can set a higher value for **Weight for Peaks**. As a result, Turbonomic only responds to longer-lasting events of 100% CPU utilization.
The following table shows the default settings for overall Turbonomic settings.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight for Averages</td>
<td>50</td>
</tr>
<tr>
<td>Weight for Peaks</td>
<td>99</td>
</tr>
</tbody>
</table>

**Desired State**

The desired state for your environment is an n-dimensional sphere that encompasses the fittest conditions your environment can achieve. The multiple dimensions of this sphere are defined by the resource metrics in your environment. Metric dimensions include VMem, storage, CPU, etc. While the metrics on the devices in your environment can be any value, the desired state, this n-dimensional sphere, is the subset of metric values that assures the best performance while achieving the most efficient utilization of resources that is possible.

The Desired State settings define the center of the sphere as well as its diameter. This is a way for you to customize what Turbonomic considers to be the desired state.

Setting the center of the sphere chooses the priority for Turbonomic analysis. If you set the balance in favor of efficiency, Turbonomic tends to place more VMs on fewer physical hosts, and to give them storage capacity from fewer data stores. As a result, high utilization can have more impact on QoS. With a balance in favor of performance, Turbonomic tends to spread virtual loads across more physical devices. This can result in the provisioning of excess resources.

The diameter setting determines the range of deviation from the center that can encompass the desired state. If you specify a large diameter, Turbonomic will have more variation in the way it distributes workload across hosting devices.

As you move each slider, a tooltip displays the numerical value of the setting. **Center** indicates the percentage of resource utilization you want, within the range you specify as **Diameter**. For example, if you want utilization of 75%, plus or minus 10%, then you would set Center = 75 and Diameter = 20. Turbonomic recommends actions that tend toward this desired state much as possible, given the dependencies within the current environment.

**NOTE:** The setting for Target Utilization can have an effect on plans that you run. If you disable provisioning and suspension for hosts and datastores, then you should always set Center and Diameter to their default values. (For more information about hardware provisioning in plans, see Action Settings on page 227.)

The following table shows the default settings for Desired State:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center</td>
<td>70</td>
</tr>
<tr>
<td>Diameter</td>
<td>10</td>
</tr>
</tbody>
</table>

**Internal Topology Settings: Hyper-V**

In Hyper-V environments, it is possible that the Hyper-V management software can report that an entity has been removed when in fact it has not been. In that case, Turbonomic can remove the entity from its market representation of your environment, when in fact the entity is still present. With the **Number of Additional Polling Cycles** setting, you can direct Turbonomic to wait a specified number of polling cycles before acknowledging that an entity has been removed.
This is a special-case setting, and you should only use it if you are in contact with Turbonomic Support.

### Storage Settings

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Additional Polling Cycles</td>
<td>0</td>
</tr>
</tbody>
</table>

#### Storage Provisioned

Storage and DiskArray Overprovisioned Percentage set how much overprovisioning Turbonomic assumes when recommending actions for VM datastores and disk arrays. For example, if a datastore has a 30 GB capacity, and Storage Overprovisioned Percentage is set to 200, Turbonomic will treat the datastore as though it has a capacity of 60 GB, or 200% of the actual datastore capacity.

#### IOPS Capacity

You can specify the IOPS (IO operations per second) that your storage devices can support. **IOPS Capacity** is the setting for datastores. The various **Disk IOPS Capacity** settings (SSD Disk IOPS, 7.2k Disk IOPS, etc) are for the different types of physical drives that might be on a disk array. Turbonomic considers these settings when calculating utilization percentage. For example, assume IOPS Capacity of 500. If a storage device has 250 IOPS, then it is at 50% of capacity for that metric. (See **Utilization Constraints** on page 350 for information about how Turbonomic uses percentage utilized.)
**Latency**

This sets the maximum storage latency to tolerate on a datastore, in ms. The default setting is 100 ms.

Turbonomic measures the latency experienced by all VMs and hosts that access the datastore. Assume a default setting of 100 ms. If a datastore exhibits latency of 50 ms, then the Turbonomic will show latency utilization of 50%. (See Utilization Constraints on page 350 or information about how Turbonomic uses percentage utilized.)

**Wasted Storage Management**

You can make settings to control how Turbonomic tracks and reports on wasted storage in your environment. Wasted storage is any disk space devoted to files that are not required for operations of the devices or applications in your environment. Wasted storage may indicate opportunities for you to free up disk space, and provide more storage capacity to running VMs and applications.

The Disable Datastore Browsing setting disables wasted storage management — By default, the global setting is to Disable for the entire managed environment (Disable Datastore Browsing is checked for the Global scope).

**NOTE:** It’s possible that a single datastore can be managed by more than one instance of vCenter Server. Browsing over such a datastore can result in conflicting values for wasted storage in reports and in the Improve Overall Efficiency dashboard. You should not enable datastore browsing for a scope that includes such a datastore.

To enable the tracking of wasted storage for the full environment, enable this setting globally. When you do so, Turbonomic displays a Wasted Storage panel in the Improve Overall Efficiency dashboard. For information about how Turbonomic shows wasted storage, see Wasted Storage on page 93 in the Dashboards view. Enabling this globally also enables the Storage Wasted Allocations report, which you can then generate within 24 hours after you enable this setting.

If there are groups of datastores you don’t want to track for wasted storage, set the given scope and disable datastore browsing there. If you prefer not to use Turbonomic resources to track wasted storage, leave the global setting checked.

The settings for Directories to Ignore and Files to Ignore specify directories and files that Turbonomic will not consider when looking for wasted data storage space. Separate items in these lists with the OR bar (“|”).

**Lock VMs to Datastores**

The setting to lock VMs to a storage group specifies whether Turbonomic will respect storage group boundaries when moving a VM’s data to another datastore. This setting is only available when you have selected a datastore group. When this is enabled, if a VM’s data is currently on a datastore within the selected storage group, then any move of that data will be to a datastore that is in the same storage group.

**Controlling Shared-Nothing Migration**

If you have enabled storage moves and VM moves, Turbonomic can perform shared-nothing migrations, which move the VM and the VM’s data simultaneously. For example, assume a VM on a host also uses local storage on that host. In that case, Turbonomic can move that VM and move its data to a different host in a single action.

Shared-nothing migrations are available for any environments that support automation of both VM moves and storage moves. In addition, you must have the action modes for VM and storage moves set to Manual or Automated. If you meet these criteria, then all VM moves will take advantage of this feature.
It’s possible that you want to automate storage and VM moves, but you do not want to use shared-nothing migration. The **Lock VMs to Datastores** option supports this — Two use cases are:

- **Ensure data on shared storage does not migrate to local storage**
  Shared-Nothing migration can result in migrating data from shared storage to local storage. To ensure that your data remains on the shared storage, create a group of the shared datastores in question. Then set the scope of the Policy view to that group, and enable **Lock VMs to Datastores**.

- **Ensure data stays on the host’s local storage**
  Assume your VM uses local storage on a host, and you want to always keep that data local to the physical machine that hosts the VM.

  To ensure data stays local to the VM's host, create a group that contains the local datastores in question. Then set the scope of the Policy view to that group, and enable **Lock VMs to Datastores**. This ensures that the VM will only move to a host with a datastore in that group, and the VM's data will be local to the physical machine that hosts the VM.

**Action Modes**

When Turbonomic uncovers potential bottlenecks, over provisioning, or other issues, it can identify and perform actions that will prevent those issues from occurring, and keep the environment in the desired state. You can specify action modes that determine how Turbonomic handles the actions it identifies for switches, disk arrays, datastores, hosts, and VMs.

**Action Automation Support**

Turbonomic doesn’t automate the same actions equally for all technologies. This is because the underlying technologies do not provide the same degree of automation. For example, assume you set the Suspend action to be automated for all VMs. In that case, Turbonomic can automate suspension for VMs managed by vCenter and XenServer, but it cannot automatically suspend VMs managed by Hyper-V. This is because Hyper-V does not provide programmatic access to the Suspend VM operation. In this case, Turbonomic will recommend that you perform the suspension using the Hyper-V console.

The following table lists actions Turbonomic supports on each entity, showing whether the underlying technology supports automation, or recommended-only actions.

<table>
<thead>
<tr>
<th>General</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Disable All Actions</td>
</tr>
<tr>
<td>This is a global setting that you can use to turn off all action recommendations. Then you can enable actions as overrides to this setting, to automate specific actions for specific clusters or groups.</td>
</tr>
</tbody>
</table>
**Application Control Module Actions**

Turbonomic uses a Scaling Policy to determine the kinds of actions to recommend for application and database servers. The policy can be one of:

- **Provision**
  Recommend actions that provision a new application server (hosted on a new VM) to meet increasing demand, or terminate a server if demand falls off. This is horizontal scaling.

- **Resize**
  Recommend actions to resize the capacity of the application server or the VM that hosts it. This is vertical scaling.
  The resources to resize are:
  - Heap and Threads for the application server
  - vMEM and vCPU for the underlying VM

To access this setting, choose **Action > Application** from the **Category** tree, and then choose a group of application or database servers from the scoped list, or from your custom groups.

---

**Application Servers**

Turbonomic performs the following actions for application servers. Remember that if the Scaling Policy is set to Provision, it will not recommend resize actions, and if the Scaling Policy is set to Resize it will not recommend start, provision, or suspend actions.

<table>
<thead>
<tr>
<th>Action</th>
<th>WebSphere</th>
<th>WebLogic</th>
<th>JBoss</th>
<th>Tomcat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Provision — VMware, only</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Provision — Other hypervisors</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Suspend</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Resize down (heap)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Resize down (threads)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Resize up (heap)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Resize up (threads)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Database Servers

Turbonomic performs the following actions for database servers. Remember that if the Scaling Policy is set to Provision, it will not recommend resize actions, and if the Scaling Policy is set to Resize it will not recommend start, provision, or suspend actions. Also note, while Turbonomic does not automate actions directly on the database, it does automate actions on the underlying VM.

<table>
<thead>
<tr>
<th>Action</th>
<th>Oracle</th>
<th>SQLServer</th>
<th>MySQL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resize down (transaction log)</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Resize down (MEM and connections capacity)</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Resize up (transaction log)</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Resize up (MEM and connections capacity)</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
</tbody>
</table>

Microsoft Applications

Turbonomic performs the following actions for Microsoft applications. Remember that if the Scaling Policy is set to Provision, it will not recommend resize actions, and if the Scaling Policy is set to Resize it will not recommend start, provision, or suspend actions.

<table>
<thead>
<tr>
<th>Action</th>
<th>Exchange</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td>✔️</td>
</tr>
<tr>
<td>Provision</td>
<td>✔️-</td>
</tr>
<tr>
<td>Suspend</td>
<td>✔️</td>
</tr>
<tr>
<td>Resize down (heap)</td>
<td>✔️</td>
</tr>
<tr>
<td>Resize down</td>
<td>✔️-</td>
</tr>
<tr>
<td>Resize up (heap)</td>
<td>✔️</td>
</tr>
<tr>
<td>Resize up</td>
<td>✔️-</td>
</tr>
</tbody>
</table>
VM Actions

For resize on VMs, actions can change resources in the following ways:

- **Resize resource capacity**
  Change the capacity of a resource that is allocated for the VM. For example, a resize action might recommend increasing the VMem available to a VM.

- **Resize resource reservation**
  Change the amount of a resource that is reserved for a VM. For example, a VM could have an excess amount of memory reserved. That can cause memory congestion on the host — A resize action might recommend reducing the amount reserved, freeing up that resource and reducing congestion.

- **Resize resource limit**
  Change the limit that is set on the VM for a resource. For example, a VM could have a memory limit set on it. If the VM is experiencing memory shortage, an action that decreases or removes the limit could improve performance on that VM.

### Action

<table>
<thead>
<tr>
<th>Action</th>
<th>vCenter</th>
<th>XenServer</th>
<th>Hyper-V</th>
<th>RHEV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td>![vCenter]</td>
<td>![XenServer]</td>
<td>![Hyper-V]</td>
<td>![RHEV]</td>
</tr>
<tr>
<td>Move</td>
<td>![vCenter]</td>
<td>![XenServer]</td>
<td>![Hyper-V]</td>
<td>![RHEV]</td>
</tr>
<tr>
<td>Suspend</td>
<td>![vCenter]</td>
<td>![XenServer]</td>
<td>![Hyper-V]</td>
<td>![RHEV]</td>
</tr>
<tr>
<td>Terminate (Remove)</td>
<td>![vCenter]</td>
<td>![XenServer]</td>
<td>![Hyper-V]</td>
<td>![RHEV]</td>
</tr>
<tr>
<td>Provision</td>
<td>![vCenter]</td>
<td>![XenServer]</td>
<td>![Hyper-V]</td>
<td>![RHEV]</td>
</tr>
<tr>
<td>Storage Move</td>
<td>![vCenter]</td>
<td>![XenServer]</td>
<td>![Hyper-V]</td>
<td>![RHEV]</td>
</tr>
<tr>
<td>Reconfigure (Change network and storage configurations)</td>
<td>![vCenter]</td>
<td>![XenServer]</td>
<td>![Hyper-V]</td>
<td>![RHEV]</td>
</tr>
<tr>
<td>Resize down (Change VCPU and memory capacities)</td>
<td>![vCenter]</td>
<td>![XenServer]</td>
<td>![Hyper-V]</td>
<td>![RHEV]</td>
</tr>
<tr>
<td>Resize up (Change VCPU and memory capacities)</td>
<td>![vCenter]</td>
<td>![XenServer]</td>
<td>![Hyper-V]</td>
<td>![RHEV]</td>
</tr>
<tr>
<td>Enforce Non Disruptive Mode</td>
<td>![vCenter]</td>
<td>![XenServer]</td>
<td>![Hyper-V]</td>
<td>![RHEV]</td>
</tr>
</tbody>
</table>

**NOTE:** VM actions include the modifier, Enforce Non Disruptive Mode. When you enable this modifier, Turbonomic ensures that for Automated and Manual modes any resize actions that can be executed will not require a reboot or any other disruption to the affected VM. If the action will disrupt the VM, Turbonomic posts the action in Recommended mode. If it will not cause any disruption, then Turbonomic can post it as Automated or Manual. For more information, see Enforce Non Disruptive Mode on page 361.
Host (PM) Actions

<table>
<thead>
<tr>
<th>Action</th>
<th>vCenter</th>
<th>XenServer</th>
<th>Hyper-V</th>
<th>RHEV</th>
<th>UCS (blades only)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Suspend</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Terminate</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Provision</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
</tbody>
</table>

Storage (Datastore) Actions

Storage actions for environments that do not include Disk Array Storage Controllers as targets:

<table>
<thead>
<tr>
<th>Action</th>
<th>vCenter</th>
<th>XenServer</th>
<th>Hyper-V</th>
<th>RHEV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provision</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
</tbody>
</table>

Turbonomic supports the following actions for datastores on disk arrays:

<table>
<thead>
<tr>
<th>Target</th>
<th>Move</th>
<th>Provision</th>
<th>Resize (up)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dell Compellent</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>HP 3Par</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>NetApp ONTAP</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>NetApp ONTAP</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>VNX</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>VMAX</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Nutanix</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Pure Storage</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>XTremIO</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
</tbody>
</table>
**Disk Array Actions**

For environments that have Disk Array Storage Controllers as targets:

<table>
<thead>
<tr>
<th>Target</th>
<th>Move</th>
<th>Provision</th>
<th>Resize (up)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dell Compellent</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HP 3Par</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NetApp ONTAP</td>
<td>✅</td>
<td>✅ (C-Mode, only)</td>
<td>✅</td>
</tr>
<tr>
<td>VMAX</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VNX</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nutanix</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pure Storage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pure Storage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XTremio</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Storage Controller Actions**

Actions for individual Disk Array Storage Controllers:

<table>
<thead>
<tr>
<th>Target</th>
<th>Provision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dell Compellent</td>
<td>✅</td>
</tr>
<tr>
<td>HP 3Par</td>
<td>✅</td>
</tr>
<tr>
<td>NetApp ONTAP</td>
<td>✅</td>
</tr>
<tr>
<td>VMAX</td>
<td>✅</td>
</tr>
<tr>
<td>VNX</td>
<td>✅</td>
</tr>
<tr>
<td>Nutanix</td>
<td>✅</td>
</tr>
<tr>
<td>Pure Storage</td>
<td>✅</td>
</tr>
<tr>
<td>Pure Storage</td>
<td>✅</td>
</tr>
<tr>
<td>XTremio</td>
<td>✅</td>
</tr>
</tbody>
</table>
Switch Actions

For environments that have Fabric Managers as targets:

<table>
<thead>
<tr>
<th>Action</th>
<th>Cisco UCS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td></td>
</tr>
<tr>
<td>Move</td>
<td></td>
</tr>
<tr>
<td>Suspend</td>
<td></td>
</tr>
<tr>
<td>Provision</td>
<td></td>
</tr>
<tr>
<td>Resize</td>
<td></td>
</tr>
</tbody>
</table>

Virtual Datacenter Actions

For direct actions on VCloud Director and CloudStack virtual datacenters, Turbonomic only supports resize actions. However, Turbonomic does automate actions for the underlying entities (VMs and hosts) that are managed by the virtual datacenter.

<table>
<thead>
<tr>
<th>Action</th>
<th>VCD</th>
<th>CloudStack</th>
<th>VMM</th>
<th>OpenStack</th>
</tr>
</thead>
<tbody>
<tr>
<td>Move</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Suspend</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Terminate</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Provision</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Resize (Change VCPU and memory capacities)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Action Mode Settings

For each action Turbonomic can perform you can specify the action mode, or how it will handle the action. Turbonomic supports the following action modes:

- Disabled — Do not recommend or perform the action
- Recommended — Recommend the action so a user can perform it using the given hypervisor or by other means
- Manual — Recommend the action, and provide the option to perform that action through the Turbonomic user interface
- Automated — Turbonomic performs the action automatically
The following figure shows override settings for a group of Development hosts. In this case, Turbonomic will automatically start physical machines in this group. To set modes for all hosts in the environment, you should make global host settings for the given actions (see Global Settings on page 326).

Setting Action Modes for a Group

To get the best results from Turbonomic’s Intelligent Workload Management, you should set as many actions as possible to Automated. To do that, you should set the actions to Automated at the global level. If some clusters run applications that are highly critical, you can override the global setting for those clusters, and set them to Manual.

Enforce Non Disruptive Mode

VM actions include the modifier, Enforce Non Disruptive Mode. When you enable this modifier, Turbonomic ensures that for Automated and Manual modes any resize actions that can be executed will not require a reboot or any other disruption to the affected VM. If the action will disrupt the VM, Turbonomic posts the action in Recommended mode. If it will not cause any disruption, then Turbonomic can post it as Automated or Manual.

For example, with VMware technologies you must have VMware Tools installed to enable hot resize of a VM. Assume you have VMware Tools installed on the guest OS for VM-A, but not for VM-B, and you have set Resize up to Automated for the cluster:

- If you enable this modifier for VM actions:
  Turbonomic will automate resize actions for VM-A, but will only recommend resize actions for VM-B.

- If you do not enable this modifier for VM actions:
  Turbonomic will automate resize actions for VM-A and VM-B.
If you have set the actions to Manual, the effect is the same — Turbonomic will post the manual actions to the To Do list only if they are not disruptive to the VM’s operation. Otherwise the actions will be Recommended. Enforcing non disruptive mode is a way to safely automate resize actions for VMs.

In addition to the Enforce Non Disruptive Mode setting, Turbonomic automatically discovers the VMs that support Hot Add of CPU and Memory, and places these VMs in groups. You can use these groups the same as you would any other groups.

Non Disruptive Groups — Found in the Groups navigation tree

You can enforce non disruptive mode as a general policy, and then schedule action windows to automate resize actions during downtimes. Be aware that scheduled actions do not respect the enforced non disruptive mode — Scheduled resize actions will execute during the scheduled window even if they require a reboot. This is useful for setting up certain action behaviors, but you must be aware that enforced non disruptive mode has no effect on scheduled actions.

Scheduling Action Restriction Windows

For some clusters or groups you might want to automate actions, but only during off-peak hours. Turbonomic includes a scheduling utility that you can use to restrict actions to a time-specific window for a given scope. You can use this to allow or disallow automation for a given window of time.

**NOTE:** The Turbonomic Economic Scheduling Engine continually calculates actions that cause your environment to converge on the desired state. These actions are in response to the environment at a given point in time. When you restrict the automation of a given action to a certain time window, Turbonomic will only calculate and perform actions that are appropriate for the environment during that scheduled window. You should review manual actions during time periods when automation is restricted, so you can manually adjust the environment in response to peak states.

By default, the global settings for all actions have no restriction windows set for them. If you globally set the VM Move action to Automated, then Turbonomic will automatically execute any recommended VM move actions whenever they arise — 24 hours a day, 7 days a week. Action restriction widows modify this, for global policies or as overrides to global policies scoped to specific groups. (For information about policy scope, see Global Settings on page 326.)

For example, assume you want to always automate Resize actions for all but the most critical VMs. You would set Resize VMs to *Automated* at a global level. Then for a critical cluster, you could set a restriction window that overrides the automation (sets Resize to Manual) during peak hours (9:00 to 5:00 M-F).

You can also restrict action modes in reverse fashion. For example, if you want to automate Resize for only one set of VMs, you can set Resize to *Manual* at the global level, and for one cluster schedule it to be *Automated* for a given time window.
NOTE: You can enforce non-disruptive mode as a general policy, and then schedule action windows to automate resize actions during downtimes. Be aware that scheduled actions do not respect the enforced non-disruptive mode — Scheduled resize actions will execute during the scheduled window even if they require a reboot. This is useful for setting up certain action behaviors, but you must be aware that enforced non-disruptive mode has no effect on scheduled actions. For more information, see Enforce Non Disruptive Mode on page 361.

Creating a Simple Action Restriction Window

To schedule a time window for an automated action:

1. Set the scope for this action.

2. Open the Action Restriction Windows editor.
   Click View Schedule to open the restrictions windows panel and then click New Action Restriction Window. You can select the window start date beforehand in the calendar, or set it as you create the policy.
3. **Specify the settings for this restriction window.**

The date range determines how many days the window will be “open”, or be in effect. You should keep the following points in mind:

- A non-recurring window has a start date, and no end date. The window will be open for the day you specify as the start date, and finish at the end of that day.
- For recurring windows you specify a date range. The window will open during times within that range.
- For daily recurrence the window will be open for the hours you specify.
- For weekly recurrence the window will be open on the days of the week that you specify, for the hours you specify.
- For monthly recurrence, the window will open one day each month — on the day you set for the Start Date. But the window recurrence remains in effect until the End Date. For example, if you specify January 1st 2013 for the start date, and December 31st 2013 for the end date, the window will be open on the first day of each month for that year.

For any given day, the window can be in effect from 00:00 through 24:00. If you want an action mode to span two days, you must specify two restriction windows. For example, to enable automation from 22:00 to 06:00, you must create two windows; one from 22:00 to 24:00, and another from 0:00 to 06:00.

Note that you can set different label colors for your restriction windows. This is a good way to track windows of a similar type. For example, you could use red for windows on critical clusters, and green for windows on prototyping clusters.

![Create Action Restriction Window](image-url)

- **Scope of restriction window.**
- **Set name and label color.**
- **Set action parameters.**
- **Specify recurrence parameters.**
- **Set start, and for recurring windows, end date. Perpetual windows have no end date.**
- **Set the time of day for the window to take effect.**
- **Provide an optional description.**
- **Specify more action restrictions for this window.**
4. When you have the settings you want, click Create.

The restriction window appears in the calendar. When you select a day in the calendar, the Action Restriction Windows list shows all the items for that day. Hover over an item to display details in a tooltip.

**Tie-break Results**

It’s possible that different restriction windows will affect the same resource instance. In that case the most conservative setting wins. The following list is from most conservative to most aggressive:

- Disabled
- Recommended
- Manual
- Automated
**Action Script Settings**

Action Scripts provide a script interface that can add custom processing to Turbonomic actions at the following entry points:

- **Pre** — Before executing an action
  Example: Send an email to notify that the action has been recommended.

- **Replace** — Execute the script instead of executing the Turbonomic action
  Example: Instead of provisioning a new VM, post the request to an internal ticketing system.

- **Post** — After executing an action
  Example:
  Send an email to notify that the action was executed.

- **Clear** — When the conditions that elicit an action recommendation have changed so that the action is no longer viable
  Example: Remove a Provision VM Request from a ticketing system (because the VM is no longer needed).

**Enabling Action Scripts**

You can set up action scripts to run on specific groups of entities. For example, you can enable the PRE-MOVE action script for one group of VMs, and enable the CLEAR-MOVE action script for a different group.

To enable scripts, open the Action policies for VMs, and select a VM group. Then choose which scripts to enable.
**Creating Action Scripts**

When you enable an action script to run, you do not provide the script name. Instead, you create one script for each type of action, entity type, and entry point. The script name captures this to specify which action the script responds to, as follows: `<EntryPoint>_<Action>_EntityType>.sh`

Some example script names are:

- `PRE.Move_VirtualMachine.sh`
  `<Pre>_Move_<VirtualMachine>`

  Execute the script when the move action appears as a recommendation.

- `RESIZE_VirtualMachine.sh`
  `<Replace>_Resize_<VirtualMachine>`

  Execute the script instead of executing the Turbonomic Resize action. Note that you can include a REST API call to accept the action or to reject it as part of the script.
POST_RECONFIGURE_VirtualMachine.sh
<Post>_<Reconfigure>_<VirtualMachine>

Execute the script after a Reconfigure action. Note that a POST script executes after an action has succeeded or failed.

CLEAR_MOVE_VirtualMachine.sh
<Clear>_<Move>_<VirtualMachine>

Execute the script after a Move action has cleared.

The supported entry points and actions are:

<table>
<thead>
<tr>
<th>Entry Point</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>Move</td>
</tr>
<tr>
<td>Replace</td>
<td>Change</td>
</tr>
<tr>
<td>Post</td>
<td>Reconfigure</td>
</tr>
<tr>
<td>Clear</td>
<td>Resize</td>
</tr>
</tbody>
</table>

To pass information into the script, Turbonomic sets values to environment variables. You can reference these environment variables in your scripts. For example, assume you want to send an email that includes the name of the VM that is an action target. You can get that name via the VMT_TARGET_NAME environment variable.

Turbonomic sets the following environment variables for an action:

- **VMT_TARGET_INTERNAL**
  The internal name of the VM this action will affect.

- **VMT_TARGET_NAME**
  The VM’s display name.

- **VMT_CURRENT_INTERNAL**
  The internal name for the current configuration or placement.

- **VMT_CURRENT_NAME**
  The display name for the current configuration or placement.

- **VMT_NEW_INTERNAL**
  The internal name for the new configuration or placement.

- **VMT_NEW_NAME**
  The display name for the new configuration or placement.

- **VMT_ACTION_INTERNAL**
  The UUID for the proposed action. You can use this to access the action via the REST API.

- **VMT_ACTION_NAME**
  The name of the action.
Application Priority

Application priority determines the conditions under which Turbonomic recommends suspending or terminating a VM. Suspending a VM means powering it down, but leaving it in the hypervisor’s list of managed VMs. Terminating a VM means removing it from the hypervisor. When Turbonomic recommends that you terminate a VM, this indicates that the VM is dormant, and no applications are running on it.

**NOTE:** Your environment may include some VMs that you never want to terminate. You might think that you can set all applications to Mission Critical as a way to direct that Turbonomic never recommends termination. In fact, Turbonomic can recommend that you terminate a dormant VM that has Mission Critical applications on it. To ensure VMs never terminate, disable the Terminate action for all VMs or for a group of VMs. For more information, see Action Modes on page 354.

Turbonomic monitors resource consumption, and works to keep Mission Critical applications running. If a Mission Critical application needs resources and none are immediately available, Turbonomic may recommend suspending non-critical VMs to free up resources, which makes them available to the critical application.

By default, all applications are **Mission Critical** (see the Global Setting for Application Priority). You can specify the priority for applications to be:

- **Mission Critical**
  The focus of Turbonomic is to keep these applications running. For example, it will never suggest suspending the VM that hosts a mission critical application.

- **Normal**
  Turbonomic may suggest suspending a VM that hosts normal applications to free up resources that a mission critical application might need.

- **Low**
  Turbonomic does not consider the needs of low priority applications when calculating the desired state for your environment.

You specify application priority for groups. The most important groups for application priority are:

- **Applications**
  Each group is named for a discovered application, and contains all the instances of that named application.

- **Physical Machines**
  For each physical machines, all the applications running on that machine.

If a VM has any Mission Critical applications on it, Turbonomic will always try to find resources for that VM, and will never recommend suspending it in order to free up resources. Turbonomic can recommend terminating a VM with Mission Critical applications, if the VM is truly dormant.

For a VM with all Normal applications, if the VM uses resources that are needed elsewhere, then Turbonomic may recommend suspending this VM. For a VM with Low-priority applications, it can recommend terminating the VM to free up resources.
NOTE: Turbonomic defines a Guest Load application for each VM. The Guest Load represents all consumption that Turbonomic cannot assign to a specific application. This includes processes for the VM’s operating system. Turbonomic ignores Guest Load priority when deciding how to free up resources. However, if a VM has only the Guest Load application on it, and that application is set to Low Priority, then Turbonomic may recommend terminating that VM.

The following figure shows override settings for the applications hosted by a specific physical machine. To set priority for all applications in the environment, you should make global settings for Application Priority (see Global Settings on page 326).

Setting Priority for the Applications on a Specific Host

Tie-break Results

When the same resource instance has conflicting settings, the most conservative setting wins. The following list is from most conservative to most aggressive:

- Mission Critical
- Normal
- Low

Discovery Policies

Turbonomic sweeps through your environment to discover the inventory items (applications, VMs, hosts, data stores, etc.) in your environment. It performs initial discovery when you first start it and add target hypervisors, and events that can change the inventory trigger subsequent discovery. You can set policies to direct:

- "ApplicationDiscovery" in the Target Configuration Guide - Application Signatures (how Turbonomic recognizes application processes), and credentials to access the VMs that host the applications
- Load Balancer Discovery on page 375 - Mapping application signatures to virtual applications
- vCenter Annotation Grouping on page 376 - vCenter tags Turbonomic can use for grouping
Application Discovery

Turbonomic discovers applications via WMI (for applications on Windows VMs) and SNMP (for applications on other VMs). To keep the list of discovered applications current, Turbonomic polls the environment every 20 minutes.

**NOTE:** For SNMP monitoring, Turbonomic receives trap messages via port 162.

For Turbonomic to perform application discovery, it requires:

- The appropriate agent running on the given VM
  - For VMs running Windows, the VM must have a WMI agent running on it
  - For SNMP discovery, VMs must run Linux, and the VM must have a running SNMP agent
- "VM Access Credentials" in the Target Configuration Guide for the given protocol (WMI, or SNMP)
- "Application Signatures" in the Target Configuration Guide to identify the applications you want to discover and manage

Application signatures identify running processes that belong to a specific application. Turbonomic ships with a default set of application signatures — you can add others to the list.

**Default Application Discovery**

By default, Turbonomic discovers the following applications:

<table>
<thead>
<tr>
<th>Application Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSSQL</td>
<td>Microsoft SQL Server</td>
</tr>
<tr>
<td>IIS</td>
<td>Microsoft Internet Information Services</td>
</tr>
<tr>
<td>LSASS</td>
<td>Microsoft Active Directory services</td>
</tr>
<tr>
<td>XenDesktop</td>
<td>Citrix XenDesktop</td>
</tr>
<tr>
<td>VMView</td>
<td>VMware View</td>
</tr>
<tr>
<td>SharePoint</td>
<td>Microsoft Sharepoint Server</td>
</tr>
<tr>
<td>Guest Load</td>
<td>The resources that Turbonomic has not assigned to any specific application (for more information, see Guest Load on page 138)</td>
</tr>
</tbody>
</table>

**Application Signatures**

An application signature is a search string that matches process names. A single application may launch a number of processes to perform its job. Rather than tracking each process as a separate application, Turbonomic can group these processes and monitor the group as a single application.

Each process will have a unique name, but the process name typically includes part of the name of the main application, or some other text that identifies it as part of the overall application. This name that’s shared in all the process names is the application signature.

Note that the same application signature is valid for all the protocols application discovery supports. When you make the list of signatures, you do not need to identify what protocol will be used to monitor them. As Turbonomic scans a VM for application processes, it uses the full list of signatures, no matter what the operating system is for that VM.
To specify an application signature:

1. **Select Application Discovery to display the editor.**
2. **Create a new application signature.**
3. **Provide an application name.**
   Application names should be unique. If you provide a name that is identical to a default application name (as described in "Default ApplicationDiscovery" in the Target Configuration Guide), then Turbonomic will use your custom application signature when grouping application processes.
4. **Enter regular expressions to identify the characters that must be in an application process name.**
   You can also specify characters that must not be in the process name. Any process name that satisfies the application signature identifies a member of the given application.
   For example, assume the following strings:
   - Match: `s.*`
   - No-match: `sq.*`
   In this case, the signature would match all process names that begin with 's', except those that begin with 'sq'.

---

**Creating Application Signatures**

<table>
<thead>
<tr>
<th>Enat</th>
<th>Name</th>
<th>Match</th>
<th>No-Match</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSSQL</td>
<td>sqlservr</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IIS</td>
<td>inetinfo.*</td>
<td>Iene</td>
<td></td>
</tr>
<tr>
<td>LSASS</td>
<td>lsass</td>
<td></td>
<td></td>
</tr>
<tr>
<td>XenDesktop</td>
<td>WorkstationA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VMView</td>
<td>vmware-svr-g</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sharepoint</td>
<td>WSSADMIN.*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SQL</td>
<td>sql.*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Click to save your changes*  
*Provide an application name*  
*Enable/disable discovery for each application*  
*Enter match and no-match strings*
**VM Access Credentials**

To discover and monitor applications, Turbonomic uses WMI on VMs running Windows, and SNMP on other VMs. You must provide valid credentials for any of the VMs that host applications you want to monitor.

---

**NOTE:** For WMI application discovery and management, the given target hypervisor requires specific permissions that allow WMI access. For more information, see the Green Circle article, ApplicationDiscoverySetup.

You select VM groups and set specific credentials for those VMs. You can select a top-level group to provide one set of credentials for all the VMs in the inventory, and then select lower-level groups to override the more general settings (for more about settings overrides, see Policy Scope on page 326).

Note that you set credentials for groups of VMs, not for individual VMs. When discovering applications on the VMs in a group, Turbonomic assumes all those VMs honor the same credentials. If the VMs in default groupings don’t all honor the same credentials, you can create custom groups to keep the same credentials together. For information about creating custom groups, see “GroupManagement” in the Target Configuration Guide.

You can specify both WMI and SNMP access credentials for the same group. For example, if the group includes VMs running both Windows and Linux, you should specify a valid Windows admin account, valid Linux credentials (SNMP community). For all VMs in the group, if they are running Windows then they must honor the provided admin credentials; for other operating systems, they must honor the provided SNMP credentials.

The settings to make are:

- **Username**
  A user with admin rights on the machine.

- **Password**
  That user’s password.

- **SNMP Community**
  A community string that is valid on the machine.

- **Retry Interval**
  The minimum amount of time to wait before trying to log into a machine again after a login timeout. It’s common to configure machines so they will lock out any login attempts after a certain number of unsuccessful attempts. The lockout typically stays in effect for a given time (15 or 30 minutes, for example). Turbonomic logs in to poll for applications every 20 minutes. You should set the retry interval to a value larger than the lockout time that is specified for the machine. This will avoid unnecessary lockouts in case the credentials you provide here are incorrect. The default retry interval value is 60 minutes.

- **Docker Port (if you have a license for the Container Control Module)**
  The port that the Docker API responds to.

The following figure shows settings for the applications that run on VMs in a specific cluster. To set credentials for all VMs in the environment, you would select a top-level item in the Scope list.
Setting Discovery Credentials for Applications in a Cluster

Credentials are inherited. For example, you can select the top-level group **Virtual Machines** and provide one set of credentials. Then you can select lower-level groups and provide override credentials. The lowest-level credential specification wins.

**NOTE:** You should avoid a situation where the same VM is a member of two different groups that are not in a nesting relationship. In this case, Turbonomic cannot reliably determine which group’s credentials it will use.

The following image shows settings for all VMs (the top-level group). This means that by default Turbonomic will use these credentials when it performs application discovery on a VM:

The next image shows settings for a specific VM. You cannot make settings on individual VMs, but you can see the username, and you can also see which group setting is in effect. In this case, Turbonomic will use these credentials for application discovery on that VM.
The Application Discovery table shows where this VM’s credentials are set. In this case, they are set in the top-level group (Virtual Machines). It’s possible for one VM to belong to many groups. If you need to change the credentials for this machine, you know where they are currently set. You can create another group to set different credentials for this VM.

### Load Balancer Discovery

Load balancers use virtual applications to manage requests to a defined set of running applications. Virtual applications are divided by service type. Turbonomic discovers the service types that are defined for the load balancers in your environment, and maps the set of applications each service type balances.

To define which applications Turbonomic associates with load balancer service types, you assign an application signature to a port, and Turbonomic will map that signature to the load balancer that manages applications of that type over the given port. The application signatures should identify applications that are currently bound to specific load balancers. (Application binding to load balancers is part of the load balancer configuration.) This provides a general mechanism to map applications to load balancers — you only need to know the appropriate application signature, and the port number.

**NOTE:** If you have enabled the Hybrid Cloud Control Module, and you have specified an AWS target that includes Elastic Load Balancing, then Turbonomic can discover that load balancer and recommend balancing across the cloud for workload bursts.

To assign signatures to a load balancer, you must first have defined appropriate signatures for the specific applications running in your environment. For information about defining application signatures, see “ApplicationDiscovery” in the Target Configuration Guide. When you have the appropriate application signatures, assign them to load balancer ports as follows:

1. **Choose Discovery > Load Balancer in the Category list.**
   A list of discovered load balancer ports appears. These are on the load balancers you set up as targets in the Admin view (see "Adding Load Balancers as Targets" in the Target Configuration Guide).

2. **Assign application signatures to a load balancer ports.**
   Assign already defined signatures to the each port. Turbonomic will resolve these signatures to the appropriate load balancer.
Assigning Application Signatures to Load Balancer Ports

vCenter Annotation Grouping

vCenter Server annotations are a way for users to classify their VMs according to custom names. For example, the vCenter administrator may use tags for Department, Owner, and Team. Each one of these tags is a way to classify the VMs. The administrator can then assign values to each tag, which further classifies the VMs. For example, the VMs can be grouped into two departments as a way to distinguish VMs for Sales from VMs for Development.

Turbonomic can use these annotations to manage vCenter VMs in groups. The following figure shows a departmental group. This corresponds to the VMs in vCenter that have been given the value Development for their Department annotations. Note that Turbonomic fully recognizes these groups. You can set scope (for user accounts or plans), generate reports, and use other group-related features.

To specify how Turbonomic discovers annotations, display VC Annotations and enter a string. The string gives the name for each annotation, separated by an OR bar. Do not include spaces at either side of the separator.
Specifying Annotation Names

Infrastructure Cost

Often you will have different classes of hardware to host your environment, and you will want to reserve more expensive hardware for critical use. For example, you might reserve more expensive hosts to run business-critical applications, and reserve lower-cost hardware for your development environment. In that case, you would want Turbonomic to place applications accordingly — critical applications on these higher-priced hosts, and development applications on the lower-cost machines.
Assigning a Host Template to the Infrastructure Cost Policy

With Infrastructure Cost policies, you create templates that approximate your different classes of machines, and then assign those templates to the policies. Turbonomic then discovers which machines best match these templates, and assigns the machines to associated groups. For example, if you create a Small, a Medium, and a Large host template, Turbonomic creates three groups — PMs_Small, PMs_Medium, and PMs_Large. It then assigns all the hosts in your environment to these groups, according to which template most closely describes each host.

When you assign a template to an Infrastructure Cost policy, you can check which machines in your environment match the template settings. This shows you which machines would be in the group for that template.
Creating an Infrastructure Cost Policy

To create an Infrastructure Cost policy:

1. Choose the device type you want — Host or Storage.
2. Choose the templates you want to add to the policy.
   You can choose an existing template from the template catalog, or create a new one.
3. Edit the template.
   Specify the following:
   • Template name and description
   • Price — You should specify a price that approximates your hardware cost as closely as possible. Currently, this price appears in generated reports. In future versions of Turbonomic the price might be used for other calculations.
   • Capacity — Do your best to approximate the capacity for the class of hardware you’re describing. Turbonomic uses these values to decide which group to put each device into. If a machine doesn’t exactly match any templates in the policy, Turbonomic assigns the machine to the closest match possible.
   • Add to Infrastructure Cost Policy — Turn on this check box to add the template to the policy. For each template that you enable, Turbonomic creates an associated group. (Note: If no machines match the given template, then the group will not appear in the GUI.)
4. Apply the changes.
   Click Apply to assign the template to the policy.
Using the Infrastructure Cost Policy

Infrastructure cost policies assign hardware to groups. The groups appear in the By Cost folder. When you set scope to a dashboard or a Workload Placement policy, you can select these or other groups.

Setting Scope to a Group by Cost

You can use these groups with the following Turbonomic features:

- **Dashboards in The Dashboards View on page 82**
  You can use Infrastructure Cost groups to set the scope of dashboards on the Dashboards view. In this way, you can save custom dashboards that only show information about a specific class of hardware.

- **Workload Placement Segments on page 336**
  With Workload Placement policies, you can ensure that certain VMs will always be placed on hardware of a certain class, or you can specify that certain VMs never get placed on a class of hardware.
Cluster Capacity Configuration

The Cluster Capacity dashboard calculates how many VMs you can safely add to the hosts or datastores in a cluster. To make this calculation, it runs planning scenarios that take into account all the conditions in your current environment. The result shows VM headroom for a given cluster.

To calculate VM headroom, the plan must assume each additional VM has been allocated a certain capacity for its resources. To accomplish this, the plan uses a VM template as a profile for the VMs that fill the cluster’s headroom.

The Cluster Capacity policy sets which VM template to use in the plan. Turbonomic can use the following types of templates:

- **Dynamic Templates**
  For each host cluster, Turbonomic calculates a template that represents the average VM in the cluster. It generates the average template daily — this keeps the template up to date when Turbonomic runs the plan to calculate headroom.

- **Discovered Templates**
  Turbonomic creates a number of VM Templates automatically as it discovers source VM data on the target hypervisors. These templates represent typical VMs that can be deployed from the given hypervisor manager.

- **Authored Templates**
  You can create your own VM templates to represent typical workload, or to represent hypothetical workload that you might want to try out in a planning scenario.

By default, Turbonomic uses dynamic templates to calculate cluster capacity data. Each cluster that is configured to use a dynamic template will have an override that sets the dynamic template for its cluster capacity configuration.

To configure cluster capacity, you can set a global VM template or set overrides for specific clusters in your environment:

- To set a template, choose an item from the drop-down list.
- To create a new template or edit an existing one, click to open the Template Catalog.

A cluster configured to use its dynamic template
By default, Turbonomic runs Cluster Capacity plans on 10 clusters a night. To specify a different number of plans to run, select the Global scope and change the value of the `numClusters` setting.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>templateName</code></td>
<td>Microsoft_SQL2008-mec</td>
</tr>
<tr>
<td><code>numClusters</code></td>
<td>15</td>
</tr>
</tbody>
</table>

### Email and Trap Notification

You can set up email and SNMP trap notifications for problems that arise on VMs, hosts, or data stores. Turbonomic can send notifications when problems occur and when they’re cleared. For example, you can set up a notification to your email address whenever there’s a Discovery problem, or an SNMP trap to your network management application whenever there’s a monitoring problem.

### Message Format

You can define the content of Email notification messages, as well as the `From` address for each message. To make these settings, select the `Email / Trap Notifications` category and make Global settings.

Edit these fields to specify the `To` and `From` addresses, and the message content.
The **From** address identifies the sender, and will be used for any replies to an email notification. If you leave this field blank, the **From** address will be the email address that is associated with the Turbonomic license installation.

**NOTE:** The **From** address also identifies the sender for report subscriptions. For more information about report subscriptions, see Managing Subscriptions on page 391.

When you define message content, you enter format variables and line breaks to determine what the message will include. For example, the following message format:

```
{6}: {5} \nDatastores: {9}\nTarget: {7}\nEvent: {0} - {4}\nCategory: {1}\nSeverity: {2}
```

Results in the following email message:

PhysicalMachine: myMachine.corp.mydomain.com  
Datastores: No value  
Target: 10.10.172.203  
Category: Workload Placement  
Severity: MINOR  
State: NOTIFY

The message format variables for a message are:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>{0}</td>
<td>Event type - The problem name. For example, “WorkloadBalance”.</td>
</tr>
</tbody>
</table>
| {1} | Sub category - One of:  
| | • Performance Bottlenecks  
| | • Storage Management  
| | • Workload Placement  
| | • Green IT  
| | • Configuration Management  
| | • Over Provisioning  
| | • Capacity Management |
| {2} | Severity - One of:  
| | • Critical  
| | • Major  
| | • Minor |
| {3} | State - Can be NOTIFY or CLEAR. |
| {4} | Description - A full description of the problem. |
| {5} | Affected entity - The name of the VM, host, or datastore associated with the problem. |
| {6} | Class name - The type of device that registers this problem. Can be one of:  
| | • VirtualMachine  
| | • PhysicalMachine  
| | • Datastore |
| {7} | Target - The IP address or name of the hypervisor that manages the affected devices. |
Notification Setup

You can set up notification for all the devices in your environment, or you can select defined groups and set specific priorities for those devices. (For information about defining custom groups, see “GroupManagement” in the Target Configuration Guide.)

For each notification, you can specify:

- **Type**
- **Address**

You can provide multiple addresses as a comma-separated list.

- **Email** — Provide the email address that will receive the notification.
- **SNMP Trap** — Provide the IP address of the device that will receive the notification.

Turbonomic sends these notifications to port 162.

**Setting Up Email Notifications for a Group**

When you set up notifications, you can choose from the following categories of events (click the cell in the Type column to make your choice):

- **Problem** - Issues Turbonomic identifies within your virtual environment
- **Discovery** - Issues that occur as Turbonomic performs discovery
- **Monitoring** - Issues that affect Turbonomic as it monitors your environment
- **Control** - Issues that affect Turbonomic as it performs recommended actions
• Mediation - Communication issues that arise when Turbonomic sends commands to discover, monitor, or change your environment
• Healthcheck - Issues that affect Turbonomic performance. These issues are discovered via periodic Turbonomic health check tests
• InterAppliance - Issues that occur on an aggregating server as Turbonomic communicates with target Turbonomic servers

In the **Severity** field you specify which events of the given category should trigger a notification.

In the **Notify State** field you choose to notify when the event occurs (NOTIFY) when it is cleared, or both.

## Retention Configuration

Turbonomic gathers metrics from your environment, and stores them to provide historical reports. To optimize data storage, it consolidates the data into three groups — Hourly, Daily, and Monthly. Daily statistics consolidate Hourly data, and Monthly statistics consolidate Daily data.

Turbonomic also saves audit log entries, and it starts new server logs at regular periods.

![Policy Editor](image)

### Specifying Retention of Historical Records

The more time you specify to retain these data, the more storage Turbonomic requires. As you modify the time to retain data, Turbonomic estimates the storage you will need for the resulting database.

To change retention settings, edit the **Value** fields. When you’re satisfied with the settings, click **Apply**.

To return to the default settings, click **Reset Defaults**.
General Settings

The General Settings include a setting to specify the currency that is used for currency values in reports and the Plan View. Do not use characters from an extended set. If you want to specify a currency other than USD ($), you should use the three-letter symbol for that currency.
The Reports View

The Reports View gives you access to the reports that are available on your instance of Turbonomic. In this view you can:

- View saved reports — Reports that have been generated and saved on your Turbonomic server
- Generate up-to-the-minute reports
- Create reports based on SQL queries
• Schedule reports to be generated at regular intervals — Add reports to or remove them from the schedule list. Scheduled reports appear in the Reports pane with a clock icon (Ticker).

• Manage subscriptions to scheduled reports

Turbonomic ships with a list of standard reports that give you selective snapshots of the state of your environment. This view lists all the standard reports so you can view or schedule them. You can also create custom reports and add them to the Reports View.

Viewing Reports

To view a report, first select the type of report you want to see in the Reports panel. If the report has been scheduled, Turbonomic generates copies at regular intervals. You can view a copy of a scheduled report, or you can view an up-to-the-minute report — a report based on the current state of your environment.

You can choose to view the report in PDF or XSLX format. PDF reports display in a browser window, and the browser downloads XSLXS reports to your local machine.

Viewing an Up-To-The-Minute Report

To view a current report, select the report type in the Reports panel, and click Generate Now.

Make the settings you want in the Generate Report dialog box, and click Apply:

• Scope
  Open the Scope dialog box and choose a group to set the report’s scope.

• Format
  Choose PDF or XSLX
• Number of Days Back
  This setting determines how much historical data to include in the report.

• Hide CPU and Storage Charts
  Hiding the charts results in a tabular report.

**NOTE:** If the **Scope** field is in the dialog box, this report requires a scope. You must set a scope before you can click the **Apply** button.

**Viewing Scheduled Reports**

When you schedule a report, Turbonomic generates the report at regular intervals and saves it on the server. When you select a report type in the Reports pane, the Generate/View Report pane updates to show a range of saved reports for the active date range (see the **Start** and **End** fields). If no reports appear in the list, that means the report was not scheduled during the time of the active date range.

You can set the date range that you want, and update the list — subsequent choices in the **Reports** pane will reflect the new date range.

**Start:** 07/31/2014  **End:** 08/01/2014  **Fetch**

To change the date range, set **Start** and **End**, then click **Fetch** to update the list.

The list of generated reports shows the report’s date and filename. You can choose to get a PDF or XSLS version of the report.

<table>
<thead>
<tr>
<th>Date</th>
<th>Filename</th>
<th>Download</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thu Jul 31 00:00:00 GMT-0400 21</td>
<td>daily_pm_top_bottom_capacity_grid</td>
<td><strong>PDF</strong></td>
</tr>
<tr>
<td>Fri Aug 1 00:00:00 GMT-0400 201</td>
<td>daily_pm_top_bottom_capacity_grid</td>
<td><strong>PDF</strong></td>
</tr>
</tbody>
</table>
Scheduling Reports

When you schedule a report, you choose the report type, and then set the following parameters:

- **Period**
  How often Turbonomic will generate the report. For weekly reports, you can specify the day of the week.

- **Scope**
  If present, you must choose a group to set the scope of the report.

- **Format**
  Specify whether to generate PDF or XLS reports.

- **Email**
  Specify one or more email addresses to create a subscription. Turbonomic will email the report to the specified addresses at intervals specified by the setting in **Period**.

- **Number of Days Back**
  This setting determines how much historical data to include in the report.

- **Hide CPU and Storage Charts**
  Hiding the charts results in a tabular report.

The scheduled reports appear in the panel. You can see when they will be generated, and you can delete schedule entries from the list.

*Note:* The email address is optional -- providing an address creates a subscription. You can provide multiple addresses as a comma-separated list. The report will be mailed to the recipients at the times specified for **Period**.
Managing Subscriptions

If you provide an email address when you create a schedule entry for a report, that creates a subscription to the report. The report will be mailed to the recipient at the intervals that are set for the scheduled period — daily, weekly, or monthly. You can provide multiple email addresses as a comma-separated list.

Note that if your subscribe to a report that has not been scheduled, the subscription also schedules the report generation. However, Turbonomic does not save duplicate reports on the server. For example, if you schedule daily generation of a report, and create a weekly subscription every Friday, Turbonomic does not save two reports on Fridays. On the other hand, if you schedule a weekly report for Mondays, and then create a subscription for Fridays, Turbonomic will save two reports a week — one on Monday and another on Friday.

The subscriptions appear in the Schedule Reports panel. Any entry in this panel that has an email address is a subscription.
Custom Reports from Views

Turbonomic includes a feature to generate a report from the display you see in the Inventory View and the Dashboards View. In addition, you can create a custom dashboard that sets scope for each panel you decide to include in the dashboard. This reporting feature includes three options:

- PDF — Generate a PDF version of the report
- XLS — Generate an XLS version of the report
- Save as Report — Save the report as an entry that you can select in the Reports View
Use this feature to create a custom report:

1. **Set the view**
   
   In the Inventory View, set the scope that you want. In the Dashboards View, choose a dashboard and set the scope, or choose a custom dashboard.

2. **Save the view as a report**

   Choose Save as Report from the Reports icon in the fly-out panel. You provide a name and description when you save the report.

3. **Manage the report in the Reports View**

   The report appears in the Reports pane. You can generate an up-to-the-minute report, schedule the report, or create subscriptions to it.

**Custom SQL Reports**

You can specify SQL queries against the Turbonomic historical database to generate a custom report. You can import a query file, or write the query directly in the Add Report dialog box. When you name and save the report, it appears in the list. You can use it the same as any other report — Schedule regular runs of the report, and set up subscriptions. You can view the report in PDF or XLS format.
Turbonomic has a space in the Green Circle dedicated to queries that other members of the community have published and shared. These queries are reviewed by Turbonomic staff and then posted to the site. Click the Green Circle icon to go to the site and download a published query. For more information about the database structure, see the Turbonomic Database Definitions article on the Green Circle.

Create a report based on a query, and add it to the list. You can then schedule and subscribe to this report.

Import a query file. Click to get published reports from the Green Circle.

Or you can write a query directly in the dialog box.
Aggregated Turbonomic Installations

In large virtual environments, you can use more than one Turbonomic instance to manage your workload. This can offer two advantages:

- Scaling up to manage larger inventories
- Separation by region, line of business, customer, or other criteria

**NOTE:** For separation of data, you can also use a single instance of Turbonomic and assign scope to user accounts. For example, this is a way to achieve separation by customer within a single instance of Turbonomic. For more information, see Account Scope on page 295.

By aggregating multiple instances in this way, you can view the entire environment through a single GUI. One special installation of Turbonomic serves as the **aggregating instance**, and it displays the combined data from each underlying **target instance**. This brings together the recommended actions, dashboards and summary displays, reporting, and other data in one application view.

In this architecture, each target instance has its own set of target hypervisors, and manages its associated workload. Users can log onto these instances “locally” as they normally would, and use their GUIs to perform administration tasks, review and perform recommended actions, run plans, or perform any other task a user can perform with Turbonomic. But aggregation offers more.

The aggregation instance treats the underlying instances as its target servers. Users can log onto the aggregation instance and use the GUI to manage the aggregated environment by executing recommended actions, viewing aggregated dashboards and summary panels, and performing other tasks. You perform these tasks through the aggregating GUI, but you can effect changes on the inventory managed by the underlying Turbonomic instances.
NOTE: An aggregating instance cannot manage hypervisors and aggregated target instances at the same time. All the targets of an aggregating instance must be target instances of Turbonomic.

## Turbonomic Versions and Aggregation

Note that all instances of Turbonomic in the aggregation architecture must be running the same version. If you update the version you are running, you should update all instances in the architecture. The earliest version of Turbonomic that supports aggregation is 3.2-19954.

## Aggregated User Accounts and Login

For any account you use to log into an aggregating instance, you should be sure the underlying Control Instances have matching user accounts. In this way, a user with an account on the aggregating instance can then log onto any of the underlying target instances. For example, a user should be able to open underlying instances from the GUI of the aggregating instance, and then set policies for those targets.

User accounts are stored locally on each instance. As a result, accounts can get out of sync. If a target was added to your aggregating instance, then you won’t necessarily have an account on the new target. To remedy this situation, ask the administrator of the target to create an account for you with settings (username, password, role, etc.) that are identical to your current aggregating account.

## Active Directory Authentication

For Active Directory accounts, user authentication works as you would expect:

- When you create a user account on the aggregating instance, that user account gets pushed down to the underlying instances. You can then log into the underlying instances using the same credentials.
- The Active Directory domain and server specifications are local to each Turbonomic instance. In this way, each instance can use authentication that is local to its domain.
Aggregation Details

The aggregation instance provides a view of the whole environment that is being managed by the target instances. The aggregating instance requests data from the target instances as its GUI needs the data.

The following list provides details of how the aggregation instance manages data from the target instances.

- **System-defined Groups**
  Turbonomic automatically groups devices in your environment into clusters and other groups. For example, it lists datastores by storage type, and VMs by storage. The aggregating instance adds the aggregated devices to these groups as appropriate. For example, if the different target instances all include iSCSI disks, then the aggregating instance shows all of these disks in the same iSCSI group. You can select these groups or items in these groups to set the scope of the aggregating instance.

- **Custom Groups**
  The aggregating instance displays all the custom groups that are defined in the target instances. You can select these groups or items in these groups to set the scope on the aggregating instance. You can create groups on the aggregating instance that include devices from different target instances. Groups you create on the aggregating instance do not have any effect on groups that are defined on target instances.

- **To Do List**
  On the aggregating instance, the To Do list shows recommended actions for all the target instances. If manual execution for the action is enabled on the target instance, then you can select that action and execute it from the aggregating instance. This sends a message to the corresponding target instance, which then executes the action.

- **Dashboards View**
  The Project Cluster Resources dashboard is not aggregated. This dashboard displays a list of target instances, and you can log into these instances to project cluster resources.

  For the other dashboards, the data you see shows a combination of the target instances. For example, the Assure Service Performance dashboard shows information for the combination of all hosts in your environment. As you set the scope of the dashboard, you can choose from all the groups and clusters in the environment.

- **Inventory View**
  The data you see in the summary panels shows a combination of the target instances. For example if your target instances each manage a number of LSASS applications, the navigation list will show the combination of all these applications under the heading for LSASS. You can select groups to set the scope of this view.

- **Plan View**
  Plans are not aggregated. The Plan view displays a list of target instances. You can log into these instances to run plans on them.

- **Deploy View**
  The Deploy view displays a list of target instances. You can log into these instances to deploy VMs on them.

- **Optimize View**
  The data you see in this view shows a combination of the target instances. You can select groups to set the scope of this view.
• **Admin View**
  On the aggregating instance, this view supports the following tasks:
  - **License Configuration**
    License configuration for the aggregating instance gets pushed down to the target instances. For information about applying licenses, see *License Configuration* on page 302.
  - **User Authentication Configuration**
    You can manage user accounts for the aggregating instance. These accounts get pushed down to the target instances as well. For more information, see *Aggregated User Accounts and Login* on page 396 and *User Authentication Configuration* on page 288.
  - **Maintenance**
    Maintenance actions such as software updates and diagnostics are for the aggregation instance, only. The target instances must perform their own maintenance activities. For more information, see *Maintenance* on page 303.

• **Policy View**
  The Policy view displays a list of target instances. You can log into these instances to specify policies on them.

• **Reports**
  The Reporting button displays a list of target instances. You can log into these instances to run their reports.
  Individual devices in the navigation tree include buttons to generate reports on demand. When you click this icon, the aggregating instance passes the request to the appropriate target instance, which generates the report.

### Configuring Aggregation

By default, each instance of Turbonomic is configured to run stand-alone. To set up aggregation, specify underlying instances of Turbonomic as targets for the aggregating instance. For information about specifying these targets, see "Adding Turbonomic Targets for Aggregation" in the Target Configuration Guide.