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What's New

This release of Turbonomic includes the following new features:

- **User Interface Enhancements**
  The new HTML user interface is now the default. Thanks to customer feedback, we have improved a number of the views. New things to see include:
  - Dashboards Page – Use this page to create custom dashboards that focus on specific areas of your environment.
  - Reporting Page – Set up subscriptions to standard reports, and generate reports on-demand.
  - Home Page Overviews – To help you focus on what’s important to you, the Home Page now shows overviews for Hybrid, On-Prem, and Cloud environments. You can still use the Search Page to set a scope to your session and drill down to details.
  - Policies and Settings – The new user interface now exposes a full range of settings for business rules and automation. Use these to set policies for different scopes in your environment.

- **Enhanced Public Cloud Support**
  We continue to improve our support on the public cloud. With this release you can see:
  - Enhanced cost analysis
    When calculating placement and resource allocation for workloads on the cloud, Turbonomic uses real data from your cloud accounts to calculate actual cost. The information Turbonomic uses includes Compute Costs for the workload templates you use, License Costs for the workload OS, Storage Costs based on the storage tier you are using, and IP Cost.
    For cloud storage, Turbonomic identifies the right storage tier for your workloads, ensuring you get storage performance without paying more than you need. It also discovers stranded, or "ghost" storage. When you delete a VM in your environment, you can forget to delete the attached storage. Turbonomic discovers and suspends this stranded storage so you don’t have to keep paying for it.
    In addition, when planning a migration from on-prem to the cloud, Turbonomic can identify stable on-prem workloads that are good candidates for Reserved Instance (RI) pricing. The resulting plan shows the cost savings you can expect by migrating these workloads to RI.
  - Relational Database Control
    Turbonomic discovers database instances in your cloud environment, and manages them as it does VM workloads. Turbonomic analysis determines correct scaling of your database services, provisioning new instances when necessary and recommending suspension of instances when appropriate.
• Enhanced Target Support
  This version of Turbonomic introduces the following target enhancements:
  - EMC VPLEX – VPLEX aggregates and refines data collected between connected Storage and Hypervisor
targets. Turbonomic supports EMC VPLEX in a local configuration.
  - Cisco UCS Central – Cisco UCS Central aggregates multiple Cisco Unified Computing System targets onto a
single point of management.
  - Storage Logical Pools – With Hitachi Data Systems and EMC VMAX 3, Turbonomic discovers and manages
logical pools in your storage network.
  - Hyper-V – This release adds support of Hyper-V 2016, and includes a number of improvements to our
Hyper-V support.

• Cloud-Native Enhancements
  For OpenShift and Kubernetes environments, Turbonomic imports Node and Pod affinity constraints, and uses
those constraints in its analysis. In addition, Turbonomic creates groups for containers.
Introducing Turbonomic

Thank you for choosing the Turbonomic platform, 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.

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

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.
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.

- **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.

Modeling the Environment as a Market

These abstractions open the whole spectrum of the environment to a single mode of analysis — market analysis. Resources and services can be priced to reflect changes in supply and demand, and pricing can drive resource allocation decisions. For example, a bottleneck (excess demand over supply) results in rising prices for the given resource. Applications competing for the same resource can lower their costs by shifting their workloads to other resource suppliers. As a result, utilization for that resource evens out across the environment and the bottleneck is resolved.

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.

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.

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.
Turbonomic Host Requirements

Turbonomic runs on hosts that meet the following requirements:

<table>
<thead>
<tr>
<th>Supported Hypervisor Technology</th>
<th>Storage Requirements</th>
<th>Memory</th>
<th>CPUs</th>
</tr>
</thead>
<tbody>
<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:</td>
<td>150GB or greater disk storage</td>
<td>16GB</td>
<td>2 vCPUs — 4 vCPUs preferred</td>
</tr>
<tr>
<td>RHEV 3.x</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Turbonomic Targets

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 4.0 — 4.6
  - Microsoft System Center 2012 Virtual Machine Manager and System Center 2012 R2 Virtual Machine Manager
  - VMware vCloud Director 1.0 — 5.1
  - OpenStack havana, Icehouse, juno, 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 VMAX
  - EMC VNX Series Storage Systems (for version details, see the [EMC VNX Support KB article](#))
  - EMC XtremIO
  - 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+
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 the Target Configuration Guide.

**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" in the Turbonomic User Guide.

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:

<table>
<thead>
<tr>
<th>VMTurbo</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</td>
<td>Tenant or TenantQuota</td>
<td>Accounts</td>
<td>Tenant</td>
</tr>
<tr>
<td></td>
<td>vDC</td>
<td>(Child)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provider VDC</td>
<td>Provider VDC</td>
<td>Resource Pool</td>
<td>Cloud</td>
<td>Pod</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>vDC</td>
<td>(Root)</td>
<td></td>
<td></td>
<td></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" in the Turbonomic User Guide.)

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 "Aggregate-Installations" in the Turbonomic User 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" in the Turbonomic User Guide).

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 in a VMware environment, 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" in the Turbonomic User Guide.

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>Virtual Application</td>
<td>N/A</td>
<td></td>
<td></td>
<td>Application signatures identify which applications are bound to specific load balancers. To increase capacity for a virtual application, Turbonomic provisions or decommissions VMs running these applications. In this way, Turbonomic adds or subtracts capacity to the virtual application. 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” in the Turbonomic User Guide.</td>
</tr>
<tr>
<td>Application</td>
<td>• Bind — For virtual applications</td>
<td>• Unbind — For virtual applications</td>
<td>N/A</td>
<td>• For applications discovered via JMX, resize the JVM heap</td>
</tr>
<tr>
<td>Application Server</td>
<td>• Start a new application server Only with a Provision scaling policy</td>
<td>• Suspend • Terminate (remove application server) Only with a Provision scaling policy</td>
<td>N/A</td>
<td>• Resize heap • Resize threads For VMs hosting the application server, resize vMEM and vCPU. Resize is only with a Resize scaling policy.</td>
</tr>
<tr>
<td>Database Server</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>• Resize DBMem • Resize Connections • Resize transaction log For VMs hosting the database server, resize vMEM and vCPU. Resize is only with a Resize scaling policy.</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.

<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</td>
<td>• Move VM (to different host, datastore, etc.)</td>
<td>• Reconfigure (including add missing network or reconfigure storage)</td>
</tr>
<tr>
<td></td>
<td>• Suspend</td>
<td>• Terminate (remove VM)</td>
<td></td>
<td>• Resize (change capacity, limit, or reservation)</td>
</tr>
<tr>
<td></td>
<td>• Terminate (remove PM)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PM</td>
<td>• Start</td>
<td>• Suspend</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Provision</td>
<td>• Terminate (remove datastore)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage (datastores for VMs)</td>
<td>• Start</td>
<td>• Suspend</td>
<td>• Move (to different storage device)</td>
<td>• Resize</td>
</tr>
<tr>
<td></td>
<td>• Provision</td>
<td>• Terminate (remove datastore)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disk Array</td>
<td>• Start</td>
<td>• Suspend</td>
<td>• Move (For NetApp, only in C-mode)</td>
<td>• Resize (Resize Up, only)</td>
</tr>
<tr>
<td></td>
<td>• Provision</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage Controller</td>
<td>• Provision</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IO 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</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></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provider Virtual Datacenter</td>
<td>N/A</td>
<td></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>

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.

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.

If resize up actions are not performed, Turbonomic can recommend to provision a VDC.

If resize down actions are not performed, Turbonomic can recommend to decommission a VDC.
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. |
| Flow1 — InDPOD Flow              | 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. |
| Flow2 — CrossDPOD Flow           | 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. |
| Heap                             | The heap capacity allocated for an application. Charts show the percentage of capacity that is used by an application. |
| HotStorage                       | For Nutanix platforms, the storage capacity on the server-attached flash. |</p>
<table>
<thead>
<tr>
<th>Resource:</th>
<th>Description:</th>
</tr>
</thead>
</table>
| **IO**  | 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. |
| **IOPS** | Storage access operations per second. Charts show the percentage of allocated IOPS capacity that is used on a datastore. |
| **Latency** | 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. |
| **Mem** | 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. |
| **NET** | 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. |
| **Power** | A measure of the power that is consumed by a physical device. |
| **QoS** | 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.  
**NOTE:** You should not set SLA capacity to applications unless you have integrated a system that monitors QoS impact and updates the SLA consumption. |
| **Storage** | Datastore capacity, measured in Kbytes. Datastore charts show the percentage of a datastore's capacity that is in use. |
| **Storage Provisioned** | 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. |
| **Swap** | The rate of memory swapping to disk, in bytes per second. The default capacity is 5,000,000 Byte/sec. |
| **Threads** | Allocated thread capacity. Charts show the percentage of thread capacity that is consumed by an application server. |
| **TransactionLog** | The disk space devoted to transaction logging for a database. |
| **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. |
<p>| <strong>VCPU</strong> | 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. |</p>
<table>
<thead>
<tr>
<th>Resource</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>VMem</td>
<td>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 4 GB.</td>
</tr>
<tr>
<td>VStorage</td>
<td>Virtual storage allocated to a VM, measured in Kbytes. Charts show the percentage of a VM’s allocated VStorage that is in use.</td>
</tr>
</tbody>
</table>
Logging In to Turbonomic

To get started with the platform, open a web browser to your Turbonomic installation. The Turbonomic platform serves the user interface to your browser, where you can log in and get started managing 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 the IP address of your Turbonomic installation, contact your system administrator.

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.

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 Home Page on page 20. This page is your starting point for sessions with the Turbonomic platform. From the Home Page you can see the following overviews of your environment:

- **HYBRID** – See all the actions that are pending for the entire environment, both on-prem and in the cloud.
- **ON-PREM** – See details for the on-prem environment. Notice that the Supply Chain excludes cloud entities and only shows the entities that are on-prem.
- **CLOUD** – See details for the cloud environment, including pending actions, a listing of your cloud accounts by cost, the locations of cloud datacenters that you are using, estimated costs, and other cost-related information.

To display this information, Turbonomic communicates with target services such as hypervisors, storage controllers, and public cloud accounts. Note that your Turbonomic administrator sets up the target configuration. For information about supported targets and how to configure them, see the Target Configuration Guide.
The Home Page

When you launch Turbonomic, the Home Page is the first view you see. From the Home Page you can:

- Use the Supply Chain Navigator to inspect lists of entities. Click an entity tier in the Supply Chain to see a list of those entities. For example, click Virtual Machine to see a list of all the VMs in your environment.

- Choose a View to see overviews of your environment:
  - HYBRID – See all the actions that are pending for the entire environment, both on-prem and in the cloud.
  - ON-PREM – See details for the on-prem environment. Notice that the Supply Chain excludes cloud entities and only shows the entities that are on-prem.
  - CLOUD – See details for the cloud environment, including pending actions, a listing of your cloud accounts by cost, the locations of cloud datacenters that you are using, estimated costs, and other cost-related information.
- Navigate to other Turbonomic pages, including:
  - Search – Set the session scope to drill down to details about your environment
  - Plan – Run what-if scenarios or plan migrations to the cloud
  - Place – Use Turbonomic to calculate the best placement for workloads, and execute the placement at the time you specify
  - Dashboard – Set up custom views with charts that focus on specifics in your environment
  - Reports – Generate reports and manage subscriptions to those reports
  - Settings – Configure Turbonomic to set up business rules and policies, configure targets, define groups, and perform other administrative tasks
Getting Home

Wherever you are in your Turbonomic session, you can always click the Home icon to return to the Home Page.

The Supply Chain – Home Page

To perform intelligent workload management, 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 tiers of your environment, into the virtual tier and out to the cloud. By managing relationships between these buyers and sellers, Turbonomic provides closed-loop management of resources, from the datacenter, through to the application.
Reading the Supply Chain

By looking at the Supply Chain, you can see:

- How many entities you have on each tier
  Each entry in the supply chain gives a count of entities for the given type.
- The overall health of entities in each tier
  The ring for each entry indicates the percentage of pending actions for that tier in the datacenter. Ring colors indicate how critical the actions are - Green shows the percentage of entities that have no actions pending. To get actual counts of pending actions, hover on a ring to more details.
- The flow of resources between tiers
  The arrow from one entry to another indicates the flow of resources. For example, the Virtual Machine entry has arrows to Physical Machine and to Storage. If the VMs are running in a Virtual Data Center, it will have another arrow to that as well. This means that your VMs consume resources from PMs, storage, and possible from VDCs.

Listing Entities From the Home Page

The Supply Chain shows the relationships of entities in your environment. When you're on the Home Page with a global scope, the supply chain filters its display according to the view you have chosen:

- HYBRID view – All the entities in your environment
- ON-PREM – All your on-prem entities
- CLOUD – All your entities on the public cloud
To see a list of entities, click an entity tier in the Supply Chain.

Hybrid View

When you set your session to the Global Scope (click HOME), you can then select the HYBRID view. This view shows all the actions that are pending for the entire environment, both on-prem and in the cloud.

Because this view shows both the on-prem and cloud aspects of your environment, it displays only those charts with data common to both. You can see information about actions, including:

- Lists of pending actions
- Overviews of pending actions
  - If you have pending actions in the public cloud, the overview includes the estimated monthly savings or cost associated with those actions. For on-prem actions, the overview can include estimated one-time savings or cost.
- Action history – You can see a history of all actions that have been recommended and executed, or of just the actions that have been accepted and executed.
To see complete lists of actions, click the **SHOW ALL** link at the bottom of the Actions chart.

---

**ON-PREM View**

When you set your session to the Global Scope (click **HOME**), you can then select the **ON-PREM** view. This view shows an overview of your on-prem environment. If you don't have any workload on the public cloud, then you should use this as your starting point for a Turbonomic session. If you have a hybrid environment (on-prem and on the public cloud), then you can refer to this view to see a detailed on-prem overview.
The Supply Chain shows all the on-prem entities in your environment. The charts show details about your environment, including:

- Overviews of pending actions
  When appropriate, the overview includes estimated one-time savings or costs associated with the actions.

- Action history
  You can see a history of all actions that have been recommended and executed, or just the actions that have been accepted and executed.

- Top Cluster utilization
  See a list of the five most utilized clusters. The chart shows these clusters, along with a count of actions for each. To drill down into the cluster details, click the cluster name. To see and execute the specific actions, click the ACTIONS button for that cluster. To see all the clusters in your environment, click SHOW ALL.

- Optimized Improvements
  Compare current resource utilization with the utilization you would see if you choose to execute all the pending actions.

- Headroom
  See how many more workloads can run on your current infrastructure while maintaining performance.

- Risk Index
  This chart indicates the overall health of your environment over time. The Risk Index shows whether your environment is keeping in a healthy state, or whether it’s on a trend toward overutilization or underutilization of resources.
CLOUD View

When you set your session to the Global Scope (click HOME), you can then select the CLOUD view. This view shows an overview of your cloud environment. If all your workload is on the public cloud, then you should use this as your starting point for a Turbonomic session. If you have a hybrid environment (on-prem and on the public cloud), then you can refer to this view to see a detailed cloud overview.

To view cloud cost information, you must have one or more public cloud targets set up in your Turbonomic installation. For information about setting up public cloud targets, see the Target Configuration Guide.
Tracking Cloud Cost

Turbonomic tracks your cloud spend in two ways:

- **Cost for Services**
  Turbonomic uses the billing reports from your cloud service providers, as they are associated with your cloud targets. Turbonomic parses these reports to get cost breakdowns by service, service provider, and cloud account.

- **Workload Expenses**
  Turbonomic tracks the following expenses for your workloads:
  - **Compute**
    For compute expenses Turbonomic uses hourly expense per template as specified in the associated public cloud account.
  - **Storage**
    Turbonomic discovers the storage tier that supports a given workload, and uses the tier pricing to calculate storage cost.
  - **License**
    To calculate the OS cost for a VM, Turbonomic subtracts the template cost from the published workload cost. It assumes the difference is the license cost for that workload. If the OS is open source, then there will be no difference, and license cost is zero.
  - **IP**
    For some workloads, you might use IP services that incur a cost. For example, your cloud provider might charge to grant a static IP to a VM. Turbonomic includes that cost in its calculation and analysis.

Turbonomic uses this cost information when making VM resize and placement decisions, both in real time and in plans. You can see this information in Expenses charts and in the results of Migrate to Cloud plans.

Comparing Cost to Budget

Turbonomic uses Cloud Budgets to assign your desired monthly spend for your public cloud providers. Once you create a budget, then you can work with charts that show the historical spend for those providers in relation to the budget. In addition, when you have a budget in place, Turbonomic can calculate optimal placement for workloads on the cloud.

**NOTE:** To calculate workload placement on the cloud, Turbonomic requires that you have configured a Cloud Budget. For more information, see Cloud Budgets on page 95.

Cloud View Display

In this view, the Supply Chain shows all the cloud entities in your environment. The charts show details about your cloud environment, including:

- **Overviews of pending actions**
  The overview includes the estimated monthly savings or cost associated with those actions.

- **Top Accounts utilization**
  See a list of the five most utilized public cloud accounts. The chart shows these accounts, along with an estimate of the monthly cost for each. To see all the cloud accounts in your environment, click **SHOW ALL**.
• Location
  This chart displays the locations of your cloud accounts' regions or zones on a map. Hover on a data point to see
the region or zone name.

• Cloud Estimated Cost
  See your overall cloud costs, over time. This chart shows estimated costs, assuming you continually execute the
pending cloud actions.

• Action history
  You can see a history of all actions that have been recommended and executed, or of just the actions that have
been accepted and executed.

• Cost Breakdown by Cloud Account
  This chart shows costs over time for each account that you have set up as a target in Turbonomic.

• Cloud Cost Comparison
  For all of your public cloud workload, compare your current costs with the costs you would see if you execute the
pending actions. This chart lists the workloads according to the types of actions that are pending for them. For
example, you might see that 10 out of 100 VMs have pending Performance Assurancee actions. Also, you can see
the current monthly and yearly costs, the savings these actions would realize, and the resulting difference of
those savings.

• Cost Breakdown by Cloud Service
  This chart shows costs over time for each cloud service that you use in your cloud accounts. For example, you can
see the cost for AWS CloudWatch, compared to the cost for AWS S3 storage.

• Cost Breakdown by Component
  This chart shows costs over time for each component of your cloud utilization. You can see costs for:
    - Compute
    - IP (static IPs for workloads)
    - License (OS license)
    - Storage
    - Capacity

• Expenses
  See your hourly expenses over time, as well as overall monthly and yearly costs.
Working With Scoped a View

To drill down into specifics of your environment, you can set a scope to your Turbonomic session. A scoped view shows details about the specific entities in that scope. You can also use the Supply Chain to zoom in on related tiers to see details about those entities.

Things You Can Do

- Scoping the Turbonomic Session on page 30
- Navigating With the Supply Chain on page 42

Scoping the Turbonomic Session

The default scope for the Home Page shows an overview of the global environment. What if you want to focus on less than the global environment? Assume you are responsible for a subset of workloads in your environment. This could be:

- Workloads managed on a single host cluster
- The workloads in a single datacenter
- The workloads managed in a specific virtual datacenter
- A custom group of workloads you have created in Turbonomic

It’s easy to set the session scope so that Turbonomic zooms in on the part of the environment that you want to inspect. Once you set the scope, you can get a quick picture of system health for that scope.

1. Navigate to the Search Page.

   Click to navigate to the Search Page. This is where you can choose the scope you want.
2. Choose a category of entities to search.

In the Search Page, choose a category of entities that you want to search through. Find the list of entity types on the left. Select All to search the complete environment. Or you can focus on entities by type, by groups, or by clusters. When you select an entity type, the page updates to show all entities of that type.

3. Use Search to filter the listing.

For example, if you're showing All and you search for "Development", then you will see all clusters, groups, and entities with "Development" in their names.

Search for "Development" to filter the view.
4. **Expand an entry to see details.**
   For example, expand a group or a cluster to see utilization details and pending actions.

   **NOTE:** For hosts in the public cloud, utilization and capacity for host and datacenter resources don't affect Turbonomic calculations. When you expand an entry for a public cloud host, the details do not include information for these resources.
5. Select an entry to set the focus of the Home Page.

When you select an entry in the list, that sets the focus of the Home Page. For example, if you select a cluster in the **Search** listing, you set the Home Page focus to that cluster. Use the Home Page bread crumbs to set a different scope, or you can return to **Search** and set a different scope from there.
Overview Charts

The Overview Charts show your environment’s overall operating health for the current session scope. A glance at the Overview gives you insights into service performance health, overall efficiency of your workload distribution, projections into the future, and trends over time.

The charts in this view show data for the current scope that you have set for the Turbonomic session. For the global scope, the charts roll up average, minimum, and peak values for the whole environment. When you reduce the scope (for example, set the scope to a cluster), the charts show values for the entities in that scope.

Some charts included in this view are:

- **Optimized Improvements**
  A comparison of utilization in your environment before executing the pending actions, and then after.

- **Prevented Risks**
  Each action addresses one or more identified risks or opportunities in your environment. This chart shows how many actions have been executed or ignored, and whether they have been executed manually or automatically. The chart also shows how many risks have been addressed by the executed actions.

- **Active Virtual Machines vs Hosts**
  This chart shows how many active VMs are running in your environment, compared to the active compute and storage providers.

- **Historical Performance**
  In this chart you can see trends over time of resource utilization in your environment.

- **Workload Density**
  This chart shows the average ratio of VMs per host and VMs per datastore. This indicates how efficiently you’re using your infrastructure.

- **Compute Resources**
  An overview of utilization of the compute resources in your environment.

- **Storage resources**
  An overview of utilization of the storage resources in your environment.
What You Can Do:

- Set scope: See Scoping the Turbonomic Session on page 30
- Create new charts: See Creating and Editing Chart Widgets on page 64

Setting Chart Focus

The charts update to reflect the focus that you have set for your viewing session. While viewing the Overview Charts, you can set the focus in different ways:

- Set Supply Chain Focus
  Choose a tier in the supply chain to set the view focus - see Navigating With the Supply Chain on page 42
- Set Scope
  Use Search to set the scope of the viewing session - see Scoping the Turbonomic Session on page 30
- Set t

Chart Time Frame

You can set a time frame from recent hours to the past year, and set that to the charts in the view. Use the Time Slider to set specific start and end times within that range. The green section in the slider shows that you can set the time range to include a projection into the future. For this part of the time range, charts show the results you would see after you execute the current set of pending actions.

For most charts, you can also configure the chart to hard-code the time range. In that case, the chart always shows the same time scale, no matter what scale and range you set for the given view.

Note that Turbonomic stores historical data in its database. As you run Turbonomic in your environment for more time, then you can set a time range to show more history.
Details View

The Details View shows more details about the entities in your session scope. These charts focus on the utilization of resources by these entities, so you can get a sense of activity in that scope over time.

What You Can Do:

- Set scope: See Scoping the Turbonomic Session on page 30
- Create new charts: See Creating and Editing Chart Widgets on page 64

Setting Chart Focus

The charts update to reflect the focus that you have set for your viewing session. While viewing the Overview Charts, you can set the focus in different ways:

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For most charts, you can also configure the chart to hard-code the time range. In that case, the chart always shows the same time scale, no matter what scale and range you set for the given view.

Note that Turbonomic stores historical data in its database. As you run Turbonomic in your environment for more time, then you can set a time range to show more history.
Policy View

The Policy View gives you a look at the Automation Policies that are set for the entities in the current scope. For each policy, you can see whether it has been enabled or disabled. In addition, you can create new policies and apply them to that scope.

To edit a policy, click the policy name. You can then change the policy settings, or enable/disable the policy.

When you create a new policy, it automatically includes the current scope. You can add other groups to the policy scope if you like. Note that you can enable more than one policy for the same scope. If two policies apply different values for the same setting, then the most conservative value takes effect.

For more information, see Automation Policies on page 104.
List of Entities

The list of entities is a quick way to drill down to details about your environment, so you can see specifics about resource consumption or state. For example, you can see the amount of capacity that has been assigned to a VM that is currently idle.

This list always updates to reflect:

- The focus you have selected in the Supply Chain Navigator
  Select an entity type in the supply chain to update the list of entities. For example, select Physical Machine to see a list of hosts in your environment. For more information, see "The Supply Chain Navigator" in the Turbonomic User Guide.

- The scope you have set in the Search view
  You can set Scope to limit the view of all lists in the Home Page. For more information, see "" in the Turbonomic User Guide.
Pending Actions List

To perform Intelligent Workload Management, Turbonomic identifies actions you can take to avoid problems before they occur. You can perform these actions manually, direct Turbonomic to perform the actions on command, or direct Turbonomic to perform actions automatically as they arise.

The Pending Actions list shows the actions that Turbonomic currently recommends. You can select actions to execute, and you can expand action items to see more details.

Controlling List Display

For a long list of pending actions, it's useful to sort or filter the list:

- Filter the list

  Filter the list by action type, action mode, and action category. For example, filter the list to only show resize actions that are manually executable, and that give efficiency improvements.

- Search

  Filter the list by names that match what you type in the Search field.
• Sort

**By Severity**  |  **By Name**
Sort the pending actions list by severity or by name of the action target, in ascending or descending order. Turbonomic determines action severity by the amount of improvement the affected entities will gain by executing the action. Action severities are:
- Minor
- Major
- Critical

**Showing Action Details**


---

**Oracle 11g**

- 0% 0%
- 5.21 GHz 4.00 GB

**hp-esx22.corp.vmturbo.com**

- 23% → 16%
- 104.12 GHz

**hp-esx21.corp.vmturbo.com**

- 33%
- 159.99 GB

Related Risks

Physical Machine *hp-esx22.corp.vmturbo.com* is underutilized (idle or non-productive)
Expand an action item to see its details. The panel shows:

- A description of the recommended action
- Resource utilization for the affected entity
  For example, if the action is to move a VM, the details show resource utilization for that VM
- Resource utilization for the affected providers
  For example, for a VM move this shows utilization on the FROM and the TO host machines.
- Related risks or opportunities
  Risks and opportunities show the reasons for the recommended action.

**NOTE:** The action item gives the names of the affected entities. You can click on these entity names to drill down and set the Home View scope to that specific entity.

### Navigating With the Supply Chain

After you have set the scope of your Turbonomic session, you can use the Supply Chain to change the focus of the main view, and see details about different types of entities within the current scope.
Drilling Down in a Scoped Session

When you set a scope to your Turbonomic session, the Home Page shows information about your environment, including:

- **Overview** - Charts and lists to give you an overview of your environment for the given scope
- **Details** - Charts that give you a more detailed look at your environment for the given scope
- **Policy** - Any policies that are defined for the entities in the given scope
- **Entity Lists** - Details about the specific entities in the given scope

To set the focus of the Home Page, click one of the entries in the Supply Chain. Turbonomic updates the view to focus on information about that tier. For example, if you click the Host entry, the view updates to show information about the hosts in your current scope.
Plans: Looking to the Future

Use the Plan Page to run simulations for what-if scenarios that explore possibilities such as:

- Migrating workloads from your enterprise datacenter out to the public cloud
- Changing hardware supply
- Impact of downsizing, or removing resources
- Projected infrastructure requirements
- Optimal workload distribution to meet historical peaks demands
- Optimal workload distribution across existing resources
How Plans Work

To run a plan scenario, Turbonomic creates a snapshot copy of your real-time market and modifies that snapshot according to the scenario. It then uses the Economic Scheduling Engine to perform analysis on that plan market. A scenario 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 plan, Turbonomic continuously analyzes the plan 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 plan stops running, and it displays the results as the plan's desired state. The display includes the resulting workload distribution across hosts and datastores, as well as a list of actions the plan executed to achieve the desired result.

For example, assume a scenario that adds virtual machines to a cluster. To run the plan, Turbonomic takes a snapshot of the current market, and adds the VMs to the specified cluster. Turbonomic then runs analysis on the plan market, 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.

Setting Up Plan Scenarios
A plan scenario specifies the overall configuration of a plan. Creating the plan scenario is how you set up a what-if scenario to see the results you would get if you changed your environment in some way.

After you run a plan, Turbonomic saves the results and the scenario. You can run the same plan again at any time. This runs the plan scenario against the market in its current state.

Turbonomic provides workflows to create the following types of plans:

<table>
<thead>
<tr>
<th>Plan Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add Workload</td>
<td>Adding workload increases the demand that you place on your environment's infrastructure. You can set up a plan to add new workload based on individual VMs or groups of VMs in your environment, or based on templates.</td>
</tr>
<tr>
<td>Migrate to Public Cloud</td>
<td>Choose groups of workload to migrate to a public cloud. Turbonomic chooses the appropriate cloud templates to support the VMs in your cloud account, and it chooses the best regions to host these VMs. The plan shows two results - migrating to templates that match your current VM resources, and migrating to the smallest templates that can assure performance of your applications without overprovisioning your cloud VMs. The plan shows the costs you would see in your cloud account for both sets of results.</td>
</tr>
<tr>
<td>Workload Migration</td>
<td>Use this setup to see whether you have enough resources to move your workload from one provider group to another. For example, 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? Use this plan to calculate the effect such a change would have on your overall infrastructure.</td>
</tr>
<tr>
<td>Decommission Hosts</td>
<td>If your environment includes underutilized hardware, you can use a plan to see whether you can decommission hosts or storage.</td>
</tr>
<tr>
<td>Reconfigure Hardware</td>
<td>Choose hosts or storage that you want to replace with different hardware. For example, assume you are planning to upgrade the hosts in a cluster. How many do you need to deploy, and still assure performance of your applications? Create templates to represent the upgraded hosts and let the plan figure out how many hosts you really need.</td>
</tr>
<tr>
<td>Custom</td>
<td>The above plan types get you started on the setup of certain types of scenarios. With a custom plan you skip directly to the plan configuration, and set up whatever type of scenario you want.</td>
</tr>
</tbody>
</table>
Creating a Custom Scenario

When you create a custom scenario you skip the plan wizards and jump straight into setting up the plan parameters. You can name the plan, set the plan scope, change workload demand and resource supply, and specify other changes to the plan market.
The Plan's Change Summary

As you make changes to the plan scenario, those changes appear in a Change Summary. You can edit some changes (for example, add more workloads), and you can delete entries from the summary to remove those changes from the scenario.

Name the Plan

Be sure to give a name that helps you recognize the purpose of this plan.
Set the Plan's Scope

Setting plan scope is optional, but it usually helps to focus on a subset of your environment. For a very large environment, scoped plans run faster. Also, to run a plan that projects cycles into the future, you must set a scope.

After you set the scope, the user interface shows the group name and the supply chain for that scope.

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.
Add Workload

When you add workload, you add VMs to the plan market. To add workload, copy from the list of VMs in your inventory, or copy from a template. When choosing a VM, you can filter the list to show VMs with certain properties (name, number of CPUs, etc.) or by the host, storage, or network that the VM runs on. This makes it easier to sort through a long list of VMs.

When you choose the VM or template you want to add, it appears as an entry in the Change Summary. Then you can set how many copies to add.

Replace Workload

Replacing workload is a way to change the properties of VMs in your plan market. When you replace workload, you select one or more VMs that you want to change, and then you select a template to use in their place. The list of changed VMs displays in the Change Summary. You can delete individual entries from the Change Summary if necessary.

Remove Workload

Removing workload frees up resources for other workloads to use. Choose the VMs you want to remove from the plan market, and they appear in the Change Summary list.
Migrate Workload

Migrating workload means that you move VMs from their current host PMs to a different group of PMs. A typical case would be to select a group of VMs running on one cluster, and migrate them to a different cluster. Then you can run the plan to see whether the target cluster has sufficient resources to host the new VMs. You can use such a plan to see whether you can shut down a given cluster, or free up all of its resources.

When choosing VMs to migrate, you can filter the list to show VMs with certain properties (name, number of CPUs, etc.) or by the host, storage, or network that the VMs run on.

The VMs you choose to migrate appear in the Change Summary list.

Migrate to Cloud

This is a special-case migration setup that plans migration to the cloud, and shows the resulting compute costs for VMs on the cloud. For a complete description, see Planning a Migration to the Cloud on page 53.

You choose a VM group or individual VMs to migrate, and then choose where to place the VMs. For placement on the public cloud, you can choose:

- Providers
  Choose from a list of providers. Each public cloud target is an account on a given public cloud provider. Turbonomic shows all the providers that host your current public cloud accounts. Choose to migrate to one of these providers, or to have the plan choose from all of the providers.

- Regions
  Turbonomic discovers all the regions that you can access from your target cloud accounts. You can choose one region to restrict plan placement decisions.

- Groups
  Choose from a list of groups VMs that are hosted on the public cloud. This will restrict the plan to place your migrated workloads into that group.

When you run this plan scenario, Turbonomic shows workload placement plus costs in two formats:

- Allocation Plan
  This shows placement of VMs using templates that support the current resource allocations that are granted to each VM.

- Consumption Plan
  This shows placement of VMs after the plan has optimized their resource allocations. This gives placement decisions that use the most efficient templates available in the cloud region. As a result, the estimated costs are usually lower, and the plan shows the savings you can take advantage of while still assuring application performance on your migrated VMs.
Change Automation

Change Automation
See the effect on your environment if you automate actions.

Use this to enable or disable automatic resize actions for the entities in the plan.

Change Placement Policies

Change Placement Policies
Calculate optimal workload distribution after you create, enable, or disable placement policies.

By default, the plan market includes all the placement policies that Turbonomic has discovered, or that were created in Turbonomic. Also, these policies are in their real-time state (enabled or disabled).

You can use these settings to enable or disable existing policies, or you can create new policies to apply only to this plan scenario. For information about creating placement policies, see Creating Placement Policies on page 100.

Ignore Constraints

Ignore Constraints
Disable all placement policies and cluster boundaries. This shows ideal workload placement in an unconstrained environment.

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. If you disable the Cluster constraint for a VM, then the plan 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 plan will show that result.
Planning a Migration to the Cloud

Turbonomic includes a special plan to simulate migration of on-prem workload to the cloud. This plan focuses on optimizing your costs on the cloud by choosing the best templates (most adequate compute resources) and regions to host your workloads.

Run these plans to see how to move your on-prem workload onto the public cloud. The plan results:

- Give you projected monthly and yearly costs
- Show the actions to execute your migration
- Identify the optimal templates to use, combining efficient purchase of resources with assured application performance
- Choose the best regions to run your workload
- Show the cost difference between using current workload allocations and using the optimized allocations that Turbonomic has calculated.
- Identify candidates for Reserved Instance (RI) pricing, and show the cost benefits you can see by running those workloads on templates that are reserved on your public cloud provider.

**NOTE:** To run a Migration to Cloud plan, you must have created a cloud budget for the cloud targets within the plan’s scope. Turbonomic uses this budget to calculate optimal placement for the migrated workloads. For best results, you should ensure that the budget is high enough to account for the migrated workloads. Even if you set a budget very high, Turbonomic will still calculate optimal placement in plans and in real time. Turbonomic recommends that you create a single budget to track all of your public cloud targets. For more information about cloud budgets, see Creating a Cloud Budget on page 96.
Configuring a Migrate to Cloud Plan

The first step for running a plan is to create the scenario to specify how you want to change your environment. You can begin creating a scenario from different places in the user interface:

- **From the Home Page:**

  ![Plan button](image)

  You can always click the **Plan** button to get started creating a scenario. Remember that you can set the current scope for the Home Page. When you start planning from the Home Page, the plan scenario automatically begins with the current Home Page scope.

- **From the Plan Page:**

  ![Plan and Create Plan buttons](image)

  Navigate to the Plan Page, and then click **Create Plan**. These scenarios start with a global scope, but you can always edit the scope later.

In the list of plan wizards, choose **Migrate to Public Cloud**.

The wizard first gives you a list of VMs to select. You can choose from groups or individual VMs. Note that you will choose among on-prem VMs.

![Select the virtual machines to migrate](image)
After selecting the VMs you want to migrate, click **Next** and choose the destination.

For the migration destination you can choose from:

- **Providers**
  Choose from a list of providers. Each public cloud target is an account on a given public cloud provider. Turbonomic shows all the providers that host your current public cloud accounts. Choose to migrate to one of these providers, or to have the plan choose from all of the providers.

- **Regions**
  Turbonomic discovers all the regions that you can access from your target cloud accounts. You can choose one region to restrict plan placement decisions.

- **Groups**
  Choose from a list of groups of VMs that are hosted on the public cloud. The list shows datacenter groups (Regions). This will restrict the plan to place your migrated workloads into that group.

After you have set up the VMs to migrate, and you have set up the destination, click **Migrate**. Turbonomic then executes the plan.
Viewing Migrate to Cloud Results

After the plan runs, you can view the results to see how the migration affects your environment. The plan gives hybrid results, divided into a Cloud section and an On-Prem section. This gives you insight into the complete effect of your migration – both the placement and costs on the cloud, and the resulting savings for your on-prem environment.

Cloud

The Cloud section has a focus on your compute costs on the cloud. As Turbonomic runs the plan, it inspects the VMs to determine the most efficient resource allocations they can have and still assure performance of the applications they host. In many cases the plan discovers VMs that are over-provisioned. If you were to migrate such VMs to templates that match their current allocations, then you would spend more than necessary to host these VMs on the cloud.

The Cloud results show VM compute costs based on the templates it deploys VMs to. The results are in two parts - Cost for templates based on the current resource allocation, and cost for templates based on optimized allocation.

The Cloud results include the following charts:

- Cloud Cost Comparison
  This chart shows compute costs for VMs on the cloud. You can see changes in cost that result from the migration (compute cost from adding workloads), and changes from resizing existing workloads and moving them to less expensive regions. To provide detail, the chart shows how many VMs the plan found that need to be resized. If it finds undersized VMs, then costs should go up, and for oversized VMs the costs should go down.
  The plan also identifies workloads that can run as Reserved Instances (RIs). RIs provide a significant discount compared to on-demand pricing. To identify RI candidates, Turbonomic looks at the history of the workload (by default, the last 18 days). If the VM shows activity (VCPU utilization is greater than zero), and there have been no start, stop, or resize actions for the VM, then it is an RI candidate.
  The chart then compares costs that you would see in the following ways:
    - Allocation Plan
      This shows compute cost of VMs using templates that support the current resource allocations that are granted to each VM. The results are for on-demand pricing with these templates.
    - Consumption Plan
      This shows compute cost of VMs after the plan has optimized the VM resource allocations. This gives placement decisions that use the most efficient compute allocations based on templates that are available in the cloud region. As a result, the compute costs are usually lower, and the plan shows the savings you can take advantage of while still assuring application performance on your migrated VMs.
  The chart shows the results of different pricing plans:
    * On-Demand Pricing
      These costs assume all the migrated VMs will use On-Demand pricing. The costs are derived from the pricing plans you have for your given cloud accounts.
    * On-Demand Plus RI Pricing
      These costs assume all RI candidates use the appropriate RI pricing for their calculated location in the cloud. It's likely that some migrated workloads are not RI candidates – the costs show the resulting mix of RI and on-demand pricing for the migrated workloads.

- Cloud Estimated Cost
  This chart gives a timeline of compute costs on the cloud, including a projection into the future. This chart also shows Cost Without Turbonomic and Cost With Turbonomic.
• Cloud Template Summary by Type  
This chart shows the types of templates the plan recommends for the migration, including how many of each it uses, plus the costs for each. To see a detailed breakdown of the template costs, click SHOW ALL at the bottom of the chart.

• Volume Tier Breakdown  
This chart shows the distribution of storage that supports your workloads. You can see how many workloads are supported by each storage tier. For a detailed breakdown, click SHOW ALL at the bottom of the chart. The details show you:
  - Disk ID
  - Storage name
  - Size
  - Linked VMs
  - Tier name
  - Monthly Cost

• Reserved Instances Breakdown  
This chart shows the RI templates the plan recommends for the migration, including how many of each it uses, plus the costs for each. To see a detailed breakdown of the costs, click SHOW ALL at the bottom of the chart.

On-Prem

The On-Prem section focuses on the physical resources this migration would free in your on-prem datacenter. It includes the following charts:

• Headroom  
This chart shows the change in workload capacity your on-prem environment will see after migrating the VMs to the cloud. It shows this as Headroom - How many VMs can run in the environment and still assure performance.

• Host and Storage Units  
This is a snapshot of how many hosts and storage devices you have in the on-prem environment. As a result of the migration, it often shows that you need fewer hosts or storage devices.

• Optimized Improvements  
This chart compares your on-prem environment, showing a before/after snapshot. The bar charts show resource utilization by the workloads in the on-prem environment. If you migrate all of the on-prem workloads to the cloud, the right hand chart will have no data – all the workloads have been migrated so there is no workload to report on.

• Resource Summary by Count  
This chart shows the current status of your environment side-by-side with the status you would achieve after executing the migration. The chart shows the utilization index for the VMs in your environment. The higher this index is for a VM, the more heavily resources on that VM are utilized.
Place: Reserve and Deploy Workload

From the Place Page, Turbonomic uses its intelligent workload management to calculate optimal placement for workloads and then actually deploy them to your on-prem or cloud environment.

To deploy workloads from this page, you will:

- Define the workload to deploy
  This includes choosing a VM template, setting how many instances to deploy, and specifying any placement constraints.
- Find the optimal placement
  Turbonomic runs a plan to determine the best placement for the workload you defined.
- Schedule deployment or create a reservation
  Either deploy the workload directly, or reserve the resources to deploy the workload at a later time.

About Templates for Workload Placement

To specify the workload to deploy, you choose a VM template and then specify how many instances you want to deploy. The template you choose must include a specification for one or more VM images. A VM image identifies the actual deployment package:

- To deploy on-prem, a path to the physical files (for example an OVA)
- For cloud deployments, the cloud provider's named VM image (for AWS, the AMI)

If the template definition includes multiple images, then as it places the workload Turbonomic will choose the image that corresponds with the given cloud region or on-prem datacenter it is deploying to. For more information about templates, see Templates: Resource Allocations for New Entities on page 135.
About Placement Constraints

When you define the workload to deploy, you specify a template to deploy and any constraints that you want Turbonomic to respect. The constraints you can choose include:

- **Limit initial placement to the template’s image locations**
  For cloud deployment, the template you use specifies one or more VM images that are offered by the cloud providers. Each cloud region makes different images available – if you enable this constraint, then Turbonomic will only place the workload on the image’s region.

- **Limit initial placement to locations you specify**
  To limit placement, you can manually specify the cloud regions or on-prem datacenters, the virtual datacenters, or the clusters that Turbonomic can deploy this workload to.

- **Limit placement with placement policy**
  Turbonomic discovers placement policies that are defined in your environment, and you can also create your own. With this setting, you can specify which placement policies to respect. For more information about these policies, see Placement Policies on page 99.

- **Limit placement to networks**
  Turbonomic discovers the different networks in your environment. Use this constraint to limit workload placement to the networks you choose.

Displaying the Workload Placement Page

To see the reservations that are currently active and to create new reservations, click the **PLACE** button.

![Workload Placement Page](image)
Setting Up a Deployment

To set up a deployment or a reservation:

1. **Choose the workload you want.**
   
   On the Workload Placement Page, click **FIND OPTIMAL PLACEMENT**. Turbonomic displays a list of templates. Choose the template you want, and click **SELECT**.

2. **Define the workload you want to deploy, and find its placement.**
   
   Set the number of workloads you want to deploy. Remember that the more workloads you set up in a reservation, the more resources that Turbonomic will set aside.
   
   In addition to choosing your workload, you can also set up constraints to limit how Turbonomic calculates the deployment.

3. **When you've finished making the settings, click **FIND PLACEMENT**.**
   
   Turbonomic runs a plan to calculate the placement for the workloads you specified. If it succeeds, it then shows the proposed placement. You can see details including:
   
   - For cloud placement, the cloud regions and storage tiers that will host the workloads.
   - For on-prem, the physical machine and storage that will host the workloads.

4. **Create a reservation or schedule a deployment.**
   
   Provide a name for the reservation or deployment. For a reservation, you provide the reservation name – Turbonomic prepends that name to all the VMs it deploys. For a scheduled deployment, you provide names of the individual VMs.
   
   For either a reservation or a scheduled deployment, you provide dates:
   
   - For a reservation, set the start and end date. Turbonomic reserves the resources for that time, and deploys the workload by the end date.
   - For a scheduled deployment, you specify the date when you want Turbonomic to deploy the workloads. By default, the deploy date is the day you define the placement. If the deploy date is today, then you can click **DEPLOY** to deploy the workloads immediately.

5. **Save your settings.**
   
   If you're creating a reservation, click **RESERVE**. For a deployment, click **DEPLOY**.
   
   For a deployment, if the deploy date is today, then Turbonomic deploys the workloads immediately. If the deploy date is later, or if you are creating a reservation, Turbonomic reserves the resources for the workloads, and deploys them on the specified date.
Dashboards: Setting Up Custom Views

If you have specific parts of your environment that you want to return to on a regular basis, you can make custom dashboard dashboards that focus on specific groups of entities, and that show specific details about these entities. You can make these in addition to the standard views that you can see on the Home Page, you can aso set up custom dashboards.

The Dashboards Page lists all the dashboards that are available to you, and you can also create new dashboards. To view a dashboard, click its name in the list.

Turbonomic stores custom dashboards on the platform server. When you create a dashboard, you can make it private to you, or make it visible to all Turbonomic users.
Dashboards: Setting Up Custom Views

There are two common approaches you can take to creating dashboards:

- **Scope First**
  You can create a dashboard where all the charts focus on the same scope of your environment. For example, you might want to create a dashboard that focuses on costs for a single public cloud account. In that case, as you add widgets to the dashboard, you give them all the same scope.

- **Data First**
  You might be interested in a single type of data for all the groups of entities in your environment. For example, each widget in the dashboard can focus on Cost Breakdown by Cloud Service, but you set the scope of each widget to a different cloud region or zone.

Of course, you can mix and match as you want. You can set any scopes or data sources to the widgets in a dashboard, to set up whatever organization and focus that you want.

A dashboard can contain any of the supported

### Creating and Editing Custom Dashboards

A custom dashboard is a view that you create to focus on specific aspects of your environment. You can create dashboards that are private to your user account, or dashboards that any user who logs into your Turbonomic deployment can see.

### Creating a Dashboard

To create a custom dashboard:

1. **Navigate to the Dashboard Page.**

   [Dashboard icon]

   Click to navigate to the Dashboard Page.

   This page lists all the dashboards that are available to you.

   You can select one or more of the listed dashboards and delete them.

   To view a dashboard, click its name in the list.
2. Create a new dashboard.
   Click **CREATE DASHBOARD** to add a new dashboard to your Turbonomic session. The dashboard appears with a default name, and with no chart widgets. The time range is set to 24 hours by default.

3. Name the dashboard.
   Give a name that describes the dashboard. If you will share the dashboard with all Turbonomic users, the name will help them decide whether to view it.

4. Optionally, set the dashboard access.
   Dashboard access can be:
   - **Only Me** – The dashboard is only available to your Turbonomic user account
   - **All Users** – Every user can see this dashboard
   By default, access is set to **Only Me**. To change the setting, click the **Gear** icon.

5. Add chart widgets to the dashboard.
   Add as many chart widgets to the dashboard as you want. See Creating and Editing Chart Widgets on page 64.

As soon as you create a new dashboard, it appears in the list on the Dashboard Page. Users with access to it can click the dashboard name in that list to view it. At any time, you can view your dashboard and:

- Add, edit, or delete widgets
- Change the dashboard name
- Change the dashboard access setting
Editing a Dashboard

If you have created a dashboard, you can change a dashboard's name or change its access settings. To edit a dashboard:

1. **Navigate to the Dashboard Page.**
   
   ![Image](image.jpg)  
   Click to navigate to the Dashboard Page.

2. **Click the name of the dashboard that you want to edit.**
3. **Click the dashboard's Gear icon.**

   ![Image](image.jpg)  
   Set dashboard access

   Open the dashboard's Edit flyout and make your changes.

   For the dashboard's Access, you can set:
   - **Only Me** – The dashboard is only available to your Turbonomic user account
   - **All Users** – Every user can see this dashboard

4. **When you're done, close the flyout panel.**
   
   Your changes take effect when you close the panel.

Creating and Editing Chart Widgets

Turbonomic displays information about your environment in various charts. To focus in on the information you need, you can add new chart widgets to scoped views and custom dashboards, and you can edit existing widgets. You can also change the display order of widgets in their respective views.

When you create or edit a chart widget, you will choose:

- Chart type
- Commodities to chart
- Display type (line, bar, tabular, etc.)
- Timeframe
- Other options
  
  You can set different display options and set a specific scope to the chart.
Create a Chart Widget

To create a new chart:

1. **Click the Add Widget or Add Chart button.**

   - On a scoped view, each chart has an **Add Chart** button above or below it. Click the button to add a new widget. The widget first appears in Edit mode.

   - On a custom dashboard, click the **Add Widget** button at the top-right. In a scoped view, the chart first appears in Edit mode.

2. **Make chart settings to determine the data that the chart will show.**

   - Choose a chart **Type** to set the kind of information you want to display.

   - The type of chart that you select determines what kind of data you can display and track in the chart. For example, if you choose a type of Commodities or Before After Utilization, then you can set which commodities to display in the chart. If you choose Actions, you can set a filter to limit the types of actions to show. Or if you choose Supply and Demand you can then set which consumer/provider pair to chart (VMs vs Hosts, Containers vs Storage, etc.).

   - The type of chart also determines other options you can set. For example, with a Commodities chart you can choose to show Peaks, and with a Supply and Demand chart you can choose to show density.
3. Set the chart's timeframe.

If you set timeframe to DEFAULT, then this chart will show the same timeframe that you set for all the other charts in the view. To hard-code the chart's timeframe, choose any of the other options.

4. Set the chart's scope.

By default, the chart you create will match the scope that you set for the current view. However, you can hard-code the chart scope so that it always shows the scope you choose.

Override Scope

For every type of chart, you have the option to hard-code the chart's scope. Select the Override Scope option to display the Entity Picker, and then choose the entity or group that you want.

5. Choose the Chart Display type.

Most widgets can display bar or line charts. Other choices can include tabular data or ring charts.
6. Set the parts of the chart to display.

**VISIBILITY**  

SHOW ALL | SUMMARY | CHART

Most chart widgets include a Summary section and a Chart section. Choose which of these to display in the chart.

---

**Chart Types**

The Turbonomic user interface gives you different views into the status of your environment. You can also create custom dashboards to save specialized views that focus on certain details about your environment.

You can add chart widgets to these views, and you can edit existing charts. For more information about views and creating charts, see:

- The Home Page on page 20
- Dashboards: Setting Up Custom Views on page 61
- Creating and Editing Chart Widgets on page 64

Turbonomic includes many different types of charts. To plan out custom dashboards, you should be familiar with the data each one presents.

---

**Actions Charts**

Use Actions charts to keep a running history of the actions that Turbonomic has recommended, which actions you have ignored, which ones you have executed manually, and which ones have been executed by Turbonomic.

This chart uses historical data from the Turbonomic database. You can set the chart to show hourly, daily, weekly, or monthly data points.

---

**Filter**

You can filter the chart to show all actions, or to just show all accepted actions (actions that have been executed).
Display

The chart displays as a stacked bar chart or as a tabular list:

- Stacked Bar

![Stacked Bar Chart Example]

- Tabular

![Tabular Chart Example]

Capacity and Usage Charts

These charts list the resources you want to view, showing their allocated capacity and the amount of that capacity that is in use.

Filter

You can filter these charts by entity type:

- Applications
- Data Centers
- Disk Arrays
Chart Types

- Networks
- Hosts
- Storage Devices
- Virtual Data Centers
- Virtual Machines

Depending on the entity type for the filter, you can add different resource commodities that you want to measure. For example, for a chart of Hosts, you can measure commodities such as CPU, Memory, ready queue, and even network flow between VMs that are on the same host (In-Provider flow) or on other hosts (In-DPOD or Cross-DPOD flow).

Cloud Templates Chart

These charts give you a breakdown of the templates that you're using for workloads on the public cloud.

You can create charts that show Cloud Template Summary By:

- Type – Counts of each type of template that you're using in the chart's scope
- Family – Counts of templates in each family that you're using in the chart's scope
- Zones – Templates that are in use in the different cloud zones that are in the chart's scope
- CSP – Templates that are hosted by each cloud service provider for workloads in the chart's scope

Cloud Cost Breakdown Charts

To keep track of your spend on the public cloud, you can see costs by cloud service, cloud account, cloud provider, and budget group. In this way, you can go to the Cloud Overview to quickly see how your cloud costs develop over time.

Cost breakdown charts can track costs by:

- Cloud Service

To evaluate your use of different services, you can follow your expenditure for each one. For example, if you purchase Amazon Cloudwatch, you can see that cost over time. Note that for AWS clouds the service names begin with "Amazon" or "AWS". Other services show the names as they are presented in the service provider's billing report.
• **Cloud Account**

![Cost breakdown by Cloud Account](image)

$11,843.280 /mo  
Total Cloud Cost

Each public cloud target that you configure for Turbonomic represents a public cloud account. If you have targeted numerous accounts, then this chart gives you a quick read out of your costs per each one. You can see whether one account shows unusually high cost, or perhaps an account is hardly used at all and you can consider closing it down.

• **Cloud Service Provider**

![Cost breakdown by Cloud Service Provider](image)

$11,843.280 /mo  
Total Cloud Cost

You can open more than one account from a single service provider. If you are running workloads on different service providers, then this chart shows the distribution of costs across them.
• Cloud Budget Group

Budget groups specify the monthly expenditure you want to devote to workload on the public cloud. You can create budget groups for one or more public cloud targets. This chart show the history of cost for a given budget group.

Cost Data Source

Turbonomic uses the billing reports from your cloud service providers to build a picture of your overall spend. The data includes all costs that the service provider includes in the billing report. Turbonomic parses these reports into the formats it uses for the cost breakdown charts.

**NOTE:** In order for Turbonomic to access AWS monthly reports, you must create a cost and usage report in your AWS account and store it in an S3 bucket. For more information, see the Green Circle article, [https://greencircle.vmturbo.com/docs/DOC-4613](https://greencircle.vmturbo.com/docs/DOC-4613).

Reading a Cost Breakdown Chart

The chart tracks overall cost over time. The chart time scale matches the time scale you set for the overall view (for the Overview, Cloud, or Details view). It includes a vertical line to show when the last data point that was polled from your environment. Data points to the right of the vertical line are projections into the future.

**NOTE:** This cost information comes from billing reports. As you change the time scale, Turbonomic divides the reported information into the appropriate time units to match that scale. However, the source remains the same - Changing the scale does not affect the source data, or increase data polling.

The line chart shows expenses figured as overall cost per hour. The chart displays a tooltip with the date for the data point, and the given values.
Density and Headroom Chart

These charts show the number of workloads per host or storage, and they show the desired count of workloads, assuming you want to fill the headroom completely. Note that the Desired Workloads values are the results of running plans. These plans can calculate workload moves within a cluster to gain more efficiency, but they always respect the cluster boundaries – the plans never move VMs to hosts on different clusters.

You can specify the following types of Density and Headroom charts:

- Active Virtual Machines vs Hosts
- Active Virtual Machines vs Storage
- Containers vs Hosts
- Containers vs Storage
- Active Virtual Machines vs Hosts and Storage
- Containers vs Hosts and Storage
- Headroom – The total number of workloads running in the chart’s scope, plus the total headroom for that scope
- Host and Storage Units – The numbers of active Hosts and Storage devices

Expenses Charts

To help you manage costs for your public cloud environment, Turbonomic tracks compute, storage, license, and IP costs for the workloads in your environment. Are you spending too much on your cloud resources? Do you have room in your budget to run more workloads on a cloud account? Use expense charts to keep track of these costs over time.

You can optionally set up Budget Groups to assign a monthly spend to given public cloud providers. Then you can create charts that show the historical spend for those providers in relation to the specified budget. Turbonomic recommends that you create a single Budget Group to set one budget for all of your providers.

**NOTE:** To take full advantage of Turbonomic management of workloads on the public cloud, you must set up a cloud budget for the cloud targets that you want to manage. Turbonomic recommends that you create a single budget to track all of your public cloud targets. For more information about cloud budgets, see Creating a Cloud Budget on page 96.
Types of Expense Charts

You can create the following types of Expense charts:

- **Expenses**
  See your hourly expenses over time, as well as overall monthly and yearly costs.

- **Cost Breakdown by Cloud Service Provider**
  Costs over time for each cloud service provider that you use in your cloud environment. For example, you can compare the costs you incur on AWS to costs on Azure.

- **Cost Breakdown by Cloud Account**
  Costs over time for each account that you have set up as a target in Turbonomic.

- **Cost Breakdown by Cloud Budget**
  If you have more than one budget set up for your cloud environment, this chart shows costs over time for each one.

- **Cost Breakdown by Cloud Service**
  This chart shows costs over time for each cloud service that you use in your cloud accounts. For example, you can see the cost for AWS CloudWatch, compared to the cost for AWS S3 storage.

- **Cost Breakdown by Component**
  This chart shows costs over time for each component of your cloud utilization. You can see costs for:
  - Compute
  - IP (static IPs for workloads)
  - License (OS license)
  - Storage
  - Capacity

Reading the Expenses vs Budget Chart

![Expenses vs Budget Chart]

The chart tracks overall workload compute expenses over time. The chart time scale matches the time scale you set for the overall view (for the Overview, Cloud, or Details view). It includes a vertical line to show when the last data point that was polled from your environment. Data points to the right of the vertical line are projections into the future.

The line chart shows expenses figured as overall cost per hour. The red horizontal line shows your budget. If your costs are within budget, then they fall below the budget line. To see specific values, hover on a data point. The chart displays a tooltip with the date for the data point, and the given values.
Health Charts

Health charts show the current status of your environment, by entity type. For example, you can choose to show the health of all hosts in your environment, or the health of all the workloads running on a public cloud region.

Filter

You can filter these charts by entity type:

- Applications
- Data Centers
- Disk Arrays
- Networks
- Hosts
- Storage Devices
- Virtual Data Centers
- Virtual Machines

You can set the display to:

- Text
- Ring Chart
- Horizontal Bar

Improvement Statistics Charts

Turbonomic automatically executes or recommends actions, depending on the policies that you set up. For the recommended actions, you can use Improvement Statistics charts to show how utilization of resources would change assuming you accept all of the pending actions. These charts list the associated commodities, comparing the current utilization to the utilization you would see if you accepted all the pending actions.
Filter
You can filter by resource type:
• Application Resources
• Consumed Application Resources
• Historical Performance
• Workload Density
• Compute Resources
• Provided Compute Resources
• Consumed Compute Resources
• Storage Resources
• Network Resources

Display
The chart lists the given resources, comparing current utilization with the expected utilization after you execute all pending actions.

Multiple Resources Charts
For a given entity type, see the historical utilization of whichever commodities you want to track.

Filter
You can filter these charts by entity type:
• Applications
• Data Centers
• Disk Arrays
• Networks
• Hosts
• Storage Devices
• Virtual Data Centers
• Virtual Machines

Depending on the entity type for the filter, you can add different resource commodities that you want to measure. For example, for a chart of Hosts, you can measure commodities such as CPU, Memory, ready queue, and even network flow between VMs that are on the same host (In-Provider flow) or on other hosts (In-DPOD or Cross-DPOD flow).

Optimized Improvements Charts
Turbonomic automatically executes or recommends actions, depending on the policies that you set up. For the recommended actions, you can use Optimized Improvements charts to show how utilization of resources would change assuming you accept all of the pending actions.
Filter
You can filter Optimized Improvements charts by entity type:

- Applications
- Data Centers
- Disk Arrays
- Networks
- Hosts
- Storage Devices
- Virtual Data Centers
- Virtual Machines

Depending on the entity type for the filter, you can add different resource commodities that you want to measure. For example, for a chart of Hosts, you can measure commodities such as CPU, Memory, and even network flow between VMs that are on the same host (In-Provider flow) or on other hosts (In-DPOD or Cross-DPOD flow).

Display
The chart shows two bar charts for the entities that are in scope – One chart for current consumption, and the other for the consumption you would expect to see if you accept all the pending actions.

Pending Actions Chart
Pending actions show the actions that Turbonomic recommends to improve the current state of your environment. This chart gives an overview that includes how many actions are pending, and the estimated savings or costs associated with those actions.
Display

You can set the following types of display:

• Text
  The counts of Placement actions and Scaling actions for the current scope. If the chart's scope includes public cloud entities, then the chart also shows estimated savings and costs associated with the actions.

  ![Pending Actions](chart.png)
  
  **$6,000**
  
  **$650**
  
  **$505**
  
  **$246**
  
  **Estimated Savings**
  
  **Estimated Cost**
  
  **89** Placement Actions
  
  **73** Scaling Actions

  Show all 162 Actions

• Ring Chart
  The counts of different actions for the current scope. The ring chart gives a quick visual indication of the kinds of actions that are pending.

  ![Pending Actions](chart.png)
  
  **3** Start Actions
  
  **97** Placement Actions
  
  **8** Scaling Actions

  Show all 108 Actions

• Horizontal Bar
  The counts of Placement actions and Scaling actions for the current scope. The horizontal bar gives a quick visual indication of the kinds of actions that are pending.

  ![Pending Actions](chart.png)
  
  **81** Placement Actions
  
  **75** Scaling Actions

  Show all 156 Actions
• List
  An abbreviated listing of the actions for the chart's scope. So see the full list, along with action details and controls to execute actions, click the Show All link at the bottom of the chart.

Risks Avoided Charts

As you execute the actions Turbonomic has recommended, you improve your environment's health and avoid risks to performance or budget. These charts show how many risks you have avoided over time.

You can set the display to:

• Text
• Ring Chart
• Horizontal Bar

Top 5 Utilized Charts

You can create charts that show entities or groups that show the most utilization of resources. For example, see the Top 5 Clusters by utilization of MEM and CPU.

Filter

You can filter Top 5 charts by entity type:

• Accounts (public cloud)
• Applications
• Clusters (of hosts)
• Data Centers
• Disk Arrays
• Networks
• Hosts
• Storage Devices
• Virtual Data Centers
• Virtual Machines
• Volumes

Depending on the entity type for the filter, you can add different resource commodities that you want to measure. For example, for a Top 5 Storage Devices chart, you can measure commodities such as Storage Access, Storage Latency, and Storage Provisioned.

**Display**

The chart lists the top entities by consumption of the commodities that you have set. To drill down to an entity, click the entity name in the chart. This sets the scope of the Turbonomic to that entity.
Volume Tier Breakdown Charts

To help you manage costs on the cloud, these charts show the storage that hosts your workloads, broken down by the storage tiers they run on. In this way, you can see how storage utilization affects your costs.

You can set the display to:

- Text
- Ring Chart
- Horizontal Bar
Reports: Viewing Historical Data

Select a report to generate, clone, or delete it

Add a new report to the list

Click report name to edit settings

The Turbonomic database stores a history of your managed environment. Turbonomic ships with a list of standard reports that give you selective snapshots of this history. The Reports Page gives you access to these reports – On this page you can:

- View reports – Generate up-to-the-minute reports or view saved reports (see Viewing Reports on page 82)
- Schedule reports to be generated at regular intervals (see Scheduling Reports on page 84)
Storage of Generated Reports

Whenever you generate a report, Turbonomic saves the report file on the server. When setting up subscriptions, be sure to choose reports that are useful for your organization. For example, assume you set up a daily subscription to a *Monthly Overview with Cluster Summary* report. It’s likely that you could make do with a monthly subscription to such a report. Generating these reports daily can needlessly consume storage on the Turbonomic server.

You can set up subscriptions in a way that minimizes storage consumption. For example, if you make a weekly subscription to a report on Mondays, and then subscribe to the the same report on Fridays, Turbonomic will save two copies of that report every week. Instead, make two subscriptions to the report on the same day, to save only one copy of the report each week.

Viewing Reports

To view a report, first select the type of report you want from the list. 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.

To view a report, first select the type of report you want from the list. 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.

Viewing an Up-To-The-Minute Report

To view a current report, you can:

- Create a new report and generate a copy
- Select a report in the list, and generate a copy

To create a new report and generate, click **NEW REPORT** in the Reports Page, and choose the type of report you want. Then make the settings you want:

- Format – Choose PDF or XLS.
- Schedule – You can leave this report unscheduled.
- Recipients – If you want to email the report, specify the addresses of the recipients.
When you're done, click **GENERATE** – Turbonomic generates the file and either sends it to your browser or sends it to the email addresses you specified.

To generate an up-to-the-minute copy from the list of scheduled reports, select the item in the list and click **GENERATE**. Turbonomic uses the current settings for this report to generate the file, and either sends it to your browser or sends it to the email addresses you have specified in the report's settings.
Viewing Saved Reports

Whenever it generates a report, Turbonomic saves the report on the server. For a scheduled report that is in the list on the Reports Page, you can go back to these saved reports and view them.

To view a saved report:
1. **On the Reports Page, click the name of the report you want to view.**
   This opens the CONFIGURATION flyout page.
2. **Display the GENERATED REPORTS tab on the flyout.**
3. **Set a date range.**
   Turbonomic lists and copies of this report that were generated within that date range.
4. **Click a list entry to see the report.**

Scheduling Reports

When you schedule a report, Turbonomic generates a copy of it at the times you specify. To set up a subscription, you can provide email addresses of the recipients and Turbonomic will mail the report at the specified intervals.

The Reports Page gives you access to the reports that are available on your instance of Turbonomic. Use this page to:

- Choose the reports you want to see
  Turbonomic ships with a full compliment of reports. To manage reports, you set up a list of the reports you want.
- Generate up-to-the-minute reports, on demand
- Schedule reports to be generated at regular intervals
To set up a subscription:

1. Navigate to the Reports Page.

   ![Reports Icon] Click to navigate to the Reports Page.

This page lists all the reports that you currently have set up and scheduled. You can select one or more of the listed reports and:

- **Generate the selected report to see the latest data**
  When you generate a report, you can choose to email it to its subscribers, or you can download the report to your browser.

- **Clone the selected reports to add new items to the list**
  After you clone a report, click the new report's name to change the report's configuration.

- **Delete selected reports to remove them from the list**
  This removes the report from the list, and cancels any schedules. However, this does not delete any report files that were already generated and saved on the Turbonomic server.

To edit a report's configuration, click the entry in the list. This opens the Report CONFIGURATION fly-out where you can make your changes. Be sure to save your changes when you're done.
2. Configure a report and add it to the list.

To start configuring a report, click **NEW REPORT**. The next step is to choose the type of entities you want to report on. For example, choose Virtual Machines or Hosts. Turbonomic ships with a set of predefined reports for each entity type.

For the report type that you choose, you then set up the report configuration:

- **Schedule**
  How often Turbonomic will generate the report.

- **Scope**
  If present, you must choose a group or an entity to set the scope of the report.

- **Format**
  Specify whether to generate PDF or XSL reports.

- **Recipients**
  Specify one or more email addresses to create subscriptions. Turbonomic will email the report to the specified recipients at the scheduled intervals. You can add as many recipients as you want.

3. **When you're finished making the settings, click SAVE.**

   Turbonomic adds the report to the list on the Reports Page, and generates copies of it at the scheduled intervals.
Configuring Targets

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. When you configure a target, you specify the address of the service, and the credentials to connect as a client to it.

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

To configure a target, you will choose the target type, specify the target's address, and then provide credentials to access the target.

1. Navigate to the Settings Page.

   ![Settings Icon] Click to navigate to the Settings Page. From there, you can perform a variety of Turbonomic configuration tasks.

2. Choose Target Configuration.

   ![Target Configuration Icon] Click to navigate to the Target Configuration Page.
3. Filter the list of targets.

To work with a long list of targets, you can filter by the target type. You can also type a string in the Search field to filter the list, and you can sort the list by target status or target name.

4. Select one or more targets to work with.
When you select a target you can:

- **Rediscover** — Direct Turbonomic to fully discover the entities that this target manages. This will rebuild the topology that is associated with this target.
- **Validate** — Direct Turbonomic to validate its connection with the target. For example, if you create a new user account on the target, you can edit the target connection to use that account, and then revalidate.
- **Delete** — When you delete a target, Turbonomic removes all the associated entities from its model of the inventory.

5. **Expand an entry to see details, or click the entry to edit the target’s configuration.**
   For example, if you entered the wrong username or password, you can change those credentials and validate the target again.

6. **Create a new target and add it to Turbonomic.**
First, select the type of target to add. Then for the type you choose, select the specific target technology. For example, select Hypervisor/vCenter to add a VMware vCenter Server target. Then provide the address and credentials for that target.

For more details, including a list of supported targets and configuration requirements, see the Turbonomic Target Configuration Guide.
Setting Up Business Rules

Turbonomic includes a number of ways that you can guide its analysis to recommend actions that satisfy your business requirements. You can set up parameters, or business rules, that enforce placement of certain workloads on specific hardware, set limits to resource allocations, and constrain Turbonomic actions in other ways.

Note that Turbonomic works to keep your environment as efficient as possible (use as few resources as possible) while also assuring the performance of your applications. A pure environment with no constraints or placement rules would result in Turbonomic actions that only consider the optimal utilization of resources. In real-world applications it is often necessary to impose constraints.

To learn more about setting up business rules in Turbonomic, see:

- **Creating Groups** on page 92
  Creating groups is a powerful way to divide your environment into logical sets of entities. You can use these groups to set scope for views and charts. Groups are also very useful to set scope for actions and policies.

- **Creating a Cloud Budget** on page 96
  A budget group specifies the monthly expenditure you want to devote to keeping workload on the public cloud. You can create a budget group for one or more public cloud targets. You can use budget groups in Expense vs Budget charts to track how your workload expenses compare to your budget.

- **Creating Placement Policies** on page 100
  Use workload policies to restrict certain workloads to specific hardware. For example, always place critical applications on gold-standard hardware, or to make sure certain workloads never run on specific hardware entities.
  You can also use placement policies to remove cluster constraints. Another placement policy can identify licensed hardware, and always make sure there is room on the hardware for applications that require those licenses.

- **Automation Policies** on page 104
  Create policies that determine how Turbonomic will execute recommended actions for a given scope.
Creating Groups

Groups assemble collections of resources for Turbonomic to monitor and manage. When setting scope for your Turbonomic session, 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 discovers groups that exist in your environment. These groups include PM clusters, and entities grouped by different logical boundaries. For example, Turbonomic discovers Storage by Disk Array, Physical Machines by Datacenter, and VMs by Network. In addition, Turbonomic discovers pools such as virtual datacenters, or folders that implement specific HA policies.

You can also create custom groups. Turbonomic supports two custom-grouping methods:

- **Dynamic** — You define these groups by specific 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. These groups are dynamic because Turbonomic updates the group as conditions change.
- **Static** — You create these groups by selecting the specific group members.

1. Navigate to the Settings Page.

   ![Settings](image)

   Click to navigate to the Settings Page. From there, you can perform a variety of Turbonomic configuration tasks.

2. **Choose Groups**.

   ![Groups](image)

   Click to navigate to the Group Management Page.
This page lists all the custom groups that you currently have configured for Turbonomic. You can:

- Expand an entry to see group details
- Select an entry to delete the group
- Click a group name to edit it
  - For a dynamic group, you can edit the set of criteria that select the group members. For a static group, you can add or subtract specific members.
- Create new groups

To work with a long list of groups, you can filter by group type. For example, only show groups of VMs, or groups of host machines. You can also type a string in the Search field to filter the list, and you can sort the list by severity (per the most critical entity in group) or group name.
3. Expand an entry to see group details.

The details show you information about related entities such as how many hosts provide resources for a group of VMs. If there are any pending actions for the group, the details list those actions as well.

4. Create a new group.
First, select the type of entities that will be in the group. Then specify the group settings:

- Give the group a name
- Set whether the group will be static or dynamic
  - To create a static group, select the member entities from the list. To filter the list, set group criteria or enter a string in the Search field.
  - To create a dynamic group, set group criteria. The list updates to show the resulting group members.
- Specify group criteria
  - These criteria are entity attributes that determine group membership. You might create a group of all VMs that have 4 VCPUs. You can choose properties of the member entities, and you can choose properties of entities that are related to the members. For example, you can make a group of VMs that are hosted by PMs with the substring "Development" in their names.
  - As you set criteria, the list of entities updates to show the member entities.
  - Note that you can use regular expression to express your match strings.
- When you're finished, save the group
  - Save adds this group to the My Groups collection.

Cloud Budgets

Turbonomic uses Cloud Budgets to assign your desired monthly spend for your public cloud providers. You express this in real cost.

Turbonomic requires a cloud budget in order to calculate workload placement on the cloud. Turbonomic recommends moves and other actions based on the consumption of an allocated resource. On the cloud, the resource is actual cost. Assigning a budget is the way to allocate a resource – how much you are willing to spend – so that Turbonomic can determine how much of that resource capacity is currently in use.

To create a budget, you choose the public cloud targets for that budget to manage. Then for those targets, you specify the amount you want to spend per month.

**NOTE:** It is possible to create multiple budgets, but Turbonomic recommends that you create only one budget for the entire cloud. For example, assume you have two AWS targets and one Azure target. In that case, you could create individual budgets for each target, or create budgets that group similar targets together – say, one for the AWS targets, and another for the Azure target. However, Turbonomic recommends that you create a single budget for all three targets.

When you run a Migrate To Cloud plan, Turbonomic uses the budget to calculate optimal placement for the migrated workflow. For best results, you should ensure that the budget is high enough to account for the migrated workloads. Even if you set a budget very high, Turbonomic will still calculate optimal placement in plans and in real time. But if the budget is too low, then a migration plan might calculate that you have insufficient resources to place the migrated workflows.
Creating a Cloud Budget

A cloud budget specifies the monthly expenditure you want to devote to keeping workload on the public cloud. You can create a budget for one or more public cloud targets, but it's best to create one budget for all of your cloud environment.

Before you can create a budget, you must have at least one public cloud target set up for your Turbonomic installation.

**NOTE:** While you can create multiple budgets, a single target cannot have more than one budget assigned to it. Assume you have two targets – CloudA and CloudB. Now assume you have created a single budget to manage both targets. In that case, you cannot create a second budget to manage either target. For example, you cannot create a second budget to manage CloudA.

To create a budget:

1. **Navigate to the Settings Page.**
   
   Click to navigate to the Settings Page. From there, you can perform a variety of Turbonomic configuration tasks.

2. **Choose Budget Management.**

3. **Inspect the list of Budgets.**

   This page lists all the budgets that you currently have configured for Turbonomic. You can:
   - Click an entry to see details and edit the budget
   - Select an entry to delete the budget
   - Create new budgets
4. Create a new budget.

First click **CREATE BUDGET**, then specify the settings:
- Give the budget a name
- Choose the cloud targets to budget
  You can create a budget for one or more public cloud targets. Plan your budgets carefully. You cannot add the same target to more than one budget.
- Specify a Monthly budget period
  Currently, Turbonomic supports monthly budgeting.
- Specify a Monthly budget period and amount
  Use **BUDGET AMOUNT** to specify the monthly expense limit you want to maintain for workloads managed by this budget group. For example, you might want to keep your costs within $15,000.00 a month.
- When you're finished, click **ADD** to save the budget.
Setting Policies

Policies set business rules to control how Turbonomic analyzes resource allocation, how it displays resource status, and how it recommends or executes actions. You can work with two kinds of policies:

- **Placement Policies**
  To modify workload placement decisions, Turbonomic divides its market into segments that constrain the valid placement of workloads. Turbonomic discovers placement rules that are defined by the targets in your environment, and you can create your own segments.

- **Automation Policies**
  Turbonomic ships with default settings that we believe will give you the best results from our analysis and control. But for some scopes of your environment, you might want to change these settings. For example, you might want to change action automation for that scope, or change the utilization constraints.

The Policy Management page shows all the currently defined policies. You can:

- Select an entry to delete the policy
- Click an entry name to edit the policy
  You can enable or disable discovered placement policies. For a Turbonomic segment (a placement policy that was created in Turbonomic), you can edit the policy definition as well as enable/disable it.
- Create new policies
To see the policies that are applied to a scope, go to the Search page and set the Turbonomic session to that scope. Then show the Policy view. For more information, see Details View on page 36.

Things You Can Do

- Manage Imported Placement Policies – Importing Workload Placement Policies on page 99
- Create a Placement Policy – Creating Placement Policies on page 100
- Create an Automation Policy – Automation Policies on page 104
- Create an Orchestration Policy – Setting Up Action Orchestration on page 118

Placement Policies

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 99 — Review the placement policies that Turbonomic has discovered. These are policies that have been defined in your environment, outside of Turbonomic.
- Creating Placement Policies on page 100 — that restrict workload placement according to specific rules

NOTE: You can enable or disable any imported policy or created workload placement segment.

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 as you wish. By default, Turbonomic enables imported placement policies.

Turbonomic imports:

- vCenter Server DRS Rules
- CloudStack Affinity Groups

For more information about these imported rules, see the Target Configuration Guide.

To see the list of imported placement policies for your environment, navigate to the Policy Management Page (see Setting Policies on page 98).
Creating Placement Policies

Placement Policies set up constraints to affect how Turbonomic calculates the placement of workloads in your environment. In this way, you can direct Turbonomic to recommend actions that satisfy business rules for your enterprise.

Turbonomic discovers Placement policies that have been defined in your environment, and you can also create Placement policies through the Turbonomic user interface. Note that you can enable or disable any Placement policy, both for real-time analysis and for planning scenarios.

Turbonomic supports the following placement policies:

- **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
  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.

- **License** — Set up hosts with paid licenses to be the preferred providers for VMs or applications that require those licenses
  If you purchase licenses for hosts to run specific software, you want to place as many licensed VMs or applications on a licensed host as possible. A license segment identifies a group of host machines that provide a given license, and a group of VMs or applications that consume that license. When Turbonomic calculates workload placement, it will avoid moving the VMs to hosts that don’t provide the license, and will try to consolidate workload on as few licensed hosts as possible.

1. **Navigate to the Settings Page.**
   - Click to navigate to the Settings Page. From there, you can perform a variety of Turbonomic configuration tasks.

2. **Choose Policies.**
   - Click to navigate to the Policy Management Page.
   - This page lists all the policies that you currently have configured for Turbonomic.
3. Create a new Placement policy.

First, select the type of Placement policy to create, then specify the settings:

- Give the policy a name
- Choose the policy type and make the settings
- Save the policy when you're done
4. **Create a Place policy.**

**POLICY NAME**

<table>
<thead>
<tr>
<th>TYPE</th>
<th>PLACE</th>
<th>DON'T PLACE</th>
<th>MERGE</th>
<th>LICENSE</th>
</tr>
</thead>
</table>

**PLACE**

Choose consumer type.. ✸ SELECT GROUP

**ON**

Choose provider type... ✸ SELECT GROUP

- Limit workload entities to placement group
- Limit the maximum number of workload entities per placement entity to

These policies 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.

- **Specify the consumer group** — The group or cluster of entities that will be placed on the identified providers
- **Specify the provider group** — The group or cluster of entities that will provide resources to the consumers
- **Limit workload entities to placement group** — Set the policy to only place consumer entities on members of the provider group
- **Limit the maximum number of workload entities per placement entity to** — Limit how many instances of the consumer entities can be placed on a single provider

5. **Create a Don't Place policy.**

**POLICY NAME**

<table>
<thead>
<tr>
<th>TYPE</th>
<th>PLACE</th>
<th>DON'T PLACE</th>
<th>MERGE</th>
<th>LICENSE</th>
</tr>
</thead>
</table>

**DON'T PLACE**

Choose consumer type.. ✸ SELECT GROUP

**ON**

Choose provider type... ✸ SELECT GROUP
These policies 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.

- **Specify the consumer group** — The group or cluster of entities that will be excluded from the identified providers
- **Specify the provider group** — The group or cluster of entities that will not provide resources to the consumers

6. **Create a Merge policy.**

   POLICY NAME

   TYPE

   PLACE | DON'T PLACE | MERGE | LICENSE

   MERGE

   Choose consumer type..  SELECT CLUSTERS

To remove cluster boundaries you can create Merge policies. These policies 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.

For merge policies, keep the following considerations in mind:

- For most policies that merge host and storage clusters, the clusters you place in the Merge segment must be members of the same datacenter.
- For vCenter environments, use Merge policies to support cross-vCenter moves. In this case, where a datacenter corresponds to a given vCenter target, the merged clusters can be in different datacenters.
- For cloud environments, you can create policies to merge datacenters. Use these merge policies to support Migrate to Cloud plans or to support VM moves that find better costs on other zones.

To create a Merge policy, choose the type of entity to merge, and then select the groups you will merge.
7. **Create a License policy.**

<table>
<thead>
<tr>
<th>POLICY NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

   | TYPE |
   | PLACE | DON'T PLACE | MERGE | LICENSE |

   | LICENSE |
   | Choose consumer type.. |
   | SELECT GROUP |

   | ON |
   | Choose provider type... |
   | SELECT GROUP |

   These policies keep VMs and applications that use a specific license running on the hosts that provide that specific license. For example, assume you have purchased a number of licenses for a database — You pay for the right to run that database on a certain number of host sockets. In that case, it’s most advantageous to do two things:
   - Only place the associated workload on hosts that have the license assigned to them
   - Consolidate workload on those hosts as much as possible, in case you can suspend a host and save on licensing cost

   In the Turbonomic market, consumers purchase resources from providers. In a license policy, the consumers get a reduced price for resources from the hosts in the Provider Group. The result is that the workload will have strong tendency to be placed on these hosts. This helps to meet the goal of consolidating the workload on the licensed hosts. However, if the licensed hosts don't have enough capacity, then the workload can be placed on other hosts. In that case, Turbonomic will also recommend provisioning a new licensed host.

   To create a License policy:
   - Specify the consumer group — The group or cluster of entities that get priority to run on the providers
   - Specify the provider group — The group or cluster of hosts that are to give priority to the identified consumers

8. **When you have made all your settings, be sure to save the Policy.**

**Automation Policies**

As Turbonomic gathers metrics, it compares the metric values against specified constraint and capacity settings to determine whether a metric exhibits a problem, and what actions to recommend or execute to avoid a problem. With these policies you can set:

   - **Action Automation** — Whether to execute automatically or manually, or whether to just recommend the action
   - **Action Orchestration** — Whether to have Turbonomic execute the action, have Turbonomic direct an orchestrator to execute the action, or execute the action with Action Scripts

   - **Analysis Settings** — Settings that affect the Turbonomic analysis of the state of your environment. These include:
     - **Operational Constraints** such as enabling HA on VMs or ignoring hyperthreading on hosts
     - **Utilization Constraints** such as memory or CPU utilization
     - **Resize Increments**
     - **Application Priority**
You assign an Automation Policy to a scope in your environment. For example, you might want to automate all VM moves and resizes in a development cluster. With these policies you can introduce automation of actions in a controlled way, for specific scopes of entities in your environment.

**About Policy Scope**

Policy scope determines which entities will be affected by the settings you make. To set scope, you assign one or more groups to the policy. (For information about creating groups, see Creating Groups on page 92.)

It's possible to set up policies with conflicts on individual entities. Assume two groups, Group_A and Group_B. Now imagine that one host is a member of both groups. For example, the host cluster is one group, and you might have included the host in a custom group. What happens if you create two different Automation Policies, one for Group_A and another for Group_B? In that case, the host can have different policy settings.

For example, the Group_A policy could set the Suspend action to Manual, while the default for Group_B is Recommend. Note that Turbonomic always uses the most conservative setting. For this case, the Recommend setting is most conservative, so it wins.

**About Policy Schedules**

You can set a schedule for an automation policy. The schedule acts as a window of time. When that window is open, the scheduled policy takes effect. A typical use for scheduling policies is to automate disruptive actions during a period of low activity.

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**NOTE:** Turbonomic 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.

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:** For VM policies you can enable Enforce Nondisruptive Mode, and then schedule action windows to automate resize actions during downtimes. Be aware that scheduled actions do not respect the enforced nondisruptive 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 information about Nondisruptive mode, see "" in the Turbonomic User Guide.
Creating an Automation Policy

To create a policy:

1. **Navigate to the Settings Page.**

   ![Settings Icon] Click to navigate to the Settings Page. From there, you can perform a variety of Turbonomic configuration tasks.

2. **Choose Policies.**

   ![Policies Icon] Click to navigate to the Policy Management Page.

   This page lists all the policies that you currently have configured for Turbonomic.

3. **Create a new automation policy.**

   ![Automation Policy Icon]

   The first step is to select the policy type. This sets the type of entity that your policy will affect. Note that Turbonomic supports different actions for different types of entities. For example, you cannot add VMem to a storage device. Setting policy type is the first step you take to focus on which actions you want to map to your workflows.
4. **Name the policy.**

Once you have chosen the policy type, you can make all your policy settings. Start by giving the policy a useful name.

5. **Set the policy scope.**

Expand the **SCOPE** section and choose one or more groups to set as the policy's scope. You can choose from groups of entities that match the type of entity you have set for the policy. You can also create new groups and add them to the policy scope.

The scope determines which entities this policy will affect. Click **SCOPE** to expand the section, and then add one or more groups. When you click **ADD GROUPS**, Turbonomic displays a list of all the groups of entities that match the policy type. You can also create new groups if necessary.
NOTE: A single entity can be a member of multiple groups. This can result in a conflict of settings, where the same entity can have different Action Policy settings. For more information, see Setting Policies on page 98.

6. **Optionally, set a schedule for the policy.**
   Expand the **SCHEDULE** section and specify the schedule parameters.

   ![Configure Virtual Machine Policy](image)

   The schedule’s 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.
   - If you don’t want an end date for the schedule, turn on the **Perpetual** option.
   - 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.
Now that you have named the policy and set its scope, you can make the settings that affect Turbonomic analysis and action recommendations. The settings you can make are:

- Action modes – see Setting Action Modes on page 109
- Action orchestration – see Setting Up Action Orchestration on page 118
- Analysis settings – see Analysis Settings on page 123

### Setting Action Modes

To avoid problems in your environment, Turbonomic analysis identifies actions that you can execute to keep things in optimal running order. Action modes specify the degree of automation you want for these given actions. For example, in some environments you might not want to automate resize down of VMs because that is a disruptive action. You would use action modes in a policy to set that business rule.

Turbonomic supports the following action modes:

- **Disabled** — Do not recommend or perform the action
  When you disable an action, the user interface hides all of the action modes.
- **Recommended** — Recommend the action so a user can execute it via the given hypervisor or by other means
- **Manual** — Recommend the action, and provide the option to execute that action through the Turbonomic user interface
- **Automated** — You have directed Turbonomic to execute the action automatically

To get the best results from Turbonomic’s Intelligent Workload Management, you should set as many actions as possible to Automated. If some clusters run applications that are highly critical, you can set them to Manual.

The available action modes are different for different types of entities, and for different targets that manage these entities. For a listing of the action modes that you can use for each type, see Action Modes on page 111.

**NOTE:** Turbonomic policies include Action Orchestration settings. These settings determine whether Turbonomic executes the actions, or whether to map the actions to workflows managed by external orchestrators. If you want to execute via an orchestrator workflow, you must set the action mode to Manual or Automated. For more information about action orchestration, see Setting Up Action Orchestration on page 118.

### 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.

Another disruptive action is resizing up to more than 4 vCPUs on Windows 2008 and Windows 2008 R2 systems. Even if Hot Add is enabled for the system, Turbonomic considers such a resize to be disruptive.
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.

You can enforce non disruptive mode in the default VM policy, and then schedule action policies 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.
**Set Action Modes**

After you have specified the policy's entity type, name, and scope, you can specify action modes. To set action modes:

1. **Set the action mode for the actions this policy affects.**

   ![Configure Host Policy](image)

   Choose an action... and set the automation mode

   Click **ACTION MODE** to expand the section, and then set up one or more actions. When you click **ADD ACTIONS**, Turbonomic displays a list of all the actions that are viable for the policy type. Choose an action and then set the action mode. You can set the mode for one or more actions.

   The action modes you can set are:
   - **Disabled** — Do not recommend or perform the action
     - When you disable an action, the user interface hides all of the action modes.
   - **Recommended** — Recommend the action so a user can execute it via the given hypervisor or by other means
   - **Manual** — Recommend the action, and provide the option to execute that action through the Turbonomic user interface
   - **Automated** — You have directed Turbonomic to execute the action automatically

2. **When you have made all your settings, be sure to save the Automation Policy.**

**Action Modes**

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.
indicates full automation support

indicates recommended-only actions

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.
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.

### 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.

### Action

<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>

### Action

<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>

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.
- **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.

**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

<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>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<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 (Remove)</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>Storage Move</td>
<td>✔</td>
<td>✔ -</td>
<td>✔ -</td>
<td>✔ -</td>
</tr>
<tr>
<td>Reconfigure (Change network and storage configurations)</td>
<td>✔ -</td>
<td>✔ -</td>
<td>✔ -</td>
<td>✔ -</td>
</tr>
<tr>
<td>Resize down (Change VCPU and memory capacities)</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Resize up (Change VCPU and memory capacities)</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Enforce Non Disruptive Mode</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>
### 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>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>
</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>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>(C-Mode, only)</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>XTremIO</td>
<td></td>
</tr>
</tbody>
</table>
### Setting Policies

#### Users Guide

### 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>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>
</tbody>
</table>
Setting Up Action Orchestration

Action Orchestration specifies whether Turbonomic will execute an action, or whether Turbonomic will pass the action request to an orchestrator that will execute a complete workflow to effect the change in your environment. In this way, you can integrate supported orchestrators to execute actions for specific scopes of entities in your environment.

About Orchestrators

Turbonomic supports orchestrator targets. For this release, you can set UCS Director targets to execute actions.

Action Orchestration targets assign workflows that execute multiple actions to make changes in your environment. Turbonomic discovers workflows that you have defined on the orchestrator. You can then set up an automation policy that maps workflows to actions. If the action mode is Manual or Automatic, then when Turbonomic recommends the action, it will direct the orchestrator to use the mapped workflow to execute it.

This section shows how to link orchestration workflows to automation policies. It assumes you have already configured an Orchestration target. It also assumes that you have configured workflows on that target in such a way that Turbonomic can discover the workflows and map them to actions. For information about Orchestration target requirements, see the Target Configuration Guide.

About Action Scripts

Action Scripts provide a script interface that can add custom processing to Turbonomic actions at the following entry points:

- Pre
- Post
- Clear

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.

For more information about Action Scripts, see Creating Action Scripts on page 121.
Specifying Action Orchestration

After you have specified the policy's entity type, name, and scope, you can specify Action Orchestration:

1. **For each action you want to execute, set which manager will run the action execution.**
   
   First click **ACTION EXECUTION** to expand the section, and then set up one or more actions. When you click **RUN IN**, Turbonomic displays a list of the supported action managers. For this release, the supported managers are:
   - **Turbonomic — Default:** Use the standard Turbonomic execution for this action. For this choice, you can optionally specify Action Scripts to run for this action.
   - **UCS Director —** Configure Turbonomic to call UCS Director to execute a workflow for this action. For this choice you must also link a UCS Director workflow to this action. Also, you can optionally specify Action Scripts to run for this action.
   - **Action Script —** Direct Turbonomic to bypass action execution and invoke an action script instead. For this choice, you can optionally specify Action Scripts to run for this action.

   ![ACTION ORCHESTRATION Diagram]

   **NOTE:** To set up action execution, that action's mode must be set to Manual or Automated. Also, you must be sure to match the actions that you have set in the **ACTIONS MODE** section for this scope. For example, if you have set the Suspend action to Automated, then you can choose that action here to set up **ACTION EXECUTION.** For more information about action modes, see Setting Action Modes on page 109.
2. To execute an action via UCS Director, link a workflow.

In the **ACTION EXECUTION** section, click **LINK WORKFLOW**. Turbonomic displays a list of all the UCS Director workflows that it has discovered in your environment. Choose the workflow that you want to run for this action. Remember, Turbonomic will run that workflow for this action on any of the entities affected by this policy.

**NOTE:** For any workflow to work with Turbonomic, the workflow’s configuration must include specific parameters. This list includes all workflows, whether they have been configured to work with Turbonomic or not. Also, when you choose a workflow, you must be sure it is a reasonable workflow for the policy type. For example, do not link a storage workflow to a host action.
3. Optionally, enable Action Scripts for this action.

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.
- **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).

In the **ACTION EXECUTION** section, click **ACTION SCRIPT** to show options for these entry points. If you enable an entry point, then Turbonomic will execute the script for this action at the indicated entry point.

For more information about Action Scripts, see **Creating Action Scripts** on page 121.

4. When you have made all your settings, be sure to save the Action Policy.

**Creating Action Scripts**

Action Scripts provide a script interface that can add custom processing to Turbonomic. 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 (do not specify an entry point in the filename)</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 entity this action will affect.

• VMT_TARGET_NAME
  The entity'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.

• VMT_STATE_NAME
  Gives the state of the action’s execution. Can be one of Succeeded or Failed. This variable is only available for POST_ and CLEAR_ action scripts.

• VMT_STATE_DESCRIPTION
  If execution has started, this gives the string, Start execution. This variable is only available for POST_ and CLEAR_ action scripts.
Analysis Settings

Turbonomic collects metrics to drive the analysis that it uses when it calculates actions for your environment. It compares current utilization and demand against allocated capacities for resources, so it can recommend actions that keep your environment in optimal running condition.

Action policies include settings that you can make to adjust the analysis that Turbonomic performs. For example, you can set different levels of overprovisioning for host or VM resources, and Turbonomic will consider that as a factor when deciding on actions.

Turbonomic ships with a set of default analysis settings. These settings take effect until you create and apply a policy with different values for any of the given settings. You can edit the defaults if you want to change analysis settings globally.

The settings you can make are different for different types of entities. The default policies show all the settings you can make for each policy type. For a listing and additional information about these settings, see the following descriptions:

- Applications and application servers Analysis Policies: Applications and Application Servers on page 125
- Disk arrays Analysis Policies: Disk Arrays on page 127
- Hosts Analysis Policies: Hosts on page 128
- Logical pools Analysis Policies: Logical Pools on page 130
- Storage controllers Analysis Policies: Storage Controllers on page 130
- Storage Analysis Policies: Storage on page 130
- Switches Analysis Policies: Switches on page 132
- Virtual application load balancers Analysis Policies: Virtual Applications on page 132
- VMs Analysis Policies: VMs on page 133
Analysis Settings in a Policy

After you have specified the policy's entity type, name, and scope, you can make analysis settings for the policy. To set make these settings:

1. Click to expand the type of analysis setting you want to make, and add a new setting.

For example, expand UTILIZATION CONSTRAINTS and then click Add Utilization Constraint. After you click to add the item, you then choose from a list of available settings. Once you add the setting to the policy, you can then change its value. Each setting you add to the policy takes precedence over the default value for that setting.
2. When you have made all your settings, be sure to save the Automation Policy.

**Analysis Policies: Applications and Application Servers**

Turbonomic tracks utilization of resources for applications and application servers that you have set up as targets.

*Default Settings*

**APPLICATION SERVER DISCOVERY**

<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>10000000</td>
</tr>
<tr>
<td>Threads Capacity</td>
<td>500</td>
</tr>
<tr>
<td>Transactions Capacity</td>
<td>10</td>
</tr>
</tbody>
</table>
APPLICATION PRIORITIES

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application Priority</td>
<td>Mission Critical</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 Edition, Turbonomic discovers the thread pool capacity on the server, and uses that in utilization calculations. For this release, the following types of supported application 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.

**Analysis Policies: Disk Arrays**

*Default Settings*

**STORAGE SETTINGS**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>VSeries LUN IOPS Capacity</td>
<td>5000</td>
</tr>
<tr>
<td>7.2k Disk IOPS Capacity</td>
<td>800</td>
</tr>
<tr>
<td>10k Disk IOPS Capacity</td>
<td>1200</td>
</tr>
<tr>
<td>15k Disk IOPS Capacity</td>
<td>1600</td>
</tr>
<tr>
<td>SSD Disk IOPS Capacity</td>
<td>50000</td>
</tr>
<tr>
<td>Disk Array IOPS Capacity</td>
<td>10000</td>
</tr>
<tr>
<td>DiskArray Overprovisioned Percentage</td>
<td>200</td>
</tr>
</tbody>
</table>

*DiskArray Provisioned*

How much overprovisioning Turbonomic assumes when recommending actions for disk arrays. For example, if a disk array has a 30 TB capacity, and DiskArray Overprovisioned Percentage is set to 200, Turbonomic will treat the datastore as though it has a capacity of 60 TB, or 200% of the actual disk array capacity.

*IOPS Capacity*

The capacity of IOPS (IO operations per second) that your storage devices can support. Turbonomic considers these settings when calculating utilization percentage. For example, assume IOPS Capacity of 5000 for a disk array. If utilization on the array is 2500 IOPS, then the disk array is at 50% of capacity for that metric.

Note that the IOPS setting for an array will determine IOPS calculations for all the storage on that array. If you made different IOPS settings for individual datastores hosted by the array, Turbonomic ignores the datastore settings and uses the disk array settings.

- Various Disk IOPS Capacity settings (**SSD Disk IOPS, 7.2k Disk IOPS**, etc)
  - IOPS capacity settings for the different types of physical drives that are discovered on a disk array. If the storage controller exposes the types of disks in the array, Turbonomic uses multiples of these values to calculate the IOPS capacity of the disk array.

- **Disk Array IOPS Capacity**
  - Some disk arrays do not expose data for their individual disks — This is typical for flash arrays, or arrays that aggregate storage utilization across multiple tiers. Turbonomic uses this setting for the IOPS capacity of such disk arrays. Set it to the global scope to specify IOPS capacity for all disk arrays. To override this setting, set a disk array or group of disk arrays as the property scope, and then set the value you want for **IOPS Capacity**.
NOTE: The user interface shows a disk array entity for any array that is discovered through a valid disk array or storage controller target. It also shows placeholder disk arrays for disk arrays that are not discovered through a configured target. For example, you might have disk arrays that Turbonomic does not natively support. Or you might have storage that is not hosted by any disk array. Such placeholder disk array entities appear with the string "DiskArray-" prefixed to their names. The user interface allows you to set IOPS Capacity to these placeholders, but those settings have no effect. To set IOPS Capacity for that storage, you must set it to the individual datastores.

**Analysis Policies: Hosts**

**OPERATIONAL CONSTRAINTS**

**Default Settings**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ignore Hyperthreading</td>
<td>Off Turbonomic calculates extra CPU capacity when it detects hyperthreaded sockets.</td>
</tr>
<tr>
<td>Ignore High Availability</td>
<td>Off Turbonomic discovers and manages HA policies.</td>
</tr>
</tbody>
</table>

**UTILIZATION CONSTRAINTS**

**Default Settings**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU Overprovisioned Percentage</td>
<td>1000</td>
</tr>
<tr>
<td>Host Memory Utilization</td>
<td>100</td>
</tr>
<tr>
<td>Host Net Throughput</td>
<td>50</td>
</tr>
<tr>
<td>Mem Overprovisioned Percentage</td>
<td>1000</td>
</tr>
<tr>
<td>Host Ready Queue Utilization</td>
<td>50</td>
</tr>
<tr>
<td>Host CPU Utilization</td>
<td>100</td>
</tr>
<tr>
<td>Host Swapping Utilization</td>
<td>20</td>
</tr>
<tr>
<td>Host IO Throughput</td>
<td>50</td>
</tr>
</tbody>
</table>

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 values you set here specify what percentage of the existing capacity that Turbonomic will consider to be 100% of capacity. For example:

- Setting 50 for Host Net Throughput means that Turbonomic considers 50% utilization of that throughput to be 100% of capacity and 25% utilization to be 50% of capacity
- Setting 1000 for Mem Overprovisioned Percentage means that overprovisioning memory by 5 times the physical capacity shows up as 50% utilization of the Mem Overprovisioned capacity in Turbonomic
- Setting 100 for Host Memory Utilization means that Turbonomic capacity reflects the physical capacity for this resource
**DESIRED STATE**

**Default Settings**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter</td>
<td>10</td>
</tr>
<tr>
<td>Center</td>
<td>70</td>
</tr>
</tbody>
</table>

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.

**INTERNAL TOPOLOGY SETTINGS: HYPER-V**

**Default Settings**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Additional Polling Cycles</td>
<td>5</td>
</tr>
</tbody>
</table>

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.

**NOTE:** This is a special-case setting, and you should only use it if you are in contact with Turbonomic Support.
**Analysis Policies: Logical Pools**

*Default Settings*

**STORAGE SETTINGS**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LogicalPool Overprovisioned Percentage</td>
<td>200</td>
</tr>
</tbody>
</table>

**LogicalPool Provisioned**

How much overprovisioning Turbonomic assumes when recommending actions for logical pools. For example, if a pool has a 30 TB capacity, and LogicalPool Overprovisioned Percentage is set to 200, Turbonomic will treat the pool as though it has a capacity of 60 TB, or 200% of the actual pool capacity.

**Analysis Policies: Storage Controllers**

*Default Settings*

**UTILIZATION CONSTRAINTS**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage Controller Storage Amount</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>Maximum allowed utilization of storage that is managed by the Storage Controller.</td>
</tr>
<tr>
<td>Storage Controller CPU Utilization</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Maximum allowed utilization of Storage Controller CPU (from 20 to 100).</td>
</tr>
</tbody>
</table>

**Analysis Policies: Storage**

*Default Settings*

**UTILIZATION CONSTRAINTS**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage Amount Utilization</td>
<td>90</td>
</tr>
<tr>
<td>Disk Array Storage Amount Utilization</td>
<td>90</td>
</tr>
<tr>
<td>Storage IOPS Utilization Utilization</td>
<td>100</td>
</tr>
<tr>
<td>Storage Latency Utilization</td>
<td>100</td>
</tr>
</tbody>
</table>
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 values you set here specify what percentage of the existing capacity that Turbonomic will consider to be 100% of capacity. For example, setting 90 for Storage Amount Utilization means that Turbonomic considers 90% utilization of the physical storage to be 100% of capacity.

**STORAGE SETTINGS**

**Default Settings**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Files to Ignore</td>
<td>Empty String</td>
</tr>
<tr>
<td>Disable Datastore Browsing</td>
<td>On</td>
</tr>
<tr>
<td>Directories to Ignore</td>
<td>.dvsData.*</td>
</tr>
<tr>
<td>Storage Latency [ms]</td>
<td>100</td>
</tr>
<tr>
<td>Storage Overprovisioned Percentage</td>
<td>200</td>
</tr>
<tr>
<td>IOPS Capacity</td>
<td>5000</td>
</tr>
</tbody>
</table>

- **Storage Overprovisioned Percentage**
  Storage Overprovisioned Percentage sets how much overprovisioning Turbonomic assumes when recommending actions for VM datastores. 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**
  IOPS Capacity is the IOPS setting for individual datastores. To set a specific capacity for one group of datastores, select that group as the property scope and override the global setting for that scope.
  Note that IOPS capacity for a disk array takes precedence — Datastores that are members of a disk array always have the IOPS capacity that is set to the disk array.
  Turbonomic considers these settings when calculating utilization percentage. For example, assume IOPS Capacity of 500 for datastores. If utilization on a datastore is 250 IOPS, then the datastore is at 50% of capacity for that metric.

- **Storage 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%.

- **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 ON 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. 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 (“|”).

**Analysis Policies: Switches**

**Default Settings**

**UTILIZATION CONSTRAINTS**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switch Net Throughput</td>
<td>70</td>
</tr>
</tbody>
</table>

**Analysis Policies: Virtual Applications**

**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.

**Default Settings**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Applicationi Transactionis Capacity [per sec]</td>
<td>1000</td>
</tr>
</tbody>
</table>
### Analysis Policies: VMs

#### OPERATIONAL CONSTRAINTS

#### Default Settings

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ignore During VPod Creation</td>
<td>Off</td>
</tr>
<tr>
<td>Storage Latency SLA Value [ms]</td>
<td>100</td>
</tr>
<tr>
<td>Enable High Availability (Workload HA)</td>
<td>0</td>
</tr>
<tr>
<td>Enable Geographic Redundancy</td>
<td>0</td>
</tr>
<tr>
<td>Increment constant for VDC Mem Allocation [MB]</td>
<td>1024</td>
</tr>
<tr>
<td>Increment constant for VMEM [MB]</td>
<td>1024</td>
</tr>
<tr>
<td>Increment constant for Storage Amount [GB]</td>
<td>100</td>
</tr>
<tr>
<td>Increment constant for VDC Storage Allocation [GB]</td>
<td>1</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 VDC CPU Allocation [MHz]</td>
<td>1800</td>
</tr>
<tr>
<td>Increment constant for Heap [MB]</td>
<td>100</td>
</tr>
<tr>
<td>Conservative Mem Resize Up</td>
<td>-1</td>
</tr>
<tr>
<td>Conservative CPU Resize Up</td>
<td>-1</td>
</tr>
</tbody>
</table>

This specifies storage latency requirements for VMs in the given group, in ms. Turbonomic will not place the VMs on storage that cannot meet the specified requirement. For example, if you set a value of 30 ms and all the storage available to the VM has latency of 60 ms or higher, then Turbonomic will recommend provisioning new storage.

For a setting of 0, Turbonomic does not consider Storage Latency SLA when placing workload on storage.

This sets the minimum number of VMs to place in a given scope. Ensuring a minimum number of VMs in a scope is a way to specify high availability for the virtual workload in your environment.

For a setting of 0, Turbonomic does not enforce a minimum number of workloads in the given scope.

This sets a scale of Geographic Redundancy. On a scale from 0 to 100, this sets how aggressively Turbonomic will keep workloads in this group on separate providers. With a setting of 100, Turbonomic will always try to place the workloads on different providers. With a setting of 0, Turbonomic does not alter its calculations to enforce a separation of workloads on different providers.

For a setting of 0, Turbonomic does not enforce separation of workloads on different providers.

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 VDC Mem Allocation [MB]</td>
<td>1024</td>
</tr>
<tr>
<td>Increment constant for VMEM [MB]</td>
<td>1024</td>
</tr>
<tr>
<td>Increment constant for Storage Amount [GB]</td>
<td>100</td>
</tr>
<tr>
<td>Increment constant for VDC Storage Allocation [GB]</td>
<td>1</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 VDC CPU Allocation [MHz]</td>
<td>1800</td>
</tr>
<tr>
<td>Increment constant for Heap [MB]</td>
<td>100</td>
</tr>
<tr>
<td>Conservative Mem Resize Up</td>
<td>-1</td>
</tr>
<tr>
<td>Conservative CPU Resize Up</td>
<td>-1</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 allocation 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 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

#### Default Settings

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate of Resize</td>
<td>2 (Medium)</td>
</tr>
</tbody>
</table>

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 by an increment that is 1/4 of the difference between the current value and the optimal value. For example, if the current VMem is 2 GB and the optimal VMem is 10 GB, then Turbonomic will raise VMem to 4 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).
Turbonomic uses templates to describe new entities that it will deploy in your environment or in plans. The templates specify resource allocations for these entities. For example, you can run a plan that adds new VMs to a cluster. If you add ten copies of a template, then the plan places ten new VMs that match the resource allocation you have specified for the given template.

A VM template definition can include one or more images that Turbonomic uses to deploy the VM in your environment. The image identifies the actual deployment package:

- To deploy on-prem, a path to the physical files (for example an OVA)
- For cloud deployments, the cloud provider’s named VM image (for AWS, the AMI)

As you deploy an instance of a VM template, Turbonomic chooses the best image for that instance. For cloud deployments, this includes finding the machine image configuration that best matches the template configuration.

The Template Catalog shows all of the templates that have been specified or discovered for your installation of Turbonomic. From this page, you can also create new templates and edit existing ones.
Creating Templates

Templates specify the resources for entities that Turbonomic can deploy in your environment, or in plans.

A VM template definition can include one or more images that Turbonomic uses to deploy the VM in your environment. The image identifies the actual deployment package:

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The Template Catalog shows all of the templates that have been specified or discovered for your installation of Turbonomic. From this page, you can also create new templates and edit existing ones.

Creating and Editing Templates

To create a new template, navigate to the Template Catalog and click NEW TEMPLATE. To edit a template, click the template’s name. When you create a new template, the first step is to choose the entity type.

1. Navigate to the Settings Page.

2. Choose Templates.

3. Create or edit a template
   To create a new template, navigate to the Template Catalog and click NEW TEMPLATE. To edit a template, click the template’s name.

4. If you’re creating a new template, choose the entity type.
5. **Make the settings for your template.**
   For each type of template, you set allocations for different resources. You can make templates of the following types:
   - Virtual Machine
   - Host
   - Storage
   - Container

6. **Make the settings for your template, and then save your changes.**
   When the template window opens, it displays the most common resource settings. You can expand the settings to see the full collection for that template type.

7. **Save your changes.**
   After you have made your settings and named the template, click **CREATE** or **SAVE**.

### VM Template Settings

These settings specify the resources that the VM will consume.

For on-prem deployments, Turbonomic assigns 75% of the physical CPU resources to VCPU. For example, if you specify 1 VCPU for this VM, 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 on-prem, Turbonomic assigns 100% of the physical resources that you specify for the template. You can add multiple storage devices to the VM template.

For storage, you can specify more than one datastore for the VM template.

To support VM deployment, you can specify one or more images. The image is the actual deployment package for that VM. To add images to the template, show the IMAGE tab, and click **Add Image**. Turbonomic displays a list of the data-centers and cloud regions that it has discovered. Choose from that list to add it to the template’s images.
After you choose the datacenter or region, you then specify:

- For On-Prem Deployment – The path to the image files in that datacenter
- For Cloud Deployment – The name of the image for that cloud region

**Host Template Settings**

For the Host resources, the Price setting is useful in plans. The plan can use the price to calculate costs or savings when adding or removing host machines.

**Storage Template Settings**

Plans can use the storage price to calculate costs or savings when adding or removing storage.

**Container Template Settings**

These settings specify the resources allocated to the container.
Administrative Tasks

To perform Turbonomic administrative tasks, you will navigate to different pages from Settings. The different tasks you can perform for Turbonomic include:

- **Managing User Accounts** on page 139
  Create and manage user accounts for Turbonomic.

- **Maintenance: Proxies, Logging, and Troubleshooting** on page 144
  Perform general tasks such as managing HTTP proxies or sending troubleshooting data to Support.

- **Updating Turbonomic** on page 146
  See your current version, check the availability of update versions, and perform online updates.

- **License Configuration** on page 147
  Review the status of your current license, and apply any license upgrades.

Managing User Accounts

As an administrator, you specify accounts that grant users specific access to Turbonomic. User accounts determine the following for a given user login:

- User credentials
- Type - dedicated user or tenant on a virtual datacenter
- Role - access to specific Turbonomic features
- Scope - how much of the environment this user can manage
- Authentication Type - either local or Active Directory.
You can use these accounts to group users by their roles. Of course you want a set of ADMIN users who have full control over the environment and the Turbonomic platform. You can also set up users with access to specific clusters in your environment. You can even set up accounts for tenant customers, and only show them the virtual workloads they own in their specific virtual datacenters.

1. Navigate to the Settings Page.

Click to navigate to the Settings Page. From there, you can perform a variety of Turbonomic configuration tasks.

2. Choose User Management.

This page lists all the user accounts that you currently have configured for Turbonomic. You can:

- Select an entry to delete the account
- Click a name to edit the account
- Create new user account
- Configure Active Directory settings
3. Filter the list of users.

To work with a long list of users, you can filter by role. For example, only show administrator, or only show observer users. You can also type a string in the Search field to filter the list, and you can sort the list by name.

4. Work with Local user accounts.

Turbonomic stores local accounts and their credentials on the Turbonomic platform. Local authentication is for individual users. To create a user group, use Active Directory.
5. **Work with Active Directory accounts.**

Active Directory (AD) authentication uses credentials that are managed by an Active Directory server. You can specify AD authentication for individual users or for AD groups.

**NOTE:** Turbonomic does not support nested AD groups – AD logins must be for users in a top-level group. If a user is a member of multiple groups, then Turbonomic uses the first AD account that succeeds.

To enable AD you must specify either an AD domain, an AD server, or both. This is the AD connection that Turbonomic uses for all AD users. Click **Connect to AD**, and make the following settings:

- **Active Directory Domain**
  - If you specify a domain, and do not specify a server, authentication will use any AD server from that domain. Note that to enable groups, you must specify a domain so that AD can find a given user via the User Principal Name (UPN).

- **Active Directory Server**
  - To disable AD groups, specify a server but do not specify a domain. If you specify a domain and a server, authentication will use that server, and will also support groups.

- **Secure**
  - Use a secure connection when communicating with AD servers. Note that the AD domain must be configured to use LDAPS, and you must have imported a certificate into the Turbonomic server. For more information, see the Green Circle articles for setting up Turbonomic to communicate to secure LDAP.
6. Create or edit a user account.

To create an account, choose Local Users or Active Directory, then click the Add User button. To edit an account, click the account's user name in the list.

Each account has a specific role:
- Observer — The most restricted role, this user can view the state of the environment, but cannot view or execute actions, and cannot run plans.
- Advisor — With this role, the user can run plans, but cannot execute actions or deploy workloads.
- Automator — This user can execute actions and deploy workloads, but cannot perform administrative tasks.
- Administrator — This user can access all Turbonomic features, and can perform administrative tasks to configure the Turbonomic platform.
- Shared Observer/Advisor — The shared roles are for tenant users who are 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. These users can only have the Observer and Advisor roles. In addition, a Shared user account must be scoped.

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. Click Define Scope and choose which groups or clusters this user can see.
Maintenance: Proxies, Logging, and Troubleshooting

The Maintenance Options Page provides tools to load configuration files onto your Turbonomic installation, set logging levels, export data for technical support, and import diagnostic files from Technical Support. Many of tools are for advanced users. You should contact Turbonomic technical support before you use them.

To execute these actions, navigate to the Maintenance Options page:

1. **Navigate to the Settings Page.**

2. **Choose Maintenance Options.**

   Maintenance Options

**HTTP Proxy**

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.
Export State

If your environment requires an HTTP proxy for Turbonomic to access the web, provide the credentials here.

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 platform. You should be aware that setting more verbose logging levels increases the disk space required to store the log files. You normally change these settings only while you're working with a Turbonomic support engineer.

Usage Data and Analytics

With your permission, the Turbonomic platform can automatically collect analytics information from your installation and send it to Turbonomic to help improve our quality and performance. The data you share includes:

- **Topology Data**
  - This information includes the types of targets you have set up, how many entities per target, and the relationships between these entities.

- **Log Data**
  - Logs give us a history of any issues that might have occurred with your Turbonomic installation.
The data does not include any sensitive information such as user or target credentials. At weekly intervals, your Turbonomic platform collects and encrypts this data and sends it to Turbonomic.

**NOTE:** When you first install and start Turbonomic, you have the option to enable this feature. At any time after you have enabled Usage Data and Analytics, you can always turn it off again.

To enable or disable this setting, navigate to Settings > Maintenance Options. Then turn on the option to enable sharing of user data, or turn the option off to disable it.

### Updating Turbonomic

Use the Updates page to check whether any Turbonomic updates are available for your version, to see information about your version, and to perform online updates of your platform:

- **ABOUT**
  This shows the current version and build of your Turbonomic installation. It also lists the platform components by name and version.

- **CHECK**
  If Turbonomic can access the offline repository, and if the repository contains a version that is greater than your current version, this tells you that you can update to the indicated version.

- **UPDATE**
  If you can perform an online update to a new version, this executes the update. Be sure to give the update enough time to complete, and then refresh your browser.

**NOTE:** Before updating your Turbonomic platform, you should create a snapshot of your current Turbonomic virtual machine. For complete update instructions, see the Installation Guide.

To navigate to the Updates page:

1. **Navigate to the Settings Page.**
   
   ![Settings](settings.png)

2. **Choose Updates.**
   
   ![Updates](updates.png)
To activate the full range of Turbonomic features, you must purchase the appropriate license. When you purchase a new product, Turbonomic sends the license key to you in an e-mail message.

The License Configuration page shows you the features that you currently have for your license. To navigate to the License Configuration page:

1. **Navigate to the Settings Page.**

2. **Choose License.**
To activate a license or to update your current license:

1. **Obtain your license.**
   Turbonomic sends the license key to you in an e-mail message.

2. **Apply the license to your Turbonomic installation.**
   First click **UPDATE LICENSE**. Then copy the license text from the email and paste it into the **ENTER LICENSE** text box.