

HP Service Health Optimizer

for the Windows[®] operating system

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Concepts Guide

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Contents

1	Welcome to this Guide	7
	Who Should Read this Guide	7
	Prerequisites	7
	Reference Documentation	7
	HP SH Optimizer Documentation	8
2	Introduction to HP Service Health Optimizer	9
	What is Virtualization?	9
	Benefits	9
	Challenges	9
	Introducing HP SH Optimizer	10
	Gaining Visibility	12
	Group Inventory View	12
	Data Center Inventory View	14
	Optimizing	15
	Forecast and Planning	18
	Forecast What-if	19
	HP SH Optimizer Reports	21
	User Roles and Responsibilities	22
3	HP SH Optimizer Deployment	23
	Deployment with BSM Service and Operations Bridge	23
	Deployment with HP Operations Manager	25
4	HP SH Optimizer Architecture	27
	Components	28
	HP SH Optimizer Content Pack	28
	HP SH Optimizer Server	29
	Inventory	29
	Scenario Manager	29
	Long-term Forecast	30
	Report Viewer	30
5	Key Concepts in Capacity Analytics	31
	Reference VM Size	31
	Quick Optimization Opportunity Rating	32
	Optimal VM Placement	33
	Seasonality-based Trend Analysis	34
	Optimal VM Sizing	36
	Undersized and Oversized VMs	36

Undersized VM Analysis.....	36
Oversized VM Analysis.....	37
Right VM Size.....	38
VM Activity.....	39
Idle VM Analysis.....	39
Powered-off VM Analysis.....	40
Glossary.....	41
6 We appreciate your feedback!.....	45

1 Welcome to this Guide

This guide is an introduction to HP Service Health Optimizer (HP SH Optimizer) and describes the features, deployment scenarios, architecture, and the key analytical concepts used in this product.

Who Should Read this Guide

You should read this guide if you are one of these users:

- IT architect or virtualization architect
- Director of IT applications
- Capacity planner or capacity manager

Prerequisites

HP SH Optimizer works in conjunction with HP SH Reporter, a business-aware cross-domain historical infrastructure performance reporting solution. HP SH Optimizer uses the performance data collected by HP SH Reporter. You must be familiar with HP SH Reporter before you install and start using HP SH Optimizer.

Reference Documentation

It is recommended that you read the *HP Service Health Reporter Concepts Guide* before you install and use HP SH Optimizer.

You can optionally read the following documents before using HP SH Optimizer:

- *HP Service Health Reporter Installation and Configuration Guide*
- *HP Service Health Reporter Online Help for Administrators*
- *HP Service Health Reporter Online Help for Users*

The above documents are available in your HP SH Reporter installation and at:

<http://h20230.www2.hp.com/selfsolve/manuals>.

HP SH Optimizer Documentation

In addition to this Concepts Guide, the documentation of HP SH Optimizer consists of the following:

- **Release Notes:** Read the release notes before you start installing HP SH Optimizer. These notes specify the licensing, hardware and software prerequisites, installation media content, and the known issues of the product.
- **Installation and Configuration Guide:** Follow this guide to install and configure HP SH Optimizer in the supported deployments.
- **Online Help for Users:** Refer to this online help available from the HP SH Optimizer user interface for the tasks that you can perform on each screen.

2 Introduction to HP Service Health Optimizer

Before you understand the working of HP SH Optimizer and the key problems it can solve, you can read the following section to familiarize yourself with virtualization and understand some of its key benefits and challenges.

What is Virtualization?

Virtualization enables dividing the computer resources into multiple execution environments called Virtual Machines (VMs) by providing a layer of abstraction over physical hardware. This enables you to run multiple instances of the operating system and applications on a single physical host. VMs are used to consolidate the workloads of several underutilized servers to fewer machines for effective utilization of hardware.

Benefits

One of the main advantages of virtualization is dynamic resource management. Virtualization enables you to allocate the available hardware resources dynamically to the applications, as and when required. In the absence of virtualization, you need to use traditional methods to perform long-term forecasting of the resource demands based on historical trends of resource utilization. This process is complex and leads to over-provisioning of the resources on the physical hosts. With virtualization, you can use dynamic methods to maintain an optimal balance between the demand for resources and provisioning of resources, thus avoiding over-provisioning of resources.

Challenges

Despite many benefits, virtualization has also created numerous challenges. Capacity management and planning is one of the major challenges to enterprises opting for virtualization. Some of the key questions that still remain with virtualization are:

- How do you control the VM Sprawl?
- Have you provisioned the VMs and clusters with right size?
- Are you using the hardware resources in an optimal manner?
- How do you place the VMs optimally in a server farm?
- How many days do you have before the VM, VM Host, or cluster will run out of capacity?
- How many more VMs can you provision with the current available capacity?
- What is the impact of over utilized or underutilized VMs on your business?
- What are the potential improvement opportunities in your business if your VM infrastructure is optimized?

Introducing HP SH Optimizer

HP SH Optimizer is a business-aware topology driven capacity management and planning tool for x86-based virtualized environments. It provides visibility, enables to identify optimization opportunities, and performs forecast analysis for your infrastructure from the perspective of different *groups* and the overall data center.

In HP SH Optimizer, a *group* is defined as a logical structure that consumes a set of physical or virtual resources. For example, a *group* called CRM may consist of a three-tier application such as a database server, middleware, and web servers. Each of these applications may be running on standalone physical hosts or a virtual machine hosted on a hypervisor, such as VMware ESX or Hyper-V. In HP SH Optimizer, a *group* can be one of the following:

- Business Service as defined in HP BSM Run-time Service Model (RTSM)
- Business Application as defined in HP BSM Run-time Service Model (RTSM)
- Node Group as defined in HP Operations Manager (HPOM)
- VMware Cluster as defined in VMware vCenter object model

Two or more Business Services or Business Applications are considered as shared if at least one VM host is shared by them. For example, if the *groups* 'payroll' and 'marketing' share a VM host, HP SH Optimizer categorizes them as a shared *group*.

The data center represents all the VMs, VM hosts and physical hosts discovered by HP SH Optimizer irrespective of which *group* they belong to.

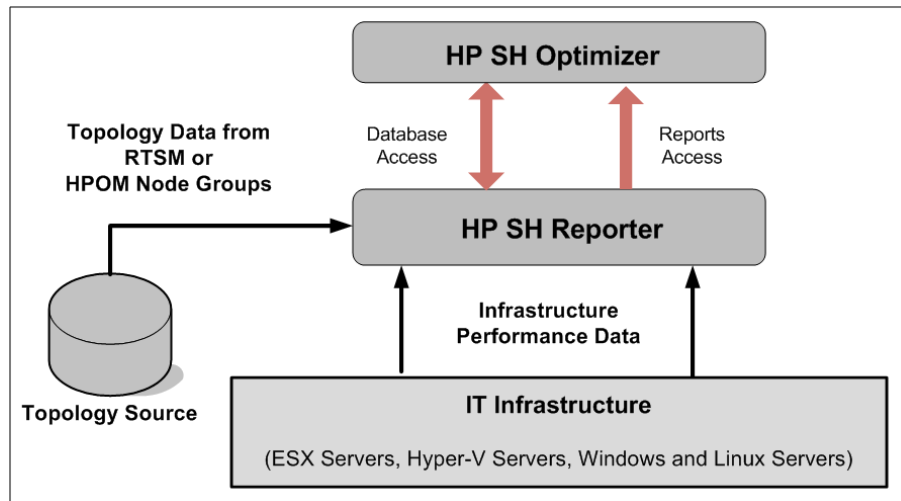
HP SH Optimizer provides key benefits in the following areas:

- **Visibility:** HP SH Optimizer provides visibility into the capacity and usage trends of your IT infrastructure resources from the perspective of different *groups* and the overall data center. HP SH Optimizer can also reduce potential VM sprawl by identifying idle, powered off, and oversized VMs. It also helps you improve and maintain expected application performance over time by identifying undersized VMs.
- **Optimization opportunities:** Based on the historical resource usage trends and available capacity, HP SH Optimizer recommends ways to optimize your current hardware resources without impacting the service levels or performance of your *groups*. The optimizations include reducing the resource wastage by controlling VM sprawl and improving VM density by optimal VM placement. HP SH Optimizer enables you to generate an optimal VM sizing and placement plan for your *groups* by using optimization scenarios. While creating optimization scenarios, you can customize the VM hosts and workloads and define constraints such as resource headroom. Workloads can be existing VMs and/or physical hosts that may be considered for converting to VMs (P2V).
- **Forecast and planning:** HP SH Optimizer uses the current trends in the capacity utilization and deployed VMs to forecast the capacity requirements for your IT environment from the perspective of different *groups* and overall data center. This feature helps you proactively plan future hardware requirements for your environment. HP SH Optimizer also enables you to run *what-if* scenarios to predict the effect of change in capacity or demand on the remaining capacity and the number of days before a resource will run out of capacity for a particular scenario.

Topology and Performance Data Collection

HP SH Optimizer leverages the topology information from RTSM or HP Operations Manager Node Groups to provide a cohesive view of the resource capacity, usage, remaining capacity and opportunity for optimization, with respect to your *groups*. HP SH Optimizer works in conjunction with HP SH Reporter, which is a business-aware cross-domain historical infrastructure performance reporting solution. HP SH Optimizer uses the performance data collected by HP SH Reporter. For the purpose of providing capacity planning and optimization recommendations in virtualized environments, HP SH Optimizer collects only the utilization and available capacity data from HP SH Reporter. Apart from using the required data from the HP SH Reporter platform data store (also called the performance management database), HP SH Optimizer also uses SAP BusinessObjects, which is part of HP SH Reporter, for its user authentication and reporting requirements.

Figure 1 Performance Data Collection from HP SH Reporter

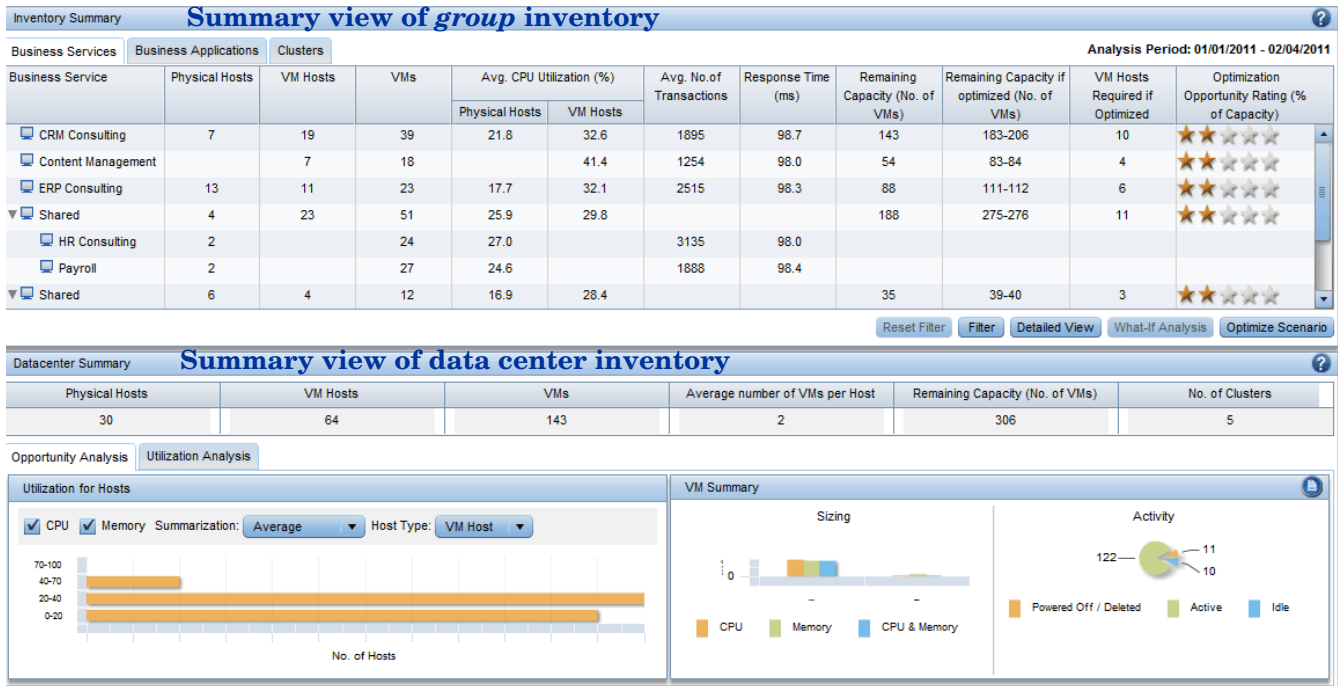


For information on the architecture and workflow of HP SH Optimizer, see [HP SH Optimizer Architecture](#).

Gaining Visibility

HP SH Optimizer provides a complete and detailed view of your existing infrastructure that enable you to understand the current capacity, current usage, and the opportunity that you have for optimization of resources. It provides a *group* based Inventory View and a complete Data Center View of your infrastructure.

Figure 2 Summary View of Inventory (Group and Data Center)



Group Inventory View

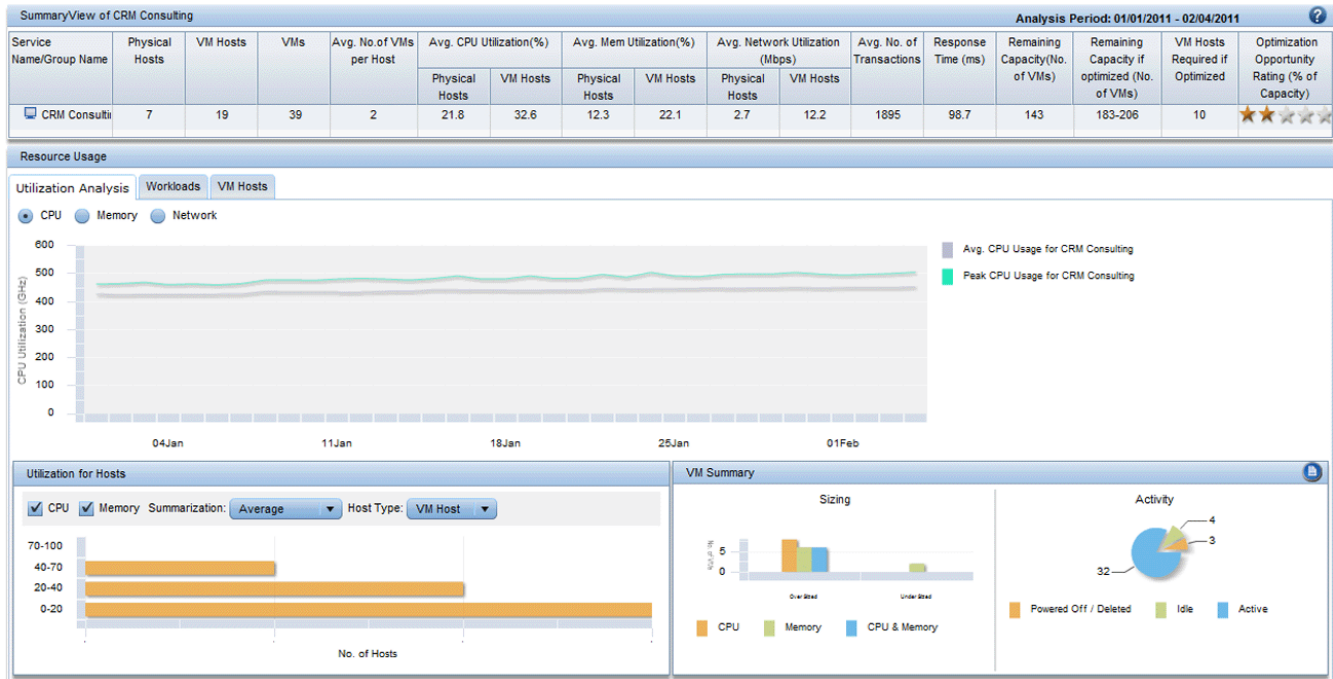
Using the *Group* Inventory View, you can see the physical and virtual infrastructure inventory in the perspective of your *groups*, such as Business Services, Business Applications, and cluster hierarchy. You can choose any of the *groups* (individual or shared) and view the detailed inventory associated with the *group*.

HP SH Optimizer enables you to view the following for each of the *groups*:

- The physical hosts, VM hosts, and the VMs associated with the *group*
- The resource usage in terms of average CPU utilization percentage of the physical hosts or VM hosts for each of the Business Services or Business Applications
- The remaining capacity, in terms of [Reference VM Size](#), before and after performing the optimization as recommended by HP SH Optimizer
- The average number of end-user transactions and their response time per *group*. This information is displayed if you have the Real User Monitor (RUM) and the Business Process Monitor (BPM) applications in your environment and the HP SH Reporter content packs installed for these applications.

The following figure shows a sample detailed *Group* Inventory View for a selected Business Service.

Figure 3 Group Inventory - Detailed View



HP SH Optimizer provides a lightweight opportunity index analysis engine that performs a quick analysis to show the **Quick Optimization Opportunity Rating** for each *group*. This rating is displayed on the user interface as a series of highlighted stars (see [Figure 3](#) for a sample). The star rating is an indicator of the improvement in average utilization of VM hosts, increase in free capacity, and reduction in the number of VM hosts if the VMs are placed optimally as recommended by HP SH Optimizer. The greater the number of highlighted stars, more is the opportunity for resource optimization.

You can see in [Figure 3](#) that HP SH Optimizer also shows the number of hosts that you will save if you perform the optimization as compared to the number of hosts that you are currently using. In addition, it shows the number of VMs that you can place if you perform the optimization.

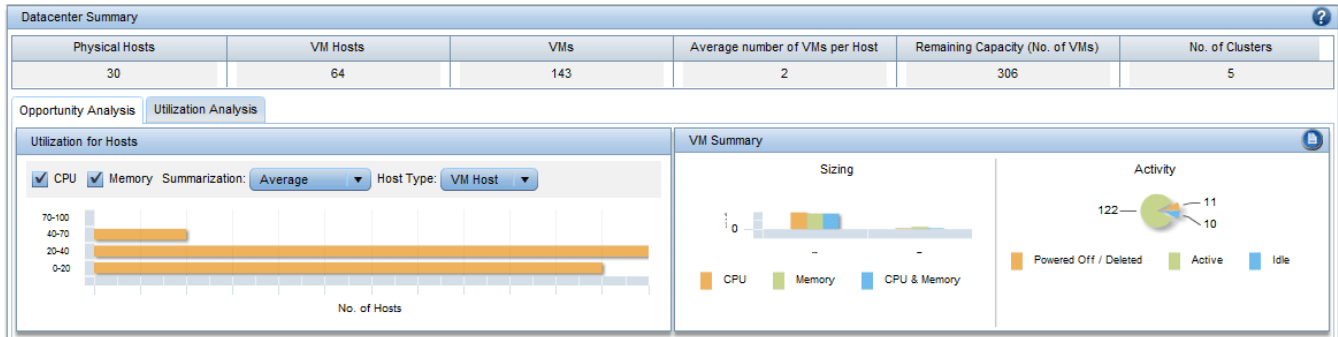
The detailed view for a selected *group* also shows:

- The average and peak utilization of resources assigned to the *group*, over time
- The resource utilization for the VM hosts or physical hosts that belong to the *group*
- The number of oversized, undersized, idle, and powered-off or deleted VMs in the *group*

Data Center Inventory View

In addition to the *groups*, HP SH Optimizer also provides a view of your complete data center with its current resource utilization and the potential optimization opportunity that can help you to improve the resource utilization and reduce VM sprawl.

Figure 4 Data Center Inventory View



You can use the Data Center Summary of HP SH Optimizer to view:

- The utilization analysis showing the number of VM hosts with:
 - Sub-optimal resource allocation
 - Potential risk of exceeding resource utilization threshold
 - Peak utilization less than the specified threshold
- The CPU and memory utilization of the physical hosts and VM hosts that helps to analyze the opportunity for optimizing your resources.
- The summary of VMs that have over-allocated or under-allocated CPU or memory resource. This view enables you to understand if VMs in your data center are oversized or undersized with respect to CPU and memory. HP SH Optimizer also provides recommendations for the right VM sizing.
- The VMs in your data center that are active, powered-off or deleted, or idle for a long period of time. This view enables you to identify and minimize potential VM sprawl.

HP SH Optimizer identifies oversized, undersized, and idle VMs based on the custom thresholds that you define in the product configuration. For more information on VM sizing analysis and right size recommendation, see [Key Concepts in Capacity Analytics](#).

Optimizing

Once you get a visibility of your existing IT infrastructure capacity and a peek into the opportunity for resource optimization, you need to understand the ways in which you can perform the required optimization to maximize your resource utilization. In order to achieve this, HP SH Optimizer provides a powerful what-if tool for optimization analysis. This tool enables you to create optimization scenarios with key business constraints and arrive at an optimal VM placement plan. You can use the VM placement plan to take necessary actions on placing the VMs and improving resource utilization.

You can select one or more *groups* (shared or individual) for optimization. All selected groups are considered to share all the resources that are part of those *groups*. While creating an optimization scenario for a *group*, you can customize the workloads and capacity for the *group*. You can:

- Add workloads existing in your data center
- Add workloads with custom-defined configuration
- Add capacity associated with nodes existing in your data center
- Add custom-configured capacity
- Remove existing workloads and VM hosts
- Remove existing capacity

HP SH Optimizer enables you to specify a time period, such as business hours, non-business hours, or a full day for the optimization analysis. This enables you to restrict the optimization opportunity analysis and get the VM placement recommendations for selected time periods when say, the VMs are mostly used. You can eliminate the time periods when the VMs are mostly idle such as during non-business hours.

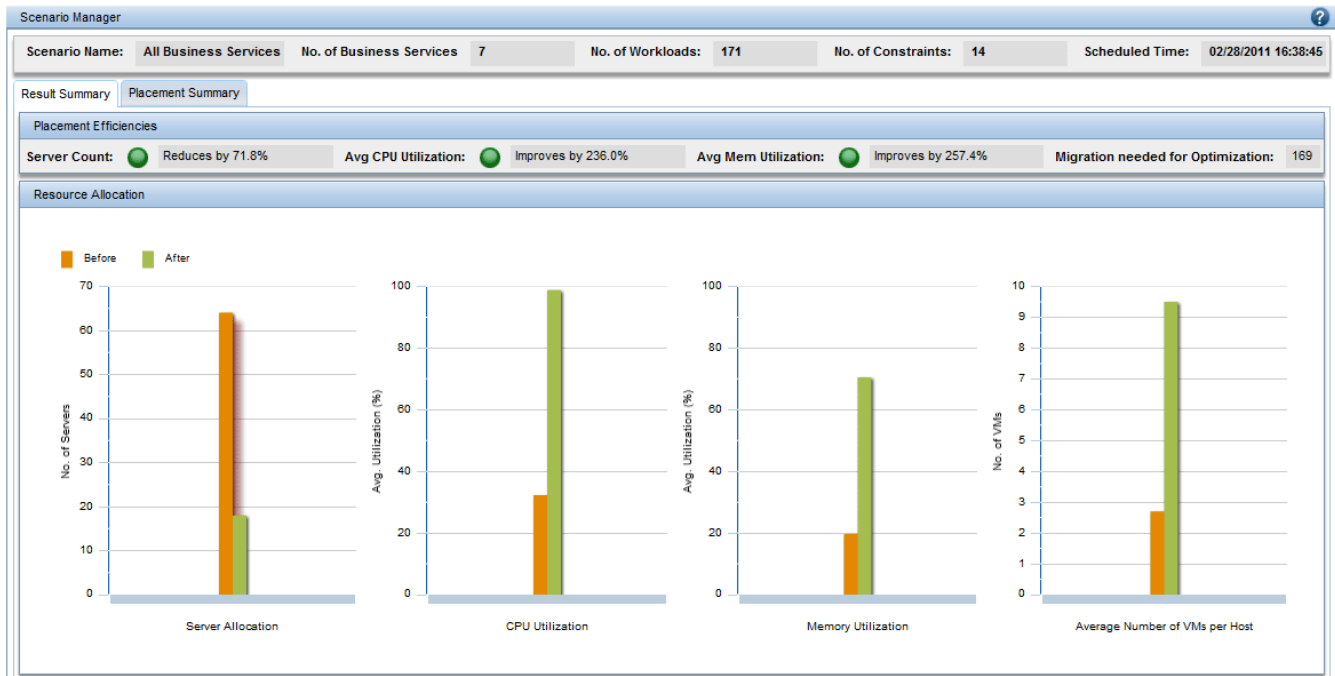
When creating an optimization scenario, HP SH Optimizer enables you to define constraints for the *group* or workload. For example, you can specify a headroom group constraint. Headroom is the percentage of CPU or memory that needs to be kept reserved for future business growth or sudden peaks in utilization. Similarly, you can specify a workload constraint that a specific node must reside on a selected host. You can also define cluster level constraints for high-availability clusters that can specify the resource that must be reserved for failover.

HP SH Optimizer runs the optimization scenario and provides recommendations for optimal VM placement. The result of a typical optimization scenario shows:

- The reduction in server count
- The improvement in CPU and memory utilization
- The increase in VM density

The following figure shows a sample result summary.

Figure 5 Result Summary



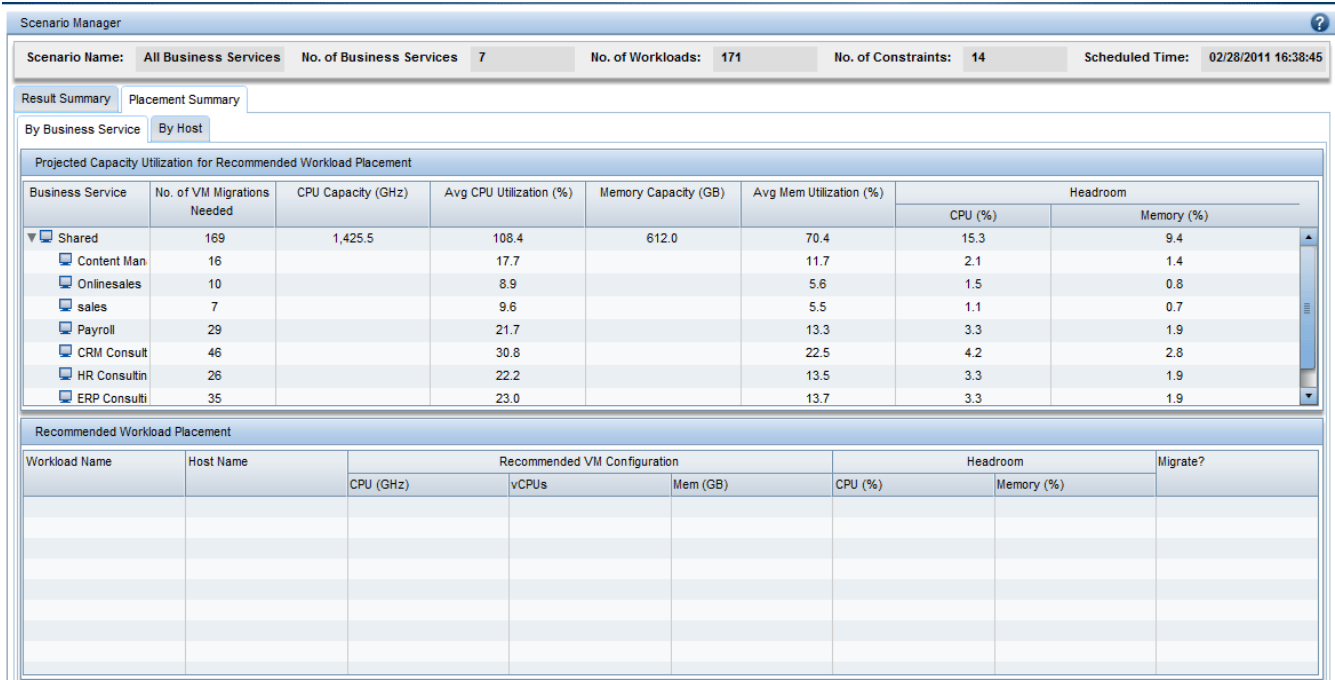
HP SH Optimizer also provides a summary of the placement plan that shows:

- The projected resource utilization of the VM hosts and the remaining capacity for each host
- The recommended VM placement by host view and *group* view, that is, which host should be hosting how many VMs

You can use these optimization results with any automated provisioning tool to provision the suggested configuration and VM placement in your data center.

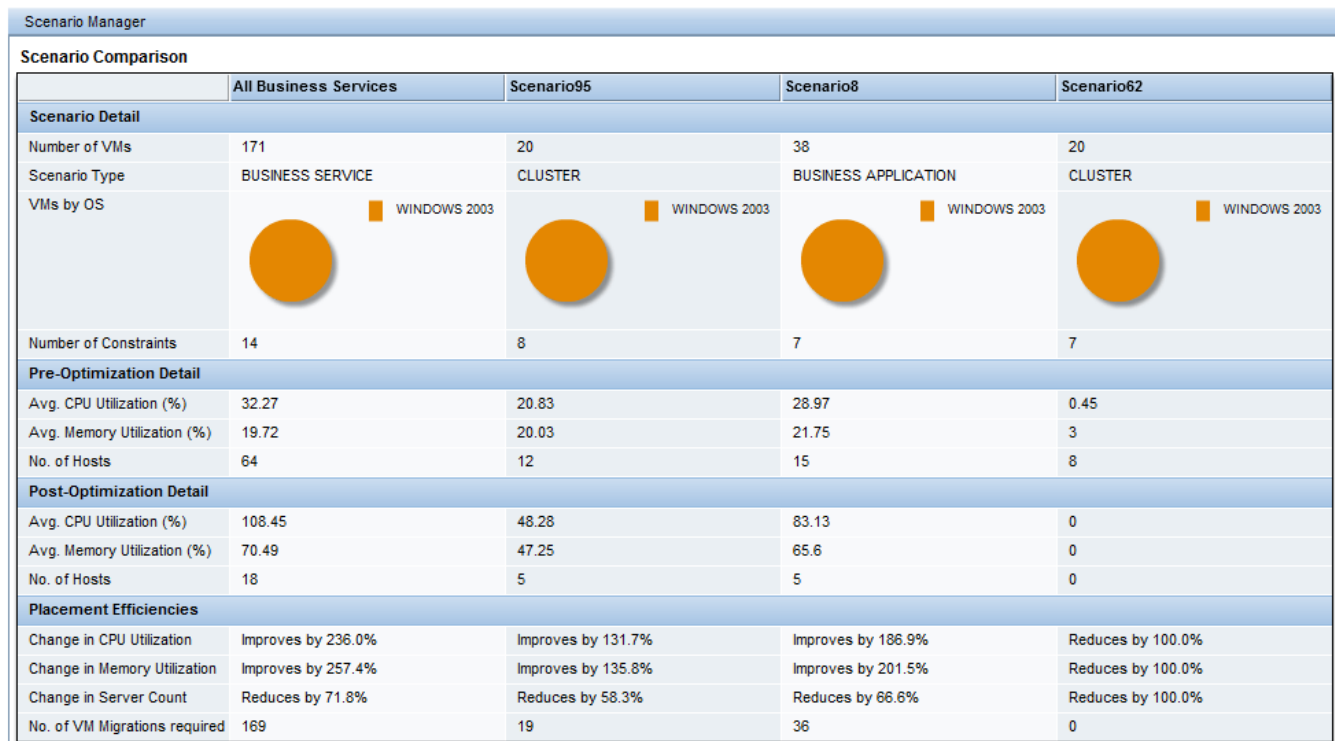
The following figure shows a sample post-optimization placement summary.

Figure 6 Placement Summary



You can also compare two or more optimization scenarios before you take a decision on performing a particular optimization. The following figure shows the result of a sample scenario comparison:

Figure 7 Scenario Comparison Results



Forecast and Planning

For effective capacity planning and management, you must be able to predict the future resource utilization and identify potential resource scarcity. HP SH Optimizer provides a detailed forecast of the VM host capacity, VM size, and potential out-of-capacity issues with respect to each of the *groups* and the complete data center. HP SH Optimizer performs historical trend analysis with linear forecasting using at least six weeks of performance data that is stored in the performance management database.

The forecast inventory summary for *groups* show:

- The projected number of VMs deployed per *group* in the next 30, 60, or 90 days
- The projected VM capacity availability per *group* in the next 30, 60, or 90 days
- The remaining days after which one or more VMs or VM hosts will run out of their capacity based on current utilization.

You can select any of the *groups* (individual or shared) and view the detailed forecast associated with the *group*. The detailed forecast shows:

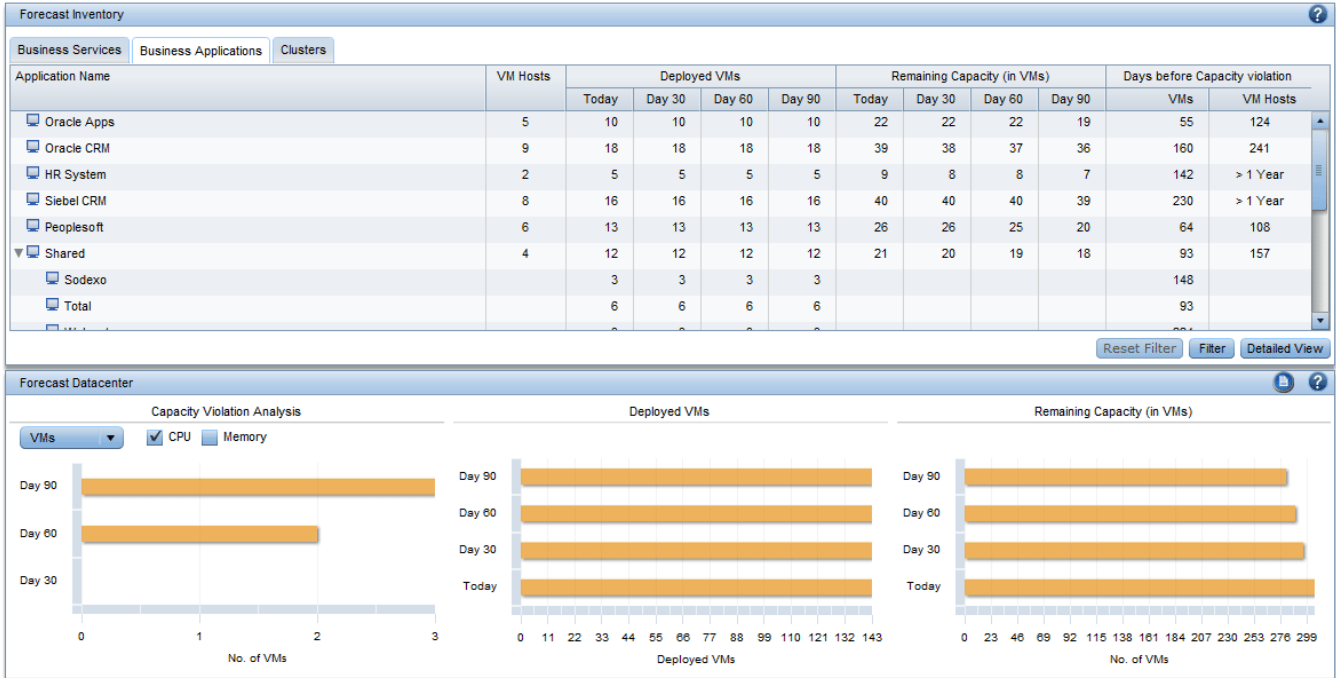
- The projected 95th percentile resource utilization for the *group* in the next 30, 60, or 90 days
- A detailed analysis of the number of VMs, VM hosts, or cluster in the *group* that will run out of CPU or memory in the next 30, 60, or 90 days
- The projected 95th percentile resource utilization and number of days remaining for capacity violation for each of the VMs and the VM hosts associated with the *group*.

HP SH Optimizer also provides a forecast view for your data center. You can use this view to:

- Analyze the time and the number of VMs, VM hosts, or clusters in your data center that will run out of resource (CPU or memory or both) capacity
- View the projected number of VMs deployed in your data center in the next 30, 60, or 90 days
- View the remaining number of VMs in your data center in the next 30, 60, or 90 days based on resource utilization trends.

The following figure shows a sample inventory and data center forecast view.

Figure 8 Inventory and Data Center forecast



Forecast What-if

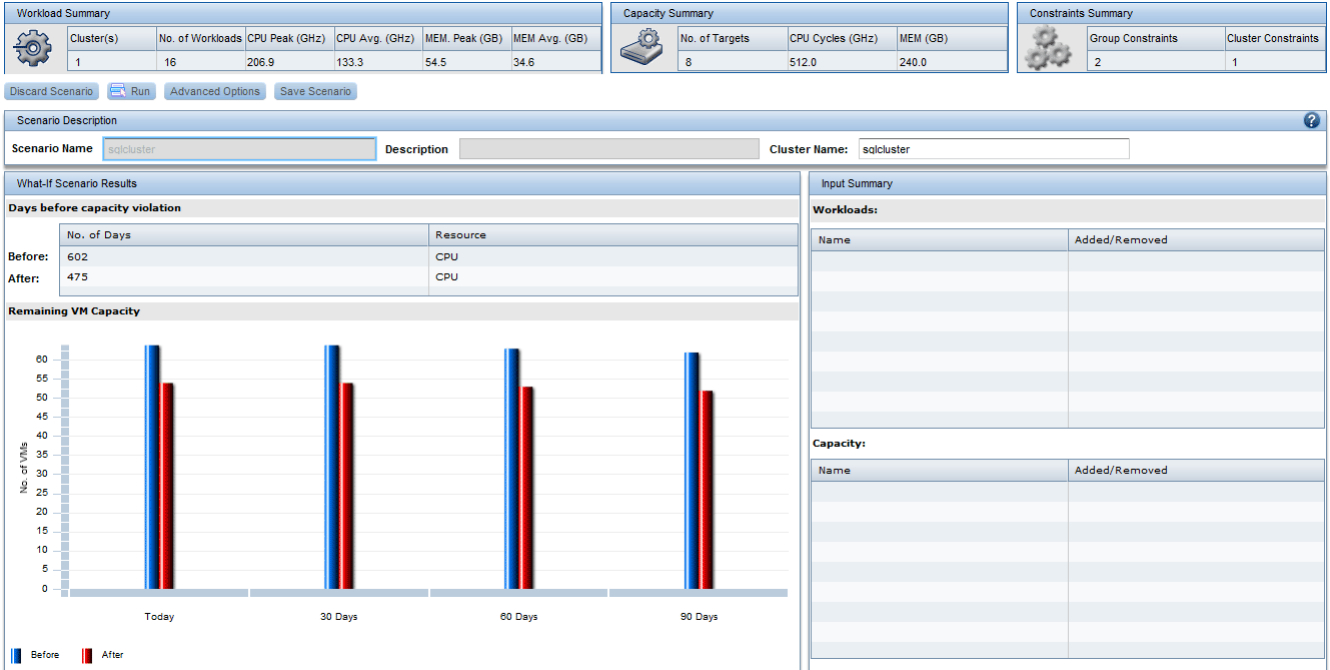
HP SH Optimizer provides a quick on-demand *what-if* analysis for your cluster environment. You can use the *what-if* functionality to analyze the impact of modifying workload and VM host capacity on:

- The remaining capacity in the next 30, 60, and 90 days
- The days remaining for capacity violation

HP SH Optimizer enables you to create *what-if* analysis scenarios that are very similar to the optimization scenarios. You can select a cluster and customize the workloads and capacity. You can also define constraints such as resource (CPU or memory) headroom and failover host for the selected cluster.

The HP SH Optimizer analytical engine performs the on-demand forecast *what-if* analysis to show the remaining VM capacity after 30, 60, and 90 days and the days remaining for the resource to run out of capacity. The following figure shows the result of a sample *what-if* analysis.

Figure 9 What-if Analysis Results



HP SH Optimizer Reports

HP SH Optimizer provides out-of-the-box reports that can be launched from a specific context or from the main navigation menu. You can use the information on the reports to take necessary action such as optimizing your resources, placing the VMs, or planning for your future hardware requirements. These reports are SAP BusinessObjects Web Intelligence reports. Note that SAP BusinessObjects is installed when you install HP Service Health Reporter, which is a prerequisite for HP SH Optimizer.

A typical Web Intelligence report in HP SH Optimizer displays one or more components such as graphs, tables, or charts. You can save the reports in different formats such as PDF, Microsoft Excel Worksheet, and .csv file.

The following figure shows a sample forecast summary report.

Figure 10 Forecast Summary Report



User Roles and Responsibilities

HP SH Optimizer can be typically used by the following users:

- Virtualization architect - Also known as the IT Administrator; this user has the following responsibilities:
 - Analyze and identify appropriate workload size and application capacity requirements
 - Proper placement of workloads for Business Application, Cluster, Business Service, and HPOM Node Groups
 - Ensure proper capacity allocation for handling peak and seasonal load
 - Identify over-utilized and under-utilized physical servers and VM hosts
 - Identify the powered-off and idle VMs
 - Identify and resolve incorrect VM sizing problems
 - Perform appropriate sizing for migration from physical to virtual environment
 - Evaluate the requirements for hardware refresh
- Capacity Planner - Also known as the Service Manager or Planner; this user has the following responsibilities:
 - Continuously monitor the remaining capacity of your IT infrastructure in the perspective of business services, applications, and clusters
 - Monitor sudden capacity violations and performance problems
 - Constantly monitor the trends of resource usage and forecast resource usage growth
 - Identify the days remaining before which a VM, VM host, physical host, or cluster will run out of capacity and take necessary actions to mitigate this risk
 - Evaluate the effect of adding or removing workloads on the existing capacity and on the number of days remaining for capacity violation
 - Evaluate the effect of modifying the cluster and VM configuration
- Director of IT Applications - Also known as the Director of IT; this user has the following responsibilities:
 - Analyze the IT infrastructure resource usage trends against the existing capacity in the perspective of business services, business applications, clusters, or data center
 - Maintain service level objectives while optimizing the cost of service delivery
 - Estimate and plan future resource and capacity requirements
 - Evaluate and estimate cost of enterprise software upgrade

3 HP SH Optimizer Deployment

After you install and configure HP SH Reporter (a prerequisite for HP SH Optimizer), it connects to a topology service definition. The topology service definition logically relates your business services to your IT elements. HP SH Reporter enables you to define a topology service definition and collect the infrastructure data from the nodes that are part of the topology.

HP SH Reporter (and in turn HP SH Optimizer) provides support for the following topology service definitions:

- BSM Run-time Service Model (RTSM)
- HP Operations Manager for Windows (HPOM for Windows)

At one time, HP SH Reporter can connect to only one of the topology service definitions — BSM RTSM or HPOM — and not to multiple topology definitions.

HP SH Optimizer supports the following two deployments:

- [Deployment with BSM Service and Operations Bridge](#)
- [Deployment with HP Operations Manager](#)

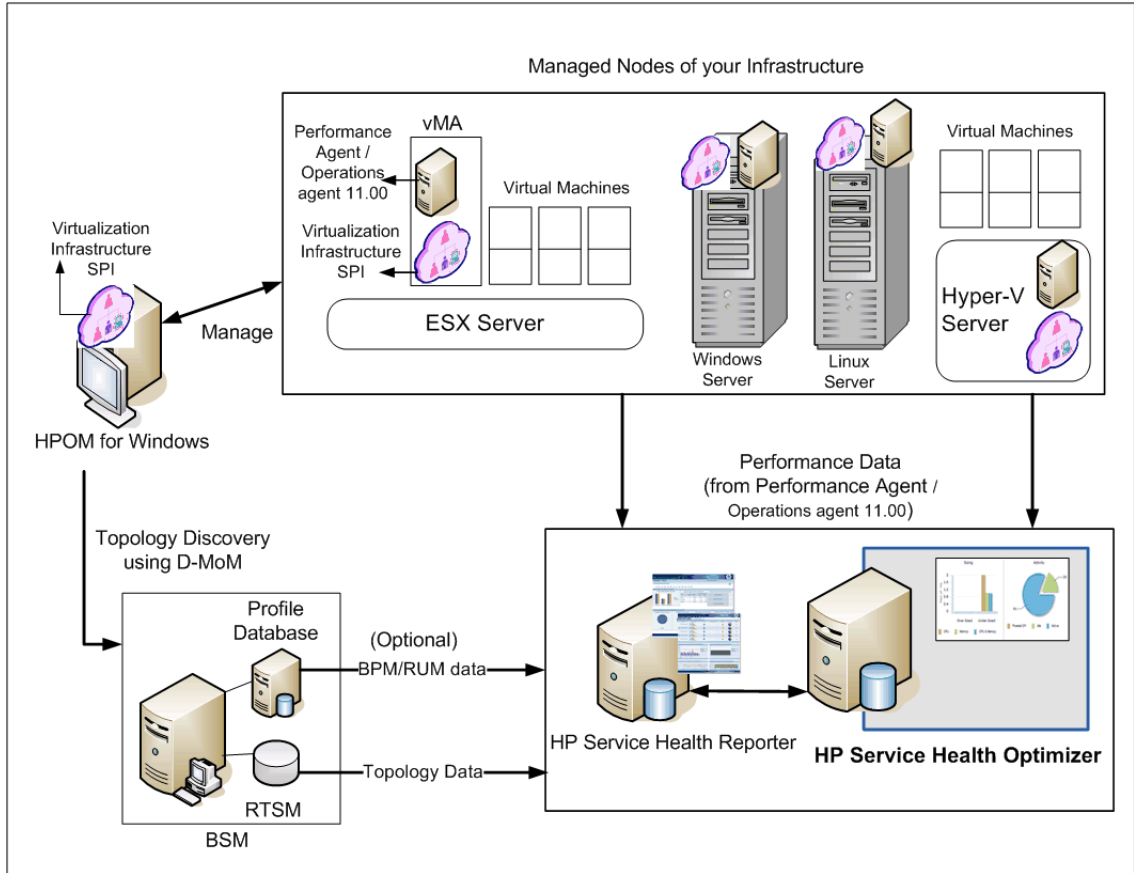
Deployment with BSM Service and Operations Bridge

In this deployment, RTSM is the source of topology information (Business Service and Business Application) for HP SH Optimizer. The infrastructure topology (that is, the VM hosts, VMs, and physical hosts) information is discovered by HP Operations Smart Plug-in for Virtualization Infrastructure for HPOM for Windows and populated in the RTSM database by using the Toposync or HPOM D-MoM dynamic topology synchronization technique.

The performance data of the physical hosts and VM hosts is collected by the HP Performance Agent or HP Operations agent (version 11.00 or later) installed on the managed nodes in your environment. To collect the virtualization infrastructure metrics (from VMware vMA or Microsoft Hyper-V nodes), you must install the HP Operations Smart Plug-in for Virtualization Infrastructure (Virtualization Infrastructure SPI) on the HPOM server and deploy the Virtualization Infrastructure SPI on the managed nodes. The Virtualization Infrastructure SPI discovers the host machines, virtual machines (guest machines), resource pools, and VMware clusters.

The following figure is a pictorial representation of the above deployment.

Figure 11 HP SH Optimizer Deployment with BSM Service and Operations Bridge



This deployment includes the following BSM setups:

- Full BSM
- BSM Service and Operations Bridge Basic
- BSM Service and Operations Bridge Advanced

In this deployment scenario, HP SH Optimizer works if the following HP Software products are available in your environment:

- RTSM for topology information
- BSM platform
- OMi as the operations bridge in BSM solution
- HPOM for Windows with Virtualization Infrastructure SPI
- HP Performance Agent or HP Operations agent (version 11.00 or later)

You can leverage the BSM End-User Management data if the following products are available in your environment:

- Real-User Management (RUM) - Install this application if you want to collect and use real-user transaction data in HP SH Optimizer
- Business Process Monitor (BPM) - Install this application if you want to collect and use synthetic-user transaction data in HP SH Optimizer

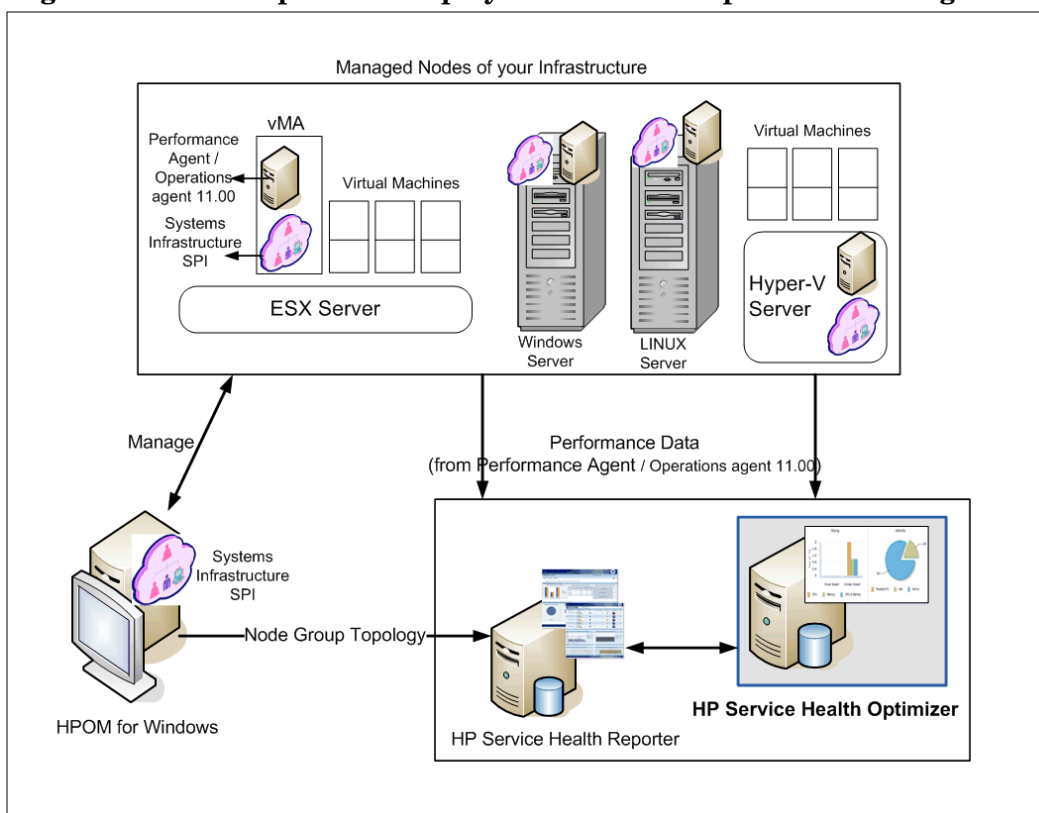
Deployment with HP Operations Manager

In this deployment, the source of topology information is Node Groups. Node Group is a group of managed nodes defined in HPOM that are logically combined for operational monitoring. The discovery of the managed nodes is also done by HPOM.

The performance data of the physical hosts and VM hosts is collected by HP Performance Agent or HP Operations agent (version 11.00 or later) installed on the managed nodes in your environment. To discover ESX hosts and populate the HPOM Node Groups, you must install the HP Operations Smart Plug-in for Systems Infrastructure (Systems Infrastructure SPI) on the HPOM server and deploy the Systems Infrastructure SPI on the managed nodes. After you deploy the Systems Infrastructure SPI on the managed nodes, it discovers and populates the HPOM Node Groups with the 'node group-to-host' mapping information. The VM host-to-VM relationship and cluster-to-VM host relationship in VMware clusters are discovered by HP Performance Agent.

The following figure is a pictorial representation of the above deployment explanation.

Figure 12 HP SH Optimizer Deployment with HP Operations Manager



In this deployment scenario, HP SH Optimizer works if the following HP Software products are available in your environment:

- HPOM for Windows with Systems Infrastructure SPI
- HP Performance Agent or HP Operations agent (version 11.00 or later)

Deployment Reference Summary

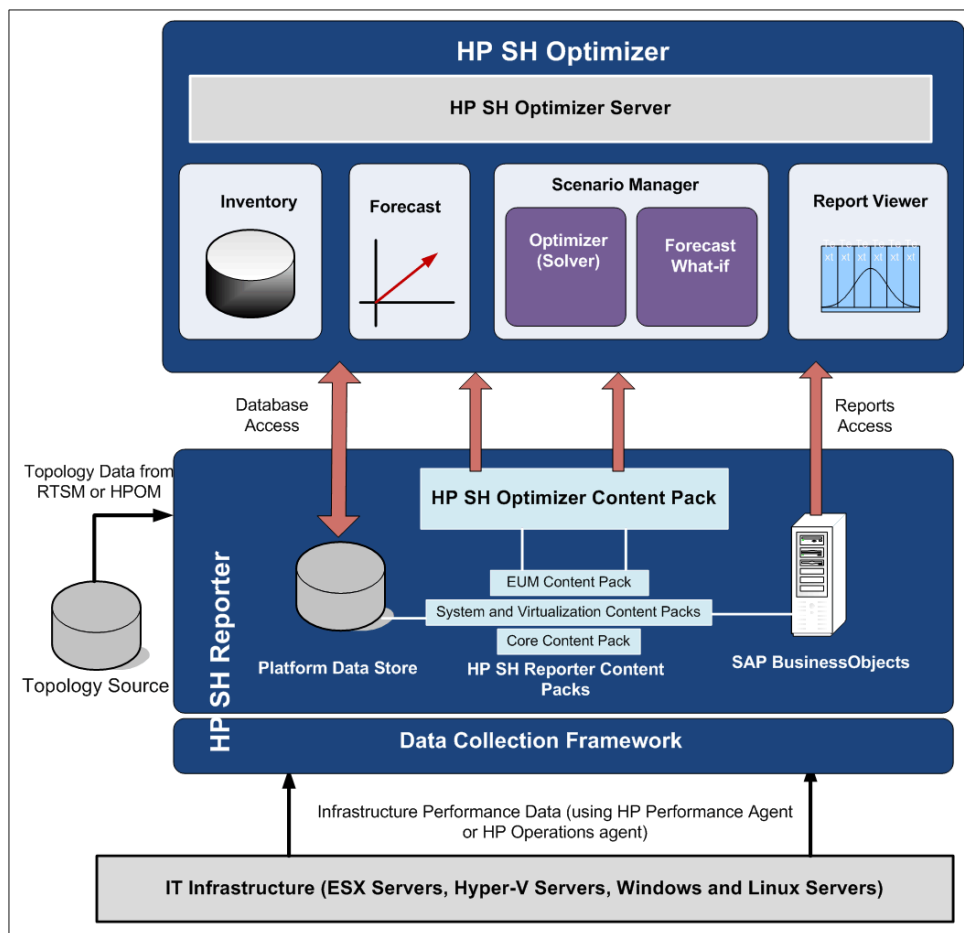
The following table shows a summary of the BSM Service and Operations Bridge and HP Operations Manager deployment requirements. You can use this as a reference to set up your environment before installing HP SH Optimizer:

Deployment	Installed HP products	
BSM Service and Operations Bridge	Required: <ul style="list-style-type: none">• RTSM for topology information• BSM platform• OMi as the operations bridge in BSM solution• HPOM for Windows with Virtualization Infrastructure SPI• HP Performance Agent or HP Operations agent (version 11.00 or later)	Optional: <ul style="list-style-type: none">• Real-User Management (RUM)• Business Process Monitor (BPM)
HP Operations Manager	Required: <ul style="list-style-type: none">• HPOM for Windows for topology information• HPOM for Windows with Systems Infrastructure SPI• HP Performance Agent or HP Operations agent (version 11.00 or later)	Optional: None

4 HP SH Optimizer Architecture

As mentioned earlier, HP SH Optimizer works closely with HP SH Reporter, which is a business-aware topology driven cross-domain historical infrastructure performance reporting solution. HP SH Optimizer leverages the performance data that is collected by HP SH Reporter content packs and stored in its platform data store (also called the performance management database).

Figure 13 High-level Architecture of HP SH Optimizer



Components

HP SH Optimizer consists of two key components: the content pack and the server.

HP SH Optimizer Content Pack

The HP SH Optimizer content pack is similar to any other HP SH Reporter content pack. It collects the data from the HP SH Reporter data store and performs the necessary data processing to make it suitable for analysis and forecasting. The key functionalities of the content pack include:

- **Data Retrieval:** The HP SH Optimizer content pack enables you to retrieve a subset of the performance data that has been collected by the System Management and Virtualization content packs of HP SH Reporter. This data is required for long-term capacity planning, infrastructure optimization, and forecasting. HP SH Optimizer uses the five-minute granular data from the HP SH Reporter data store for performing the optimization calculations. It uses the hourly and daily data from this data store for the inventory views and forecasting information.
- **Data Processing:** Apart from retrieving the data required for capacity planning purposes, HP SH Optimizer content pack also cleans the data to fill data gaps, if any, and performs additional data processing required to prepare the data for analysis. For example, the content pack calculates various statistics of VM CPU utilization with respect to configured capacity by using the VM host CPU utilization values. In this case, the VM host CPU utilization value is collected by the HP SH Reporter content pack. The HP SH Optimizer content pack also relates the data to the topology and performs data aggregation by Business Service, Business Application, cluster, or HPOM Node Group before the data is made available to the HP SH Optimizer server.
- **Forecast Calculations:** The HP SH Optimizer content pack performs offline forecast calculations by using the historical data collected over a period of time. It uses the 95th percentile of the daily summary data to compute the forecast results. The HP SH Optimizer server displays this forecast data on the HP SH Optimizer user interface.
- **Reporting:** The HP SH Optimizer content pack, just like any other HP SH Reporter content pack, contains the packages for SAP BusinessObjects Web Intelligence reports along with the content pack universe. The content pack universe provides a business-oriented, meaningful mapping of the underlying complex database and simplifies the creation of reports. In addition, content packs contain database processing or workflow streams that define the sequence of steps from data collection through processing to reporting. You can launch these WebIntelligence reports from the HP SH Optimizer user interface. You can save the reports in different formats such as PDF, Microsoft Excel spreadsheet, and .csv file.

HP SH Optimizer Server

The data collected by HP SH Optimizer content pack is stored in the performance management database and made available to the HP SH Optimizer server for analysis. The server is a web application hosted on the Apache Tomcat server.

The HP SH Optimizer server is the engine that provides all the analytical functionalities required for capacity planning and optimal VM placement recommendations. It enables you to gain visibility into your infrastructure in the perspective of the *groups* and data center, analyze the VM sizing and activity, and identify the opportunity for optimization.

The key components of the server are as follows:

Inventory

This component is responsible for processing the data and making it available for display on the Inventory View, as summary and detailed information for each of the *groups*. It also performs the processing of data to be displayed on the Data Center View. This component computes the [Quick Optimization Opportunity Rating](#) and displays the rating in the form of highlighted stars. The Inventory component also performs the analysis for, and displays, the oversized, undersized, idle, powered-off or deleted VMs on the interface. In addition, it computes the trend of opportunity for VM hosts and physical hosts, and trend of resource utilization. The HP SH Optimizer server refreshes the inventory data every four hours to provide an updated view of your infrastructure at all times.

Scenario Manager

The Scenario Manager component uses the five-minute rate data collected by the HP SH Optimizer content pack for optimization scenario analysis and forecast *what-if* analysis. It is responsible for:

- Taking the optimization scenario requests and delegating them for [Optimal VM Placement](#) analysis
- Taking the forecast *what-if* scenario requests and delegating them for *what-if* analysis
- Managing the scenarios which include editing and deleting scenarios, providing the scenario results, and comparing scenarios.

The Scenario Manager has the following sub-components:

Optimization Scenario Manager

The Optimization Scenario Manager component is responsible for:

- Validating and processing the constraints that you define in an optimization scenario, before running the scenario
- Saving the scenarios into the HP SH Optimizer database for future use
- Performing CPU normalization by using SPECint benchmark numbers
- Enabling the [Optimal VM Placement](#) analysis functionality to generate the optimal VM placement plan
- Displaying the optimization analysis results on the user interface

Forecast *What-if* Scenario Manager

This component processes the on-demand forecast *what-if* scenarios. These scenarios enable you to view on-demand forecast for a set of user-defined workloads, VM hosts, and constraints in a cluster environment. The forecast what-if analysis is different from long-term forecasting that uses the forecast data computed offline by the HP SH Optimizer content pack.

Long-term Forecast

The forecast component of the HP SH Optimizer server is responsible for:

- processing the forecast data that is pre-computed by the HP SH Optimizer content pack
- displaying the processed data as required, on the user interface.

Report Viewer

The HP SH Optimizer server provides the required interface in the form of Report Viewer to launch the SAP BusinessObjects Web Intelligence reports. You can use these reports to view the inventory summary, optimization results, and forecast results. You can save these reports in PDF, Microsoft Excel, and .csv file formats.

5 Key Concepts in Capacity Analytics

This chapter describes important concepts of capacity analytics used in HP SH Optimizer.

Reference VM Size

Reference VM size is the size of the VM used by HP SH Optimizer to express the remaining capacity of the *groups* in terms of VMs.

You can define the CPU speed in GHz and the memory size in GB for four VM sizes, namely, **Small, Medium, Large, and Custom**. Based on these VM sizes, HP SH Optimizer calculates the sizes for the following reference VMs to be used to express the capacity:

- **Data Center:** This reference VM size is the average of the configured capacity of all the VMs that are discovered by HP SH Optimizer.
- **Weighted Average of Small, Medium, and Large:** This reference VM size is the weighted average of the **Small, Medium, and Large** VM sizes that you define. The calculation is as follows:

Reference VM CPU size (in GHz) = ((Number of **Small** VMs * CPU size of **Small** VM) + (Number of **Medium** VMs * CPU size of **Medium** VM) + (Number of **Large** VMs * CPU size of **Large** VM)) / Total number of VMs in your data center

- **Small:** This reference VM size takes the values of the **Small** VM CPU and memory that you define.
- **Medium:** This reference VM size takes the values of the **Medium** VM CPU and memory that you define.
- **Large:** This reference VM size takes the values of the **Large** VM CPU and memory that you define.
- **Custom:** This reference VM size takes the values of the **Custom** VM CPU and memory that you define.



The default value for reference VM size is **Small**.

Quick Optimization Opportunity Rating

The Optimization Opportunity Rating on the Inventory View provides a quick indication of the available opportunity for optimization of VM resource usage with an optimal VM placement, within a *group* for the specific analysis period. It does not consider any constraints. Based on the rating you can choose to create optimization scenarios with constraints to arrive at detailed optimization analysis results. The Optimization Opportunity Rating shows:

- the number of VMs that can be hosted after optimization as compared to the current number of VMs
- the number of VM hosts required if you perform the optimization
- a star rating to indicate the potential optimization opportunity for each *group*

Figure 14 Optimization Opportunity Star Rating



This is different from the detailed and full optimization analysis feature provided by HP SH Optimizer. For information on full optimization analysis, see [Optimal VM Placement](#) and [Optimal VM Sizing](#).

The Optimization Opportunity Rating method works in two steps:

- 1 It calculates the minimum number of VM hosts required to place all the workloads for the selected *group*.
- 2 It then calculates the average utilization percentage before and after optimization.

Utilization percentage before optimization = (Used capacity before optimization / Total available capacity before optimization) * 100

Utilization percentage after optimization = (Used capacity after optimization / Total available capacity after optimization) * 100

The Utilization percentage before and after optimization are placed in one of the following ranges:

Range 1 = 0 percent to 9 percent

Range 2 = 10 percent to 29 percent

Range 3 = 30 percent to 49 percent

Range 4 = 50 percent to 69 percent

Range 5 = 70 percent to 100 percent

The star rating calculation is done as follows:

Number of stars = (Range for Utilization percentage after optimization) minus (Range for Utilization percentage before optimization)

Consider the following example:

If the Utilization percentage before optimization = 40 percent (that is, it is in Range 3) and

the Utilization percentage after optimization = 95 percent (that is, it is in Range 5)

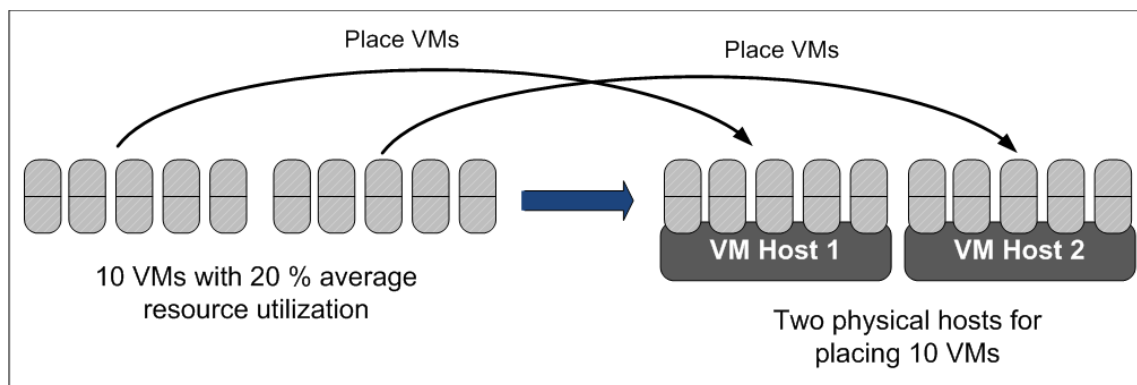
The Optimization Opportunity Rating in number of highlighted stars = Range 5 minus Range 3 = 2 stars

Optimal VM Placement

One of the biggest challenges of virtualization is to optimally place VMs on physical hosts to achieve high server utilization. VM placement can be done by using the average utilization or by using the peak utilization. In both ways, there are possibilities of over-provisioning or under-provisioning the resources on the physical hosts.

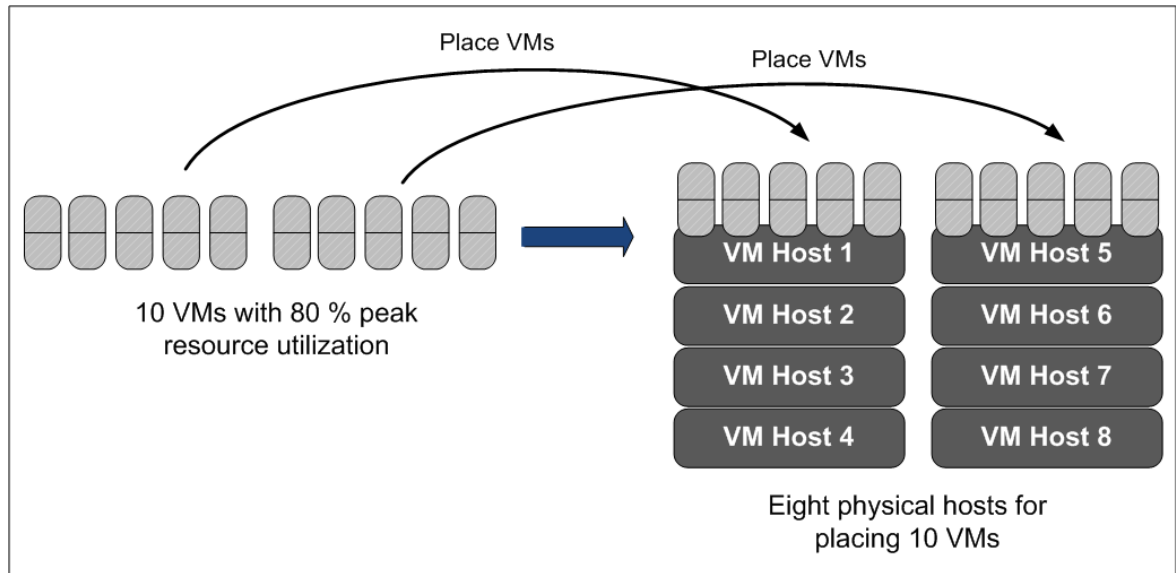
Consider VM placement using average resource utilization trends. In the following figure, it is observed that the average resource utilization of the 10 VMs is 20 percent of the total capacity. The VM placement plan uses this average value and recommends two physical hosts as sufficient for hosting the 10 VMs. In this recommendation, the sudden peaks in utilization are not considered. This method of VM placement may lead to under-provisioning of resources on the physical host than required.

Figure 15 Using Average Utilization Trends for VM Placement



Now consider VM placement using peak resource utilization trends. In the following figure, it is observed that the peak resource utilization value amongst the 10 VMs is 80 percent of the total capacity. The VM placement plan uses this peak value and recommends eight physical hosts for hosting the 10 VMs to accommodate the peak utilization. However, the peak resource utilization may not always occur. This method of VM placement thus may lead to over-provisioning of resources on the physical hosts than required.

Figure 16 Using Peak Utilization for VM Placement

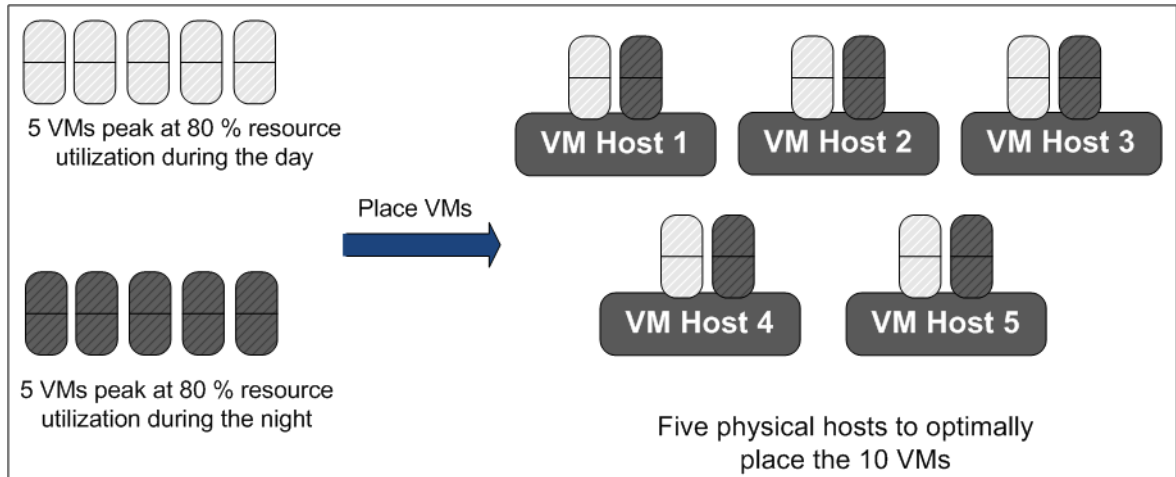


Seasonality-based Trend Analysis

To avoid over-provisioning or under-provisioning of resources, HP SH Optimizer performs a seasonality-based trend analysis of resource usage over time. Seasonality-based trends take into account the resource utilization patterns observed at different times of the day, week, or month according to your business requirements. This type of analysis is essential because applications have varying resource demand at different times. For example, in typical data centers, some VMs may experience high resource demands during the day whereas other VMs experience high resource demands during the night. The trend analysis is performed by using at least four to six weeks of the time series CPU or memory utilization data to generate the optimal VM sizing and VM placement recommendations for a given set of workloads (VMs and physical hosts) and VM hosts.

In the following figure, it is observed that five out of 10 VMs experience peak resource utilization during the day whereas the other five VMs experience peak resource utilization during the night. HP SH Optimizer considers this trend of resource utilization for each of the VMs and recommends five physical hosts for optimally hosting the 10 VMs according to their utilization pattern.

Figure 17 Using Seasonality-based Utilization Trends for Optimal VM Placement



Apart from the historical trend analysis, HP SH Optimizer considers the user-defined constraints in the optimization scenarios for defining the VM placement plan. Constraints include specifying the headroom, whether VMs must be together or apart, and whether particular *groups* must be considered as exclusive. For the purpose of optimization analysis, all physical hosts selected in a scenario are converted to VMs.

Optimal VM Sizing

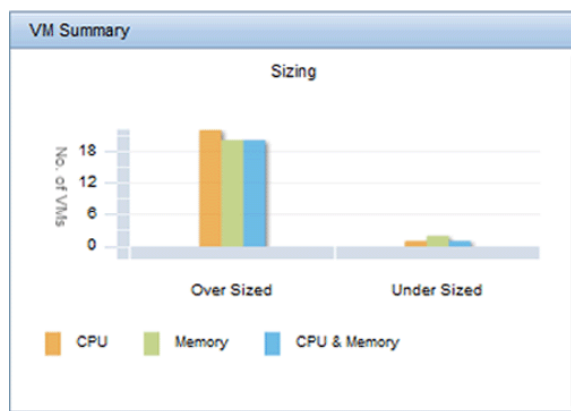
Undersized and Oversized VMs

A VM is undersized if the utilization is beyond the defined acceptable utilization level by a factor which is greater than the acceptable tolerance level. Any utilization value that exceeds this tolerance level is not acceptable for service level agreements. Using undersized VMs for a prolonged time period may lead to reduced application performance.

Whereas, A VM is oversized if the utilization is below the defined acceptable utilization level by a factor which is greater than the acceptable tolerance level. Any utilization value that is less than this tolerance level is not acceptable for service levels. Using oversized VMs cause wastage of resources in the enterprise.

The HP SH Optimizer Inventory enables you to view the number of undersized and oversized VMs in your data center using the CPU, memory, and both CPU and memory utilization as shown in the following figure. It also provides [Right VM Size](#) recommendations that you can use to size the VMs appropriately so that the VMs are no longer underutilized or over utilized.

Figure 18 Undersized and Oversized VMs



HP SH Optimizer uses a two level analysis to identify a VM as undersized or oversized. Each of these levels uses a threshold that you can define by using the Thresholds configuration feature on the user interface.

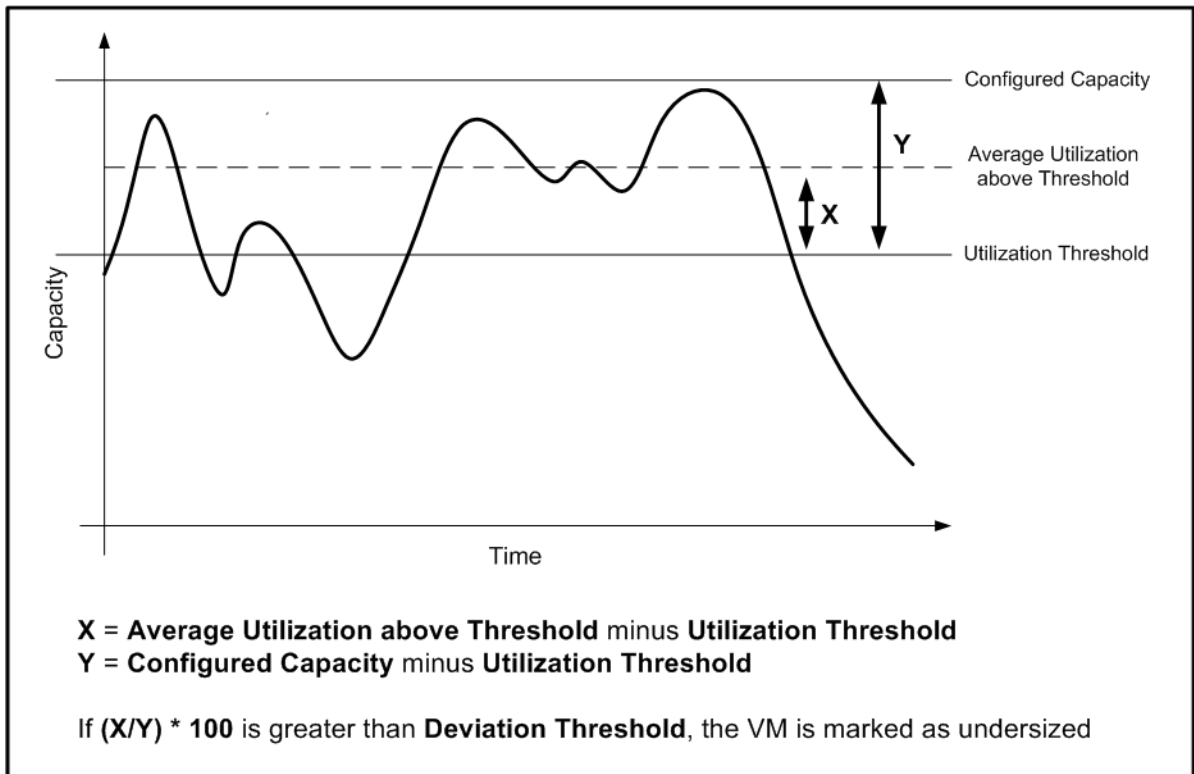
Undersized VM Analysis

HP SH Optimizer performs the undersized VM analysis as follows:

- 1 It obtains the user-defined **utilization threshold** value. The default value is provided by HP SH Optimizer.
- 2 It identifies if the VM has an average utilization above the utilization threshold for the specified analysis period.
- 3 It obtains the user-defined **deviation threshold** which is the percentage of extra utilization that can be accepted without impacting service levels. This threshold is the tolerance level beyond which the utilization is not acceptable. The default value is provided by HP SH Optimizer.
- 4 HP SH Optimizer then calculates the actual deviation which is the percentage of average utilization above the utilization threshold with respect to the headroom above the utilization threshold.

- If the above deviation value is greater than the **deviation threshold** (that is, the tolerance level), the VM is marked as undersized.

The following figure illustrates the calculation of undersized VM.



Consider the following example:

The utilization threshold is defined as 60%. HP SH Optimizer identifies that the average utilization of the VM CPU or memory or both is above 60% for the specified time period.

Now, consider that the deviation threshold is defined as 10%. This means that the VM can accommodate another 10% deviation from the current average utilization above the threshold.

HP SH Optimizer calculates the actual deviation which is the percentage of average utilization above the threshold with respect to the remaining capacity. The deviation value comes to 20% which is higher than the deviation threshold of 10%.

Based on the above calculations, HP SH Optimizer marks this VM as undersized.

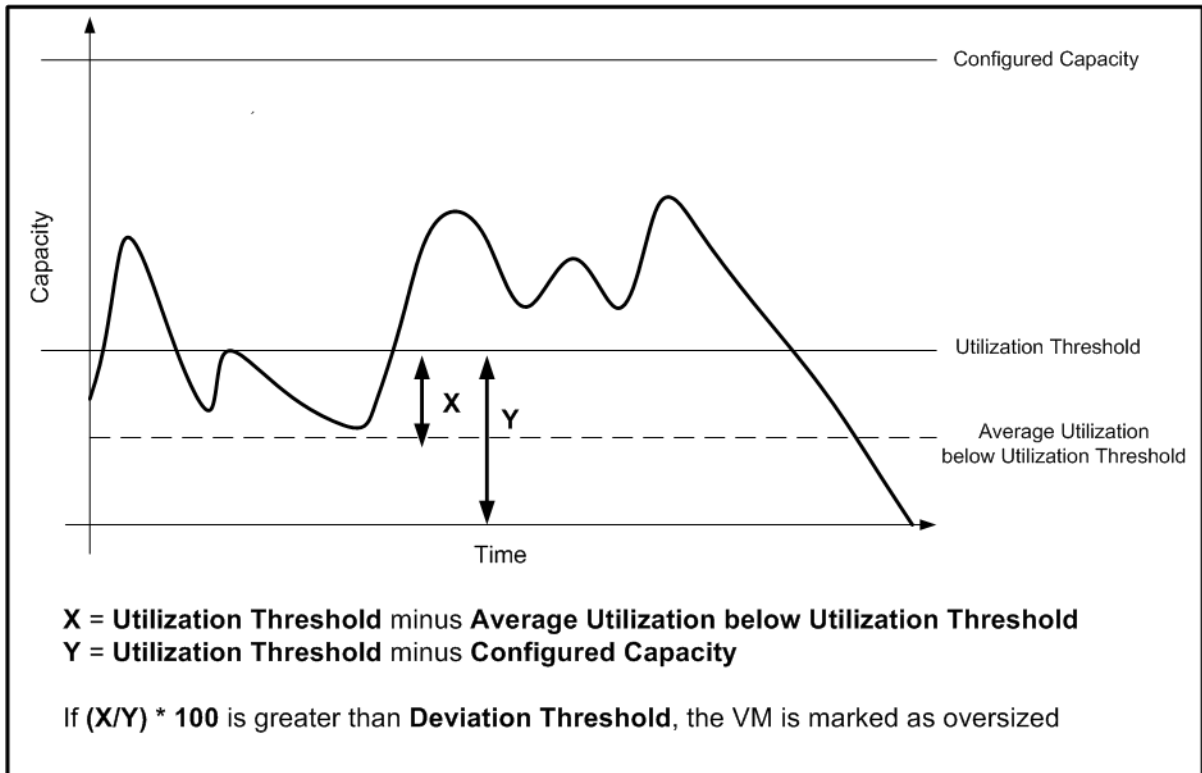
Oversized VM Analysis

The concept of oversized VM is just the opposite of undersized VMs. HP SH Optimizer performs the oversized VM analysis as follows:

- It obtains the user-defined **utilization threshold** value. The default value is provided by HP SH Optimizer.
- It identifies if the VM has an average utilization below the **utilization threshold** for the specified analysis period.
- It obtains the user-defined **deviation threshold** which is the percentage of lesser utilization that can be accepted without impacting service levels. This threshold is the tolerance level below which the utilization is not acceptable. The default value is provided by HP SH Optimizer.

- 4 HP SH Optimizer then calculates the deviation which is the percentage of average utilization below the **utilization threshold** with respect to the headroom above the **utilization threshold**.
- 5 If the above deviation value is greater than the **deviation threshold** (that is, the tolerance level), the VM is marked as oversized.

The following figure illustrates the calculation of oversized VM.



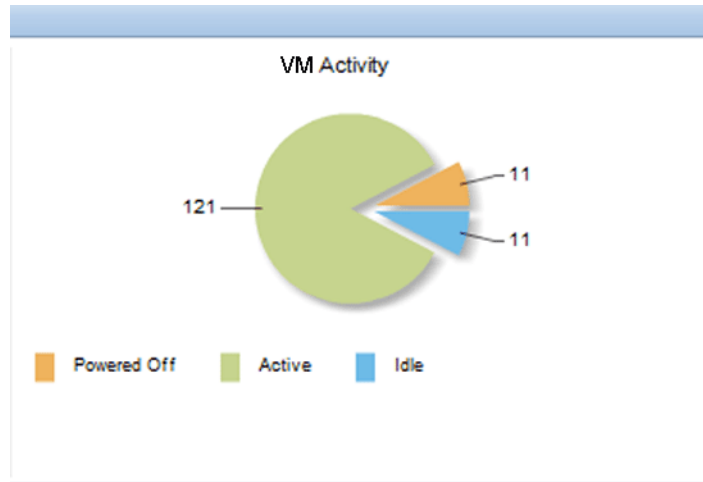
Right VM Size

HP SH Optimizer identifies the undersized and oversized VMs in your data center. It then provides VM sizing recommendations that you can use to size the VMs appropriately so that the VMs are no longer underutilized or over utilized.

HP SH Optimizer calculates a VM CPU or memory size in which the percentage deviation is at the degree threshold level (that is, the tolerance level). HP SH Optimizer then adds CPU or memory headroom of 10 percent to accommodate any future increase in utilization.

VM Activity

To ensure optimal usage of the existing enterprise resources, you must be able to monitor the VMs that are idle or powered-off for a long time. HP SH Optimizer identifies the VMs that have been idle or powered-off based on threshold values that you can define. This enables you to identify and reduce the VM sprawl.



Idle VM Analysis

The concept of idle VMs is similar to that of oversized VMs. Idle VMs are those that have very low utilization for a prolonged period of time.

HP SH Optimizer identifies the VMs that have an average utilization always less than the **idle threshold** for the specified time period as idle. You can define this **idle threshold** value.

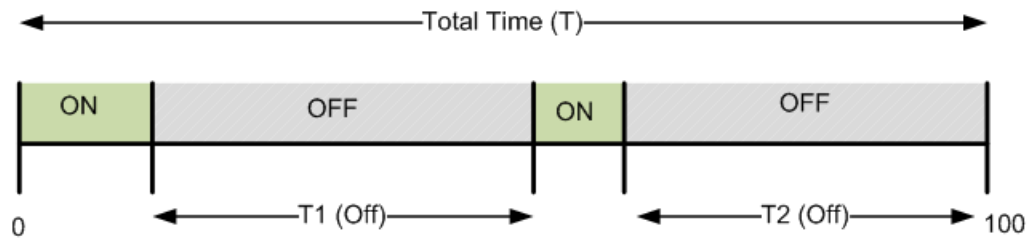
HP SH Optimizer performs the idle VM analysis as follows:

- 1 It obtains the user-defined **idle threshold** value. The default value is provided by HP SH Optimizer.
- 2 It identifies if the VM has an average utilization below the **idle threshold** for the specified analysis period.
- 3 It obtains the user-defined **deviation threshold** which is the percentage of lesser utilization that can be accepted without impacting service levels. The default value is provided by HP SH Optimizer.
- 4 HP SH Optimizer then calculates the deviation which is the percentage of average utilization below the **idle threshold** with respect to the headroom above the utilization threshold.
- 5 If the above deviation value is greater than the **deviation threshold**, the VM is marked as oversized.

Powered-off VM Analysis

HP SH Optimizer monitors the time periods for which a VM has been powered-off in the total analysis time. If the percentage ratio of the total powered off time to the total analysis time period is greater than the **powered-off threshold** value, HP SH Optimizer marks the VM as powered-off. You can define this powered-off threshold value by using the Thresholds configuration feature on the user interface.

The following figure illustrates powered-off VM analysis:



Let Powered-off threshold = X

If $\frac{(T1 (Off) + T2 (Off))}{T}$ Greater than X, then the VM is marked as Powered off

Glossary

A

Analysis Period

The time difference between the latest and the oldest time stamp of the data available in the HP SH Reporter platform data store. HP SH Optimizer performs its analytical calculations on this data set.

C

Cluster

A group of systems grouped together over a network, to improve performance and availability of systems over that provided by a single system. The distributed software installed on the networked computers turns them into a distributed system and presents the user with a single-system image.

Complete Duration / Business Hours / Non-Business Hours

The time duration for which the data is considered for optimization analysis. Each of these time durations can be configured by the user.

Constraint

A user-defined check used to limit the workloads that must be considered for creating an optimization scenario.

Apart constraint

A user-defined constraint where two VMs are specified as hosted on two different VM hosts.

Exclusive constraint

A user-defined constraint where a virtual workload is specified as hosted on a specified VM host.

Together constraint

A user-defined constraint where two VMs are specified as hosted on a single VM host.

D

Data Center

Data center represents all the VMs, VM hosts and physical hosts discovered by HP SH Optimizer irrespective of which *group* they belong to.

Deviation Threshold

The percentage of extra utilization that can be accepted without impacting service levels. This threshold is the tolerance level beyond which the utilization is not acceptable. The default value is provided by HP SH Optimizer.

H

Headroom

The percentage of CPU or memory that needs to be kept unused for future business growth or sudden peaks in utilization.

N

Normalized CPU

CPU normalization is done by HP SH Optimizer using the SPECint benchmarks incorporated in the product. SPECint benchmarks specify the standard CPU speeds for the different CPU models. HP SH Optimizer sends the CPU models for all the available CPUs along with the count of CPUs and the CPU speed for each CPU to the SPECint database incorporated in HP SH Optimizer.

O

Optimization Opportunity Rating

A quick indication of the available opportunity for optimization of VMs within a *group* for the specific analysis period. It does not consider any constraints.

Optimization Scenario

A combination of inputs and user-defined constraints on a *group* used by HP SH Optimizer to provide optimal VM placement and VM sizing recommendation.

Oversized VM

Oversized VMs are those VMs that consistently use less capacity than their configured capacity.

P

Physical Workloads

A physical machine on which one or more applications are installed and running.

R

Recommended VM Size

The right VM CPU or memory size that is recommended by HP SH Optimizer so that the VMs are no longer under utilized or over utilized.

Reference VM Size

The size of the VM used by HP SH Optimizer to specify the remaining capacity of the *groups* in terms of VMs. By default, HP SH Optimizer calculates the reference VM size by using the average size of the VMs in the data center.

U

Undersized VM

Undersized VMs are those that consistently use greater capacity than the configured capacity.

Utilization Threshold

The user-defined threshold used by HP SH Optimizer for calculating the oversized, undersized, and idle VMs.

V

Virtual Workloads

A virtual machine on which one or more applications are installed and running.

VM density

The average number of VMs per VM host.

VM host

A machine on which a VM is hosted.

VM sprawl

With VM Sprawl, the number of VMs running in a virtualized infrastructure increases over time, simply because of the ease of creating new VMs, not because those VMs are absolutely necessary for the business.

W

What-if Scenario

A quick on-demand what-if analysis for your cluster environment to check the impact of modifying resource allocation, on the capacity of VMs.

Workload

Any physical or virtual machine on which one or more applications are installed and running. A virtual host is not a workload.

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