



Installing and Administering N1 Grid Console - Container Manager 1.0

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Contents

Preface	13
1 Introduction to N1 Grid Console - Container Manager 1.0	17
Container Manager Overview	17
N1 Grid Container Model	19
Resource Management	21
Resource Pools	22
Resource Controls	23
Resource Utilization Reports and Extended Accounting Data	24
Before Using Container Manager	24
Server Consolidation	24
2 Container Manager Installation and Setup	27
Container Manager Software Description	27
Installing Container Manager Software	31
▼ To Install Container Manager During Sun Management Center Installation	32
▼ To Install Container Manager During Upgrade to Sun Management Center 3.5 Update 1	32
▼ To Install Container Manager Individually	32
Setting Up Container Manager Software	34
▼ To Set Up Container Manager During Sun Management Center Installation or Upgrade	35
▼ To Set Up Container Manager Individually	35
Backup and Restore	37
Agent Update	37

Uninstalling Container Manager Software	37
▼ To Remove the Container Manager Software	38
3 Managing Containers	39
Container Management Overview	39
About Container Definitions	41
Container States	42
Defined Container	43
Active Container	43
Inactive Container	43
Container Manager GUI	44
▼ To Launch the Container Manager GUI	44
▼ To Restart Sun Web Console	45
Container Manager GUI Tabs	45
Hosts View	46
Containers View	48
Organizing Hosts and Containers With Groups	49
Default Containers	50
About Container Creation	52
Container Types	52
About Making Resource Reservations	53
Creating Containers	55
▼ To Launch the New Container Wizard	56
Creating a User-Based or Group-Based Container	60
Creating an Application-Based Container	64
Moving or Starting Processes in a Container	76
▼ To Move Processes Into an Application-Based Container Individually	77
▼ To Start an Application in a Container	78
Activating or Deactivating Containers	79
▼ To Activate a Defined Container	80
▼ To Activate an Inactive Container	81
▼ To Deactivate an Active Container	81
Viewing Container Processes	82
▼ To View the Processes Running in a Container From the Hosts View	84
▼ To View the Processes Running in a Container From the Containers View	85
Modifying Containers	85
▼ To Modify a Container Definition Using a Property Sheet	88

▼ To Modify a Container Using a Property Sheet	89
Modifying Containers With a Resource Change Job	90
Alarm Management	95
▼ To Set an Alarm Threshold	96
▼ To Remove an Alarm Threshold	97
Resource Utilization Reports and Extended Accounting Data	97
Data Collection Process	99
Requesting a Report	99
Deleting Containers	103
▼ To Delete a Container Definition	104
4 Managing Resource Pools	105
Resource Pool Overview	105
Creating New Resource Pools	106
▼ To Create a New Resource Pool	106
Modifying Resource Pools	107
▼ To Modify a Resource Pool	107
Deleting Resource Pools	107
▼ To Delete a Resource Pool	108
A Installing Using the Command Line	109
Installing Container Manager Software	109
▼ To Install Container Manager During Sun Management Center Installation	110
▼ To Install Container Manager During Upgrade to Sun Management Center 3.5 Update 1	110
▼ To Install Container Manager Individually	110
Setting Up Container Manager	112
▼ To Set Up Container Manager During Sun Management Center Installation or Upgrade	112
▼ To Set Up Container Manager Individually	113
Removing the Container Manager Software	115
▼ To Remove Container Manager Using <code>es-uninst</code>	115
Glossary	117
Index	119

Tables

TABLE 2-1	Task Map: Software Installation List	28
TABLE 2-2	Container Manager Features According to Solaris OS Version	30
TABLE 3-1	Container Manager GUI Tabs	46
TABLE 3-2	Project Type Details	53
TABLE 3-3	Property Sheet Details	86
TABLE 3-4	Sample of Resource Change Job Scheduling	91
TABLE 3-5	Alarm Threshold Names	96

Figures

FIGURE 1-1	Example of a N1 Grid Container	19
FIGURE 1-2	Example of Containers on a Host	20
FIGURE 1-3	Example of Projects on a Host	21
FIGURE 1-4	Example of Resource Pools Supporting the Containers on a Host	22
FIGURE 3-1	Container States	42
FIGURE 3-2	Sample: Sun Web Console Login Page	44
FIGURE 3-3	Sample: Hosts View Showing the Container Table	47
FIGURE 3-4	Sample: Containers View with Container Definitions Table Showing	48
FIGURE 3-5	Sample: Default Containers Group With Container Definitions Showing	51
FIGURE 3-6	Sample: Accessing the New Container Button From a Group Name	56
FIGURE 3-7	Sample: Accessing New Container Button From a Host Name	57
FIGURE 3-8	Sample: Accessing New Container Button From a Resource Pool	58
FIGURE 3-9	Sample: New Container Wizard Overview Panel	59
FIGURE 3-10	Sample: Project Type Panel Showing Selected Type as Application	67
FIGURE 3-11	Sample: Completed Project Identifiers Panel Without a Match Expression	68
FIGURE 3-12	Sample: Completed Project Identifiers Panel With a Match Expression	68
FIGURE 3-13	Sample: Creating Active Container Later Panel	69
FIGURE 3-14	Sample: Creating an Active Container Now	71
FIGURE 3-15	Sample: Completed Search For a Host Panel	73
FIGURE 3-16	Sample: Selecting Create a New Resource Pool	74
FIGURE 3-17	Sample: Completed Resource Reservations Panel	75
FIGURE 3-18	Sample: Summary Panel	75

FIGURE 3-19	Sample: Hosts Associated with this Container Definition Table	80
FIGURE 3-20	Sample: Containers View with Deactivate Button Enabled	81
FIGURE 3-21	Sample: Processes Table For an Active Container	83
FIGURE 3-22	Sample: Property Sheet For Changing Resource Reservations and Resource Pool	86
FIGURE 3-23	Sample: Property Sheet For Modifying a Container Definition	87
FIGURE 3-24	Sample: Resource Change Jobs Table	92
FIGURE 3-25	Sample: Summary Panel in Resource Change Job Wizard	94
FIGURE 3-26	Sample: Real Time CPU Utilization Graph Report For an Active Container	100
FIGURE 3-27	Sample: Real Time Memory Utilization Graph Report For an Active Container	100

Examples

- EXAMPLE 3-1** Determining a Match Expression For Mozilla 65
- EXAMPLE 3-2** Determining a Match Expression for Tomcat Server 66
- EXAMPLE 3-3** Verifying a Match Expression for Tomcat Server 66
- EXAMPLE 3-4** Moving ORACLE Processes Individually 77
- EXAMPLE 3-5** Verifying That the Processes Were Moved Into the Container With `ps` 78
- EXAMPLE 3-6** Verifying That the Processes Were Moved Into the Container With `prstat` 78
- EXAMPLE 3-7** Starting an Application Inside a Container on Solaris 9 OS 79
- EXAMPLE 3-8** Verifying Which Project an Application is Associated 79
- EXAMPLE A-1** Example Output After Set Up is Complete 114

Preface

The *Installing and Administering N1 Grid Console - Container Manager 1.0* (Container Manager) guide provides instructions on how to use Container Manager to create, use, and manage containers.

Who Should Use This Book

The document is intended for users familiar with the Sun™ Management Center product. Therefore, many terms and concepts related to the Sun Management Center are not explained here. For more information about Sun Management Center, refer to *Sun Management Center 3.5 Installation and Configuration Guide* and *Sun Management Center 3.5 User's Guide*.

How This Book Is Organized

This document describes how to install and use the Container Manager software.

Chapter 1 provides an introduction to Container Manager.

Chapter 2 provides instructions for installation and set up.

Chapter 3 provides instructions for creating, using, and managing containers.

Chapter 4 provides instructions for creating, using, and managing resource pools.

Appendix A provides instructions for installation and setup using the command line.

Glossary is a list of words and phrases found in this book and their definitions.

Related Information

The following documents provide information about concepts that are useful when using the Container Manager software.

- *Solaris Resource Manager 1.3 System Administration Guide*
- *System Administration Guide: Resource Management and Network Services*
- Sun Blueprints book *Consolidation in the Data Center* by David Hornby and Ken Pepple
- Sun White Paper *Consolidating Oracle RDBMS Instances Using Solaris Resource Manager Software* available at <http://www.sun.com/software/resourcemgr/wp-oracle/>

The latest information on Sun Management Center software and add-on products is available at <http://www.sun.com/solaris/sunmanagementcenter>.

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Typographic Conventions

The following table describes the typographic changes that are used in this book.

TABLE P-1 Typographic Conventions

Typeface or Symbol	Meaning	Example
AaBbCc123	The names of commands, files, and directories, and onscreen computer output	Edit your <code>.login</code> file. Use <code>ls -a</code> to list all files. <code>machine_name%</code> you have mail.
AaBbCc123	What you type, contrasted with onscreen computer output	<code>machine_name%</code> su Password:
<i>AaBbCc123</i>	Command-line placeholder: replace with a real name or value	The command to remove a file is <code>rm filename</code> .
<i>AaBbCc123</i>	Book titles, new terms or terms to be emphasized	Read Chapter 6 in the <i>User's Guide</i> . These are called <i>class</i> options. Do <i>not</i> save the file.

Shell Prompts in Command Examples

The following table shows the default system prompt and superuser prompt for the C shell, Bourne shell, and Korn shell.

TABLE P-2 Shell Prompts

Shell	Prompt
C shell prompt	<code>machine_name%</code>
C shell superuser prompt	<code>machine_name#</code>
Bourne shell and Korn shell prompt	<code>\$</code>
Bourne shell and Korn shell superuser prompt	<code>#</code>

Introduction to N1 Grid Console - Container Manager 1.0

This chapter provides an introduction to N1 Grid Console - Container Manager 1.0 (Container Manager).

The following topics are discussed:

- “Container Manager Overview” on page 17
- “N1 Grid Container Model” on page 19
- “Resource Management” on page 21
- “Resource Utilization Reports and Extended Accounting Data” on page 24
- “Before Using Container Manager” on page 24

Container Manager Overview

Container Manager is an add-on software product to the Sun Management Center 3.5 Update 1 release. The software organizes existing resource management utilities that run on the Solaris™ 8 and Solaris 9 Operating Systems. Specifically, this release provides tools to simplify the configuration of Solaris Resource Manager 1.3 and Solaris 9 Resource Manager. The ability to manage resources with these utilities is useful when undergoing a server consolidation project. Once your consolidation project is completed, this release also provides tools to do the following tasks:

- Prioritize resources for specific applications
- Isolate applications from one another
- Limit resource consumption for specific applications

For more information about the Solaris resource management utilities, see *Solaris Resource Manager 1.3 System Administration Guide* and *System Administration Guide: Resource Management and Network Services*.

This release is a resource management application that helps you prevent contention for resource consumption between software applications. The Container Manager software enables the control of the amount of central processor units (CPUs) and physical memory allocated for use by each software application. This ability is achieved, in part, with the use of a *container*.

A container helps organize and manage the system resources that a service requires. The service is delivered by an application, which is a workload to the system. Using containers enables you to customize the workload environment, and control the level of resources delivered so that an application can perform according to need. You specify in each container the amounts of CPU and physical memory resources you want to allocate for each application. Resource contention between applications running on the same host is limited because you specify minimum CPU and maximum memory resource levels for each application. With this container management application, you are able to accomplish the following tasks:

- Resource allocation, organization, and control
- Resource usage monitoring
- Gathering of CPU extended accounting data

The ability to establish resource levels is similar to reserving resources for use by an application. For example, if an application is running by itself in a container, the application can use any unused CPU resources available, even if that amount exceeds the minimum CPU reservation. When more than one application is running on a host, each in its own container, the resource reservations take effect and contention for CPU resources is limited. Each application will be guaranteed the minimum CPU reservation established for the container in which that application runs.

When a container's maximum memory limit, or *memory cap*, is exceeded, the system tries to page out the memory in order to limit the amount used to the capped value. The *rcapd* daemon is used for enforcing memory caps. For more information about memory capping and how the *rcapd* daemon works, see "Physical Memory Management Using the Resource Capping Daemon" in *Solaris Resource Manager 1.3 System Administration Guide*. For more information about how CPU resources are allocated and how the fair share scheduling class works, see "Fair Share Scheduler" in *System Administration Guide: Resource Management and Network Services*.

Establishing resource constraints for applications avoids the overutilization of system resources by one application. This ability to constrain resource consumption prevents another application from being starved for system resources such as CPU and memory.

Resource management tools such as Container Manager are useful in implementing server consolidation in your data center. Server consolidation produces the following benefits:

- By maximizing the number of applications that can run on your servers, you ensure that your compute resources are not wasted.
- A reduction of the number of servers in your data center simplifies management.

You must develop your server consolidation plan before you install the Container Manager software. For more information, see “Before Using Container Manager” on page 24.

N1 Grid Container Model

An N1 Grid Container is an abstraction layer that helps organize and manage the collection of physical system resources. The container enables the creation of a blueprint that details the resource requirements for an application. The resource requirements of the application are the focus of the N1 Grid Container model. This model focuses on the service or workload. The service is delivered by an application, which is a workload to the system. A workload is a set of associated processes, such as an executing application.

An earlier form of workload-based management was implemented in the Solaris Resource Manager 1.3 release. In that release, the workload was associated with the `lnode`. Container Manager software builds upon this earlier effort. The current container model provides a tool to help you organize and manage the ongoing delivery of resources for services. Common examples of services could be monthly payroll, customer order look-up, and web service delivery.

You need to be able to describe the environment that an application will be limited to when undergoing a server consolidation. Establishing this description enables you to move from having one application running per server to having many applications running on a single server. The container provides this description, as well as being its instantiation. A simple container could, for example, only describe system resources such as CPU, physical memory, and bandwidth. A more complex container could, for example, also control security, namespace isolation, and application faults.

The following illustration of an N1 Grid Container shows the relationship between services and resources.

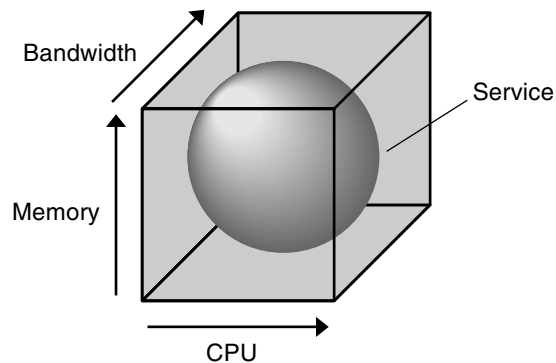


FIGURE 1-1 Example of a N1 Grid Container

The box represents the container. Three kinds of resources are shown along the x, y, and z axes of the box that surrounds the service. In this model, CPU, Memory, and Bandwidth are fundamental resources. The service is bound by the box to represent how this service is contained by the container. For this release, Container Manager controls only CPU and physical memory resources.

Because Container Manager focuses upon the workload, the amount of resources used by an individual host is not monitored. The software instead monitors the amount of resources that is used by the service. In this model, a single instance of a service represents at least one process running on an individual host. The data is retained for possible system health monitoring and accounting purposes.

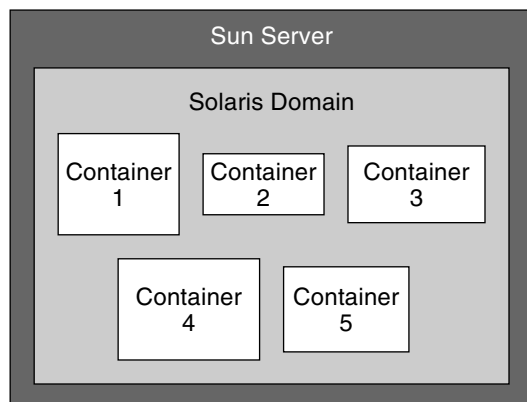


FIGURE 1-2 Example of Containers on a Host

More than one container can be active on an individual host at the same time. If multiple containers exist on a single host, you can set the boundaries of the containers so that the host can expand and contract them. In this case, resources that other containers are not currently using are available to a container that can use them.

Ultimately, the number of containers that can be active on an individual host is determined by the amount of CPU and memory resources available, and how much of these resources each container reserves. The system must be able to meet the combined resource requirements of all the active containers, which are sized according to the needs of the applications.

For more information about managing containers with Container Manager, see Chapter 3.

Resource Management

In a general sense, a *resource* represents a process-bindable OS entity. More often, a resource refers to the objects constructed by a kernel subsystem that offers some form of partitioning. A resource can also be considered an aspect of the computing system that can be manipulated with the intention of affecting application behavior. Examples of resources include physical memory, CPUs, or network bandwidth.

Container Manager works with resource management utilities in both the Solaris 8 and Solaris 9 Operating System. In the Solaris 8 release, resource management is provided by Solaris Resource Manager 1.3. Every service is represented by a *lnode*, or *limit node*. The *lnode* is used to record resource allocation policies and accrued resource usage data. *lnodes* correspond to UNIX user IDs (UIDs). The UID can represent individual users and applications by default. For more information about *lnodes* and resource management, see “Limit Node Overview” in *Solaris Resource Manager 1.3 System Administration Guide*.

In the Solaris 9 release, resource management is provided by Solaris 9 Resource Manager. In this release, the *project* is similar to the *lnode*, and provides a network-wide administrative identifier for related work. All the processes running in a container have the same project identifier, also known as the *project ID*. The Solaris kernel tracks resource usage through the project ID. Historical data can be gathered using extended accounting, which uses the same tracking method. In Container Manager, the project represents the container. For more information about projects and resource management, see “Projects and Tasks” in *System Administration Guide: Resource Management and Network Services*.

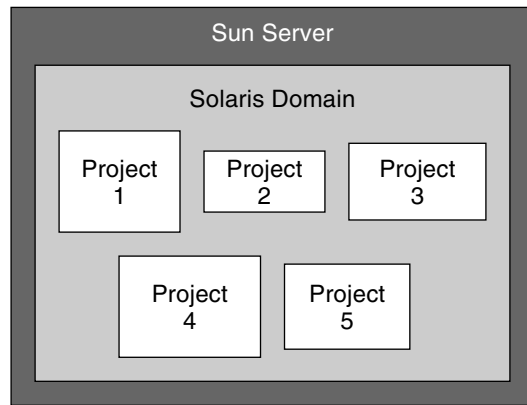


FIGURE 1-3 Example of Projects on a Host

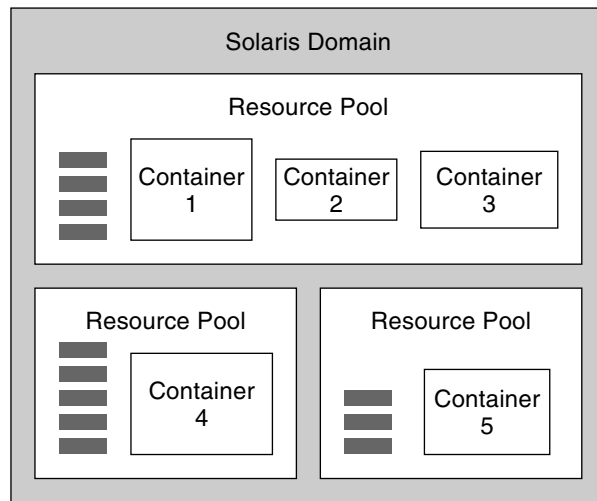
Information about the processes running in a container is obtained from the Container Manager GUI. The gathering of data will be transparent to you as you create and manage containers using the software.

Different methods can be used to create container boundaries. One method is to partition the system by using resource pools. Another method is to establish limits on the project through resource controls.

Resource Pools

A *resource pool*, or *pool*, is a Solaris 9 software configuration mechanism that is used to partition the resources of a host. A *resource set* is a process-bindable resource. Memory sets and processor sets are examples of resource sets. Only processor sets are currently available in the Solaris 9 release. A pool binds the various resource sets available on a host. For more information about resource pools, see "Resource Pools" in *System Administration Guide: Resource Management and Network Services*.

A resource pool can hold one or more containers. In the case of one container, the resources that are linked to the pool are dedicated to that container. In the case of multiple containers, the resources that are linked to the pool are shared with the containers. The following illustration shows the relationship between resource pools and containers.



■ CPU resources

FIGURE 1-4 Example of Resource Pools Supporting the Containers on a Host

A host can also have only one resource pool, as is always the case when running on the Solaris 8 Operating System. This pool is called `pool_default`. Because resource pools do not exist in this OS version, the `pool_default` is created artificially. All of the CPUs on a host running the Solaris 8 release are considered to be in a single pool by convention.

For more information about managing resource pools with Container Manager, see Chapter 4.

Resource Controls

In the case when more than one container is bound to a single pool, you can set guarantees, or limits, on a single container. These limits are called *resource controls*. An example of a control is the setting a minimum CPU limit, as in the case of using the fair share scheduler (FSS). Another example is the setting of a physical memory cap, as in the case of using the `rcapd` daemon. When setting a minimum CPU guarantee, the idle CPU cycles in one container can be used by the applications in the other containers. For more information about resource controls, see “Resource Controls” in *System Administration Guide: Resource Management and Network Services*.

Resource Utilization Reports and Extended Accounting Data

Reports that provide historical resource utilization data per container, resource pool, or host are available if you have the Performance Reporting Manager add-on product installed with Container Manager. CPU data, memory utilization data, and CPU extended accounting data are stored in the database by the Performance Reporting Manager data collection service. From the GUI, you can request a graph report that details resource usage, or you can export the data to a text file in comma-separated value (CSV) format. The latter can be used in a billing and accounting application, for example.

For more information about Performance Reporting Manager software, see *Sun Management Center 3.5 Performance Reporting Manager User's Guide*. For more information about the available reports and accounting data, see "Resource Utilization Reports and Extended Accounting Data" on page 97.

Before Using Container Manager

Prior to installing and using the Container Manager software, you should make an assessment of your resource consumption needs. As part of the container creation process, you will provide a minimum CPU reservation and a physical memory cap for the processes that will run inside the container. The creation process is best done if you have already evaluated your needs, developed your goals, and have a resource plan in place. Additionally, a master list of the specifications of all the hardware involved is also useful before you begin.

Server Consolidation

A key component for undergoing a successful server consolidation is to have a master list of all the servers, storage, and applications that are candidates for consolidation. Once your consolidation plan has been finalized, you can begin to implement the plan with this list.

If you are planning on performing a server consolidation in your data center, you will need to perform several tasks prior to installing and using the Container Manager software. A partial list of tasks to be performed includes the following:

- Determine your server consolidation plan.

- Trend the resource usage of the software applications involved in the consolidation plan.
- Develop a plan to migrate all software applications to the appropriate servers.
- Determine which Solaris operating system version is running on the servers involved in the consolidation plan.

For more discussion about how to plan and execute a server consolidation, you can read the Sun Blueprints book *Consolidation in the Data Center* by David Hornby and Ken Pepple.

Container Manager Installation and Setup

This chapter contains procedures for installing, setting up, and uninstalling the N1 Grid Console - Container Manager 1.0 (Container Manager) software with wizards. For information about using the command line for these procedures, see Appendix A.

For the latest information about installing, setting up, and using the software, see *N1 Grid Console - Container Manager 1.0 Release Notes*.

This chapter discusses the following topics:

- “Container Manager Software Description” on page 27
- “Installing Container Manager Software” on page 31
- “Setting Up Container Manager Software” on page 34
- “Backup and Restore” on page 37
- “Agent Update” on page 37
- “Uninstalling Container Manager Software” on page 37

Container Manager Software Description

Container Manager is installed as an add-on product to the Sun Management Center 3.5 Update 1 software. The add-on software is installed on the Sun Management Center server layer or agent layer, depending upon the function of the host. Sun Management Center is a three-tier application that consists of the following three layers: server, console, and agent. For more information about the three-tier architecture, see “Sun Management Center Overview” in *Sun Management Center 3.5 Installation and Configuration Guide*.

Note – Container Manager requires that several additional software products be installed. It is important that you read all related documentation before beginning installation. You might need to apply software patches or plan for a reboot of the system in order to complete installation of other products. The size requirements of these products should be planned for as well before starting installation.

The following Task Map lists the tasks required to complete installation of the required software. Note that some software requires installation on one or more of the Sun Management Center layers: server, agent, or console.

TABLE 2-1 Task Map: Software Installation List

Task	Layer	Instructions
Required patches See product documentation for the location of patches.	As needed: server, agent, console	<i>N1 Grid Console - Container Manager 1.0 Release Notes</i> <i>Sun Management Center 3.5 Update 1 Release Notes</i> (Solaris 8 OS) <i>Solaris Resource Manager 1.3 Release Notes</i>
Sun Management Center 3.5 Update 1 The software is available on the Sun Management Center 3.5 Update 1 CD-ROM.	As needed: server, agent, or both	<i>Sun Management Center 3.5 Installation and Configuration Guide</i> <i>Sun Management Center 3.5 Update 1 Supplement</i> <i>Sun Management Center 3.5 Update 1 Release Notes</i>
Sun Web Console 2.0.2 The software is available from the Sun Management Center 3.5 Update 1 CD-ROM.	server Automatically installed with Sun Management Center 3.5 Update 1 installation.	<i>Sun Management Center 3.5 Update 1 Supplement</i> <i>Sun Management Center 3.5 Update 1 Release Notes</i>
Tomcat 4.0.5 The software is available from the Sun Management Center 3.5 Update 1 CD-ROM. Is required by Sun Web Console 2.0.2.	server Automatically installed with Sun Management Center 3.5 Update 1 installation.	<i>Sun Management Center 3.5 Update 1 Supplement</i> <i>Sun Management Center 3.5 Update 1 Release Notes</i>

TABLE 2-1 Task Map: Software Installation List (Continued)

Task	Layer	Instructions
<p>JDK™ version 1.4.2, or higher</p> <p>JDK version 1.4.2_03 software is available from the Sun Management Center 3.5 Update 1 CD-ROM.</p> <p>Is required by Sun Web Console 2.0.2.</p>	<p>server</p>	<p>See installation README included with the software.</p>
<p>(Solaris 8 OS only) Solaris Resource Manager 1.3</p> <p>Provides the necessary resource management utilities on Solaris 8 OS.</p> <p>This software is available from http://store.sun.com.</p>	<p>agent</p> <p>Note – When installing Sun Management Center server layer software, the agent layer is automatically installed as well. You should install this product on any server that will function as an agent system as well.</p>	<p><i>Solaris Resource Manager 1.3 Release Notes</i></p> <p><i>Solaris Resource Manager 1.3 Installation Guide</i></p> <p><i>N1 Grid Console - Container Manager 1.0 Release Notes</i></p>
<p>(Optional) Performance Reporting Manager</p> <p>Installation is only required if you want access to the resource utilization reports and accounting features of Container Manager. Use of this software is included in the license.</p> <p>The software is included with the Sun Management Center 3.5 Update 1 CD-ROM.</p>	<p>server and agent, for all systems for which you want to request data graphs</p> <p>Note – Performance Reporting Manager server layer requires that you have 1 GB RAM and 1 GB swap space available on the machine.</p>	<p><i>Sun Management Center 3.5 Performance Reporting Manager User's Guide</i></p> <p><i>Sun Management Center 3.5 Update 1 Supplement</i></p>

TABLE 2-1 Task Map: Software Installation List (Continued)

Task	Layer	Instructions
<p>N1 Grid Console - Container Manager 1.0</p> <p>The software is included with the Sun Management Center 3.5 Update 1 CD-ROM.</p>	<p>As needed: server, agent, or both</p> <p>Note – A server layer installation requires a directory with at least 300 megabytes for the software’s database. You will be prompted for a directory on the device with that space during set up.</p>	<p>“Installing Container Manager Software” on page 31</p> <p><i>N1 Grid Console - Container Manager 1.0 Release Notes</i></p>

The Container Manager software runs on the following versions of the Solaris operating system:

TABLE 2-2 Container Manager Features According to Solaris OS Version

OS Version	Container Manager Features
Solaris 8 6/00 through Solaris 8 2/02 (SPARC® only)	Together with the Solaris Resource Manager 1.3 software, supported features include the ability to specify a minimum CPU reservation and a memory cap.
Solaris 9 FCS through Solaris 9 8/03 (SPARC and x86)	Supported features include the ability to specify a minimum CPU reservation. There is no memory control support.
Solaris 9 12/03, or later (SPARC and x86)	Supported features include the ability to specify a minimum CPU reservation and a memory cap.

The Container Manager agent runs on all the hardware platforms that Sun Management Center 3.5 Update 1 supports for the agent layer. For more information, see *Sun Management Center 3.5 Update 1 Supplement*.

The Container Manager software consists of the following architecturally neutral software packages for both SPARC and x86:

- SUNWscms – Container Manager package for Sun Management Center server layer
- SUNWscmc – Container Manager package for Sun Management Center server layer
- SUNWscmca – Container Manager package for Sun Management Center server layer
- SUNWscmdb – Container Manager package for Sun Management Center server layer

- `SUNWscmh` – Container Manager online help package for Sun Management Center server layer
- `SUNWscmcm` – Container Manager package for Sun Management Center server and agent layer
- `SUNWscmp` – Container Manager package for Sun Management Center server and agent layer
- `SUNWscma` – Container Manager package for Sun Management Center agent layer

Note – The Container Manager module is automatically loaded after installation and setup of the software is complete. The module is not visible in the Sun Management Center Java or web console. You do not need to manually load this module in Sun Management Center as with other add-on software.

Installing Container Manager Software

You can install the Container Manager add-on software either using the Sun Management Center 3.5 Update 1 installation wizard or the command line. This section discusses how to install the software using the installation wizard. For more information about installing using the command line, see Appendix A.

The Container Manager software can be installed at the following times:

- At the same time that you install the Sun Management Center 3.5 Update 1 software.
- At the same time that you upgrade your existing Sun Management Center 3.5 installation to Update 1, as part of the upgrade procedure.
- After you have completed your installation of, or upgraded to, Sun Management Center 3.5 Update 1. In this case, you install the Container Manager software individually.

The Performance Reporting Manager software must also be installed if you want to use the performance and accounting data features of Container Manager. For more information about installation and setup of this software, see “Performance Reporting Manager Installation and Setup” in *Sun Management Center 3.5 Performance Reporting Manager User’s Guide*. If you do not intend to use these features, you do not need to install this add-on software.

▼ To Install Container Manager During Sun Management Center Installation

- For more information and detailed steps, see “To Install Sun Management Center and ASM” in *Sun Management Center 3.5 Installation and Configuration Guide*. To perform this procedure, you will substitute the Container Manager software for the ASM software. You can also install additional add-on software, such as Performance Reporting Manager, at the same time.

▼ To Install Container Manager During Upgrade to Sun Management Center 3.5 Update 1

- For more information and upgrade steps, see “To Upgrade Sun Management Center 3.0 to Sun Management Center 3.5” in *Sun Management Center 3.5 Installation and Configuration Guide*. You can also install additional add-on software, such as Performance Reporting Manager, at the same time.

▼ To Install Container Manager Individually

1. As superuser (`su -`), launch the Sun Management Center installation wizard by typing:

```
# /opt/SUNWsymon/sbin/es-guiinst
```

where `/opt` is the directory in which Sun Management Center 3.5 Update 1 is installed. Substitute the name of the actual directory if it is different on your system.

The Sun Management Center installation wizard appears and guides you through the installation process for the software. Click the Next button to move through the wizard.

2. Provide the source directory of the Container Manager software files when prompted.

- On SPARC systems, choose from the following:

- a. If installing from the software CD-ROM, type:

```
# /cdrom/cdrom0/image
```

- b. If installing from a directory to which the software has been copied, type:

```
# disk1/image
```

where `disk1` is the location where the software was copied.

- On x86 systems, choose from the following:

- a. If installing from the software CD-ROM, type:


```
# /cdrom/cdrom0/x86/image
```

- b. If installing from a directory to which the software has been copied, type:

```
# disk1/x86/image
```

where *disk1* is the location where the software was copied.

3. Select the checkbox Install Product Documentation if you want to install the documentation.

You can view installed documentation from a browser by going to `/var/opt/sun_docs/sundocs.html`.

4. If installing the server layer, select the desired languages from the Select Language Support panel. This panel only appears when installing the server layer.

The Checking for Available Products panel appears. When the progress bar is finished, the Products Already Installed panel appears.

5. Review the list of products already installed.

The Select Add-on Products panel appears.

6. Select N1 Grid Console - Container Manager 1.0 from the list of add-on software to be installed.

The Add-on Products License Agreement panel appears.

7. Read the license agreement.

- If you agree to the license agreement, click I Agree. The Confirmation Panel appears.
- If you do not agree to the license agreement, click I Do Not Agree. The installation wizard exits and installation quits.

You must click the I Agree button to proceed with installation.

8. Review the Confirmation Panel.

The Installation Complete panel appears when the software installation is complete.

Once installation of the Container Manager software is complete, the setup wizard guides you through the setup process for the software. For more information, see “Setting Up Container Manager Software” on page 34.

Setting Up Container Manager Software

After installation is complete, you must run the Container Manager setup wizard to configure the server and agent layers. As with installation of the software, you can run the set up process at the time you setup the Sun Management Center 3.5 Update 1 installation or upgrade. You can also set up the software individually at a later time.

These configuration files are created in the following locations during the setup process:

- System pool and processor set configuration files are stored in `/etc/pooladm.conf`.
- Extended accounting files are stored in `/var/sadm/exacct/files`.

If the `/etc/pooladm.conf` file already exists on a host, a backup of the existing file is created. This backup of the original file is named `/etc/pooladm.conf.scmbak`. If an active configuration exists on a host, all processor sets that are not associated with a resource pool are removed. The scheduling class for the resource pools is then set to fair share scheduler (FSS). Finally, the new configuration is committed and is stored in `/etc/pooladm.conf`.

If an active configuration does not exist on a host, a new configuration is discovered and stored in `/etc/pooladm.conf`. This discovered configuration is committed to make it active. The default pool scheduling class is set to FSS.

If the extended accounting files are active on a host at the time of set up, then they remain the same. If the files are not active, they are then configured and activated. During configuration, the extending accounting file name is set to `/var/adm/exacct/tasktimestamp`.

Additionally, during the set up process the following changes are made to the host by the software:

- The memory cap daemon `rcpad` is started (Solaris 8 OS, Solaris 9 12/03 OS, or later).
- All processes running under the timesharing (TS) and interactive (IA) scheduling classes are moved under the FSS scheduling class.
- Task based extended accounting is enabled.
- The default scheduling class of the host is updated to FSS, if needed.
- On systems running the Solaris 8 operating system, the `1node` hierarchy is aligned with the project hierarchy.
- On systems running the Solaris 8 operating system, the `group.staff` project is deleted from the `/etc/project` file.

For more information about resource pools, scheduling classes, and extended accounting, as well as other standard Solaris resource management concepts, see *System Administration Guide: Resource Management and Network Services*.



Caution – Standard Solaris software resource management command line commands are not supported by Container Manager. Use the Container Manager GUI to manage the software.

▼ To Set Up Container Manager During Sun Management Center Installation or Upgrade

- For more information and detailed steps, see “Sun Management Center 3.5 Installation and Setup” in *Sun Management Center 3.5 Installation and Configuration Guide*.

▼ To Set Up Container Manager Individually

1. As superuser (su –), launch the Sun Management Center setup wizard by typing:

```
# /opt/SUNWsymon/sbin/es-guisetup
```

where /opt is the directory in which Container Manager is installed. Substitute the name of the actual directory if it is different on your system.

The Container Manager setup wizard appears and guides you through the setup process for the software. The Overview panel appears first. Click the Next button to move through the wizard. Use the Back button to make corrections by moving back through the wizard.

Note – If you have installed more than one Sun Management Center add-on product, the setup wizard for each product appears automatically. Each wizard guides you through the setup process for its add-on product. Each new setup wizard appears automatically after the setup process is completed for the previous add-on product. The setup wizard for the Container Manager software might not be the first to appear.

2. Review the list in the Stopping Components panel.

The Sun Management Center components must be stopped before the setup process can continue. The Advanced Setup Options panel appears if you have completed the setup process for some of the add-on products installed. The remaining add-on software can be setup now.

3. Select from the following options:

- Reconfigure All – The setup process is run again for the base Sun Management Center software and all add-on software. All the Sun Management Center software that was previously setup is set up again.
- Configure Addons – The add-on software that was recently installed but not yet setup is now set up.
- Re-create the Sun Management Center Database

4. Review the list of products in the Setup Complete panel.

The Select Add-on Products panel appears. All products newly installed on the system that will be set up are listed. You can also run setup again on any product that was previously been set up.

5. Review the list of products to confirm that Container Manager appears as a product to be set up. Click Next to start the set up process.

A progress panel appears while all components are being set up.

6. When setting up the agent layer, if processor sets are detected that are not associated with a resource pool, a panel appears requesting permission to delete these sets. Please select from the following options:

- Yes – These processor sets will be deleted from the system. In order for Container Manager to function correctly, any processor set that is not associated with a resource pool must be removed. This removal is necessary because projects need to be associated with the pools. After this selection, these processor sets are automatically deleted for you, and the setup process continues.
- No – These processor sets will not be deleted from the system. After this selection, the setup wizard exits and the Container Manager software is not set up on the system. You are unable to use the Container Manager software on any host that has processor sets that are not associated with a resource pool.
- Cancel – The setup wizard exits. The Container Manager software is not set up on the system.

7. When setting up a server layer installation, provide the full path to a directory that has at least 300 Mbytes free disk space for the database and click Next.

8. Once the progress bar in the Container Manager DB Configuration panel completes, click Next.

9. To invoke the Start Wizard, click Next.

Once the setup procedure is complete, you have the option to start the Sun Management Center processes. For more information, see “Starting and Stopping Sun Management Center” in *Sun Management Center 3.5 Installation and Configuration Guide*.

For information about launching the Container Manager GUI, see “To Launch the Container Manager GUI” on page 44.

Backup and Restore

Use the Sun Management Center backup (`es-backup`) and restore (`es-restore`) scripts to backup or restore Container Manager data. For more information, see “Sun Management Center Backup and Recovery” in *Sun Management Center 3.5 Installation and Configuration Guide*.

Agent Update

If you want to upgrade the agent layer on multiple hosts with the Container Manager software, you can use the agent update feature. When using the agent update feature, it is best to keep all Container Manager agent machines that are in the same server context at the same Sun Management Center version levels. For more information about server context, see “Sun Management Center Architecture” in *Sun Management Center 3.5 User’s Guide*.

For more information about using the agent update feature during installation, see “Creating Agent Installation and Update Images” in *Sun Management Center 3.5 Installation and Configuration Guide*.

Uninstalling Container Manager Software

Uninstallation of the software follows standard Sun Management Center procedures. Accordingly, you can use either the command line or the uninstall wizard. The following is removed in addition to the software packages: the module entry from `base-modules-d.dat` and the application registration from Sun Web Console. You have the option to retain or delete the data stored in the database during the removal process. System resource configuration changes made during installation are not removed when the Container Manager software is uninstalled.

For information about uninstalling the software using the command line, see Appendix A. For information about standard Sun Management Center removal procedures, see “Uninstalling SyMON and Sun Management Center” in *Sun Management Center 3.5 Installation and Configuration Guide*.

▼ To Remove the Container Manager Software

1. As superuser (su -), launch the uninstall wizard by typing:

```
# /opt/SUNWsymon/sbin/es-guiuninst
```

where /opt is the directory where Sun Management Center is installed. Substitute the name of the actual directory if it is different on your system. The Sun Management Center uninstall wizard appears.

2. Select Container Manager from the list of software, and click Next.

3. Indicate whether to preserve the data files, and click Next.

The software begins to uninstall. The Container Manager packages and configuration files are removed. If you chose not to preserve the data files, they are removed as well.

4. Click Close to exit the wizard.

Managing Containers

This chapter contains procedures for creating, using, and managing containers using N1 Grid Console - Container Manager 1.0 (Container Manager).

For the latest information about the software, see *N1 Grid Console - Container Manager 1.0 Release Notes*.

The following topics are discussed:

- “Container Management Overview” on page 39
- “About Container Definitions” on page 41
- “Container States” on page 42
- “Container Manager GUI” on page 44
- “Default Containers” on page 50
- “About Container Creation” on page 52
- “Creating Containers” on page 55
- “Moving or Starting Processes in a Container” on page 76
- “Activating or Deactivating Containers” on page 79
- “Viewing Container Processes” on page 82
- “Modifying Containers” on page 85
- “Alarm Management” on page 95
- “Resource Utilization Reports and Extended Accounting Data” on page 97
- “Deleting Containers” on page 103

Container Management Overview

A container helps organize and manage the collection of physical system resources, and is useful when implementing your overall server consolidation plan. Containers offer the following features:

- Setting minimum CPU reservations and memory caps for applications to help balance system resources

Each application is guaranteed the minimum CPU reservation and the memory cap set for its container. For example, an application-based container enables you to establish both a minimum CPU reservation and a memory cap for any application running on your network. When several containers are active on the same host, with each application in its own container, contention for system resources is reduced. In this situation, the resource boundaries set for each container are enforced by the Solaris kernel operating on that host.

- Tracking of resource utilization across a datacenter

The total amount of resources that are being used by the container is tracked, in part, with project membership. Each UNIX user must be assigned to a default project, although users and groups can belong to one or more projects. The processes that a UNIX user launches can be bound to any of the projects of which the user is a member. Containers use both project membership and resource pools in order to help track and control application resource consumption.

For more information about how containers work and the resource management tools they use, see Chapter 1.

After the software is installed and set up, several default containers are available for your immediate use. You also create your own custom containers by using a wizard that guides you through the process. Every container has its own container definition. This definition can be used over again for creating new containers. Container definitions provide the following advantages:

- Ability to create multiple container instances with the identical set of CPU and memory resource boundaries.
- Spreading multiple container instances across several hosts. Whereas a single active container cannot span multiple hosts, additional container instances with the same definition can be spread across multiple hosts.
- Shortens the time necessary to create a new container instance, enabling you to quickly apportion resources as needs fluctuate.

The GUI is browser-based and provides two management views: one from the host perspective, and one from the container perspective. You can further organize each view by creating groups and selecting which elements the groups should contain.

Additionally, the processes running inside the container and the resources being used can be readily checked with the software. Several graphing options are also available to help assess the level of resource utilization per container or host, including the ability to export the data to a file. These features enable you to monitor and reassess resource consumption in order to make adjustments as needed.

With the software's alarm feature you can be notified via email when a container's resource utilization reaches a threshold of your setting. Alarm icons are also visible in the GUI for both hosts and containers.

The resource change job feature gives you the ability to schedule changes to current resource boundaries on one or more containers with one request. A wizard guides you through the steps required for creating or modifying a resource change job.

About Container Definitions

The first step when creating a custom container is to make a container definition. The container definition consists of the following information:

- Name of the container
- Description of the container (optional)
- Project type of the container
- Project name associated with the container
- The UNIX users and groups associated with the container
- The match expression, if there is one

The name you assign to a container definition is permanent and cannot be changed. The project name is likewise permanent. The other identifying information for the container definition can be changed.

The container definition is saved by the software and is available for repeated use until the definition is deleted. The container definition is used when activating a container on a host. A container is active when it has been associated with a host, and its resource reservations have been set.

Because multiple containers, with the same definition and resource reservations, can be active simultaneously on several different hosts, the container definition is a convenience for managing containers across the data center. Once the container definition has been saved, it can be used at any time to activate a container on any suitable host. In this manner the container definition can be used as a template for creating a new container instance.

You can use a container definition to create multiple container *instances*. For example, if you use a single container definition to create three active containers on three different hosts, you have one container definition and three container instances of that definition. Changing the underlying information in the definition changes all the container instances based on that definition.

The wizard gives you the option to create a container that is activated upon completion of all the steps. A container definition is created at the same time and its name is saved in the GUI. You also have the option to create just the container definition and activate the container at a later time with a wizard that guides you through the process.

For a container definition, you can perform the following tasks using the GUI:

- Create a new container definition
- Create a new group
- Move the container definition into and out of groups
- Modify the properties
- Create a new container instance (active container) on a host

- Delete the container definition

For a container instance, you can perform the following tasks using the GUI:

- Create a new group
- Move the container
- Modify the properties
- Change the resource reservations
- Create a resource change job
- Check the status of the processes running inside
- Request a utilization report and export the data to a file
- Deactivate or activate the container
- Set an alarm
- Delete the container

Container States

A container does not actually enforce the resource consumption boundaries that you set for an application. Rather, once the minimum CPU reservation and memory cap are provided and the container is activated, the Solaris kernel begins enforcing these boundaries. Before using containers, you should know more about container states. A container can be in one of the following three states: defined, active, and inactive.

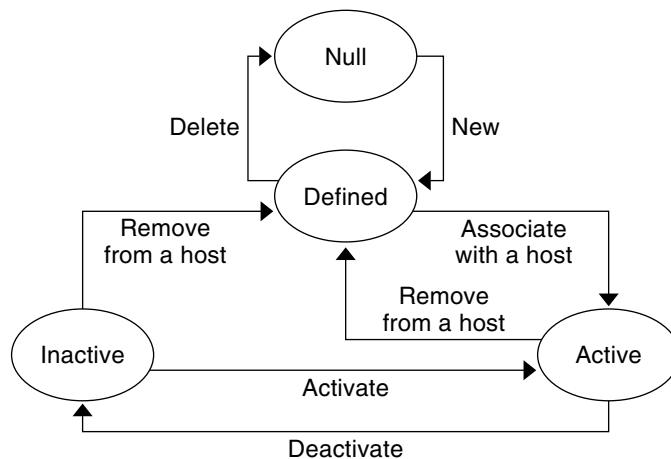


FIGURE 3-1 Container States

A container can move between these states throughout its lifetime.

Defined Container

The container definition is created during the initial stage but the container itself is still not fully formed. Each container definition must have a unique name and can be saved indefinitely in the database.

As seen in Figure 3–1, the defined container moves into the active state after the container is associated with a host. An inactive container can move back into the defined state after it has been deactivated and is no longer associated with a host.

Active Container

The first step in making a container active is to associate its definition with a host. The second step is to set the resource boundaries, namely, to assign the minimum CPU reservation and the memory cap for the container. The container must be associated with a host that can support these resource boundaries. An active container can also be referred to as being *deployed*, in the sense that the container definition has been pushed out and resides on a host.

When creating an application-based container with the New Container wizard, a *match expression* can be provided which identifies the processes associated with the application. All processes corresponding to the match expression are then automatically moved under this container. Upon container activation, an entry in the `/etc/project` database is created on the host that the container is associated with. Correspondingly, the matching processes are then moved under the project name for the container. Once the processes are moved, all resource utilization data is collected and saved for the container.

Inactive Container

When a container is deactivated, the resource boundaries are no longer enforced. A deactivated container enters into an inactive state and is deleted from the host's `/etc/project` file. While inactive, the container still exists in the software's database, pending future activation. Once the inactive container is reactivated, the container's resource boundaries are again enforced.

All data collected about the container's use of resources while it was active is preserved in the database. You can still request utilization reports for an inactive container for up to 30 days after the container was deactivated.

Container Manager GUI

Standard Solaris software resource management command-line commands are not supported by the Container Manager software. You should manage the containers from the Container Manager graphical user interface (GUI). The GUI is launched from the Sun Web Console using a browser. The following browsers are supported:

- Netscape Navigator™ 4.7x, 6.2x, and 7.x on Solaris versions 8 and 9
- Netscape Navigator 4.7x, 6.2x, and 7.x on Microsoft Windows (98/2000/XP)
- Mozilla™
- Internet Explorer 5.0 and higher (including 6.x) on Microsoft Windows (98/2000/XP)

▼ To Launch the Container Manager GUI

1. **If your UNIX user ID is not contained in the Sun Management Center `esusers` file, create this entry.**

For instructions on how to create an entry, see “Setting Up Users” in *Sun Management Center 3.5 Installation and Configuration Guide*.

2. **Launch a browser.**

For a list of supported browsers, see “Container Manager GUI” on page 44.

3. **Choose from the following URLs to go to the Sun Web Console:**

- To reach the Container Manager GUI directly after you log into Sun Web Console type:

```
https://host_machine_name:6789/containers
```

- To reach the Console page after you log into Sun Web Console type:

```
https://host_machine_name:6789
```

The host machine name must be a Sun Management Center server.

The Sun Web Console login page appears. If the login page does not appear, you may need to restart Sun Web Console. For instructions, see “To Restart Sun Web Console” on page 45.

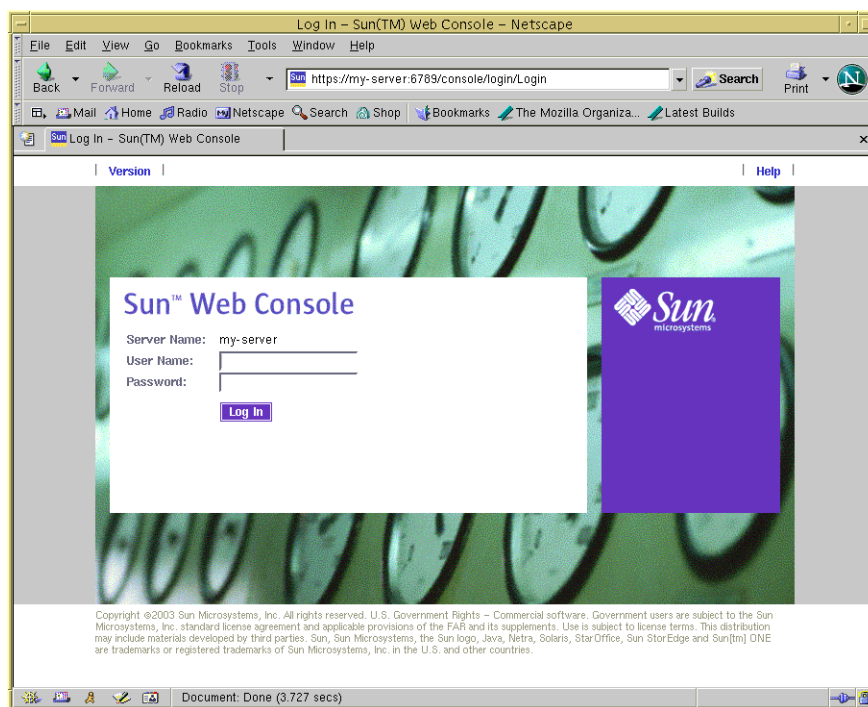


FIGURE 3–2 Sample: Sun Web Console Login Page

4. **Log into the Sun Web Console using your UNIX user ID and password.**
The Container Manager GUI appears. Two views are available from the Hosts and Containers tabs in the navigation window.
5. **If you reach the Console page, select the N1 Grid Console - Container Manager 1.0 link to access the GUI.**

▼ To Restart Sun Web Console

If you are unable to access the Sun Web Console, use this command to restart it.

- **As superuser (su -), restart the Sun Web Console by typing:**

```
# /usr/sbin/smcwebserver restart
```

Container Manager GUI Tabs

The following table provides information about the tabs that appear in the right pane of Container Manager GUI. This table is presented alphabetically but the choice and order of tabs varies according to location in the GUI.

TABLE 3-1 Container Manager GUI Tabs

Tab Name	Contents	Available From
Alarm Thresholds	Provides information about alarm threshold settings.	Hosts view, Containers view
Containers	Provides information about the containers that are associated with a host.	Hosts view, Containers view
Hosts	Provides information about the hosts associated with the selected container.	Containers view
Processes	Provides information about the processes that are currently running in the container.	Hosts view, Containers view
Properties	Provides information about the properties of the selected host, container definition, container, or resource pool.	Hosts view, Containers view
Resource Change Job	Provides information about scheduled resource change jobs. You can also create new a new resource change job from this tab.	Containers view
Resource Pools	Provides information about the resource pools on the selected host.	Hosts view
Utilization	Provides information about a container's daily, weekly, or monthly resource utilization. Real-time utilization data is available for active containers. This tab is visible only if Performance Reporting Manager software is installed.	Hosts view, Containers view

Hosts View

The Hosts view organizes information from the host perspective. All agent machines that you are managing with the software appear in the navigation window. The resource pools available for each host are shown as well. You can also manage the containers associated to the host from this view.

All agent hosts that have the software installed are automatically discovered and added to the Hosts view. This view is accessed from the left tab in the navigation window. All agent hosts that are discovered are initially placed under a default group titled Hosts. You can further organize this view by creating new groups and moving the hosts to relevant groups.

Note – Only those agent machines that are part of the Sun Management Center server context are loaded into the Hosts view. For more information about server context, see “Sun Management Center Architecture” in *Sun Management Center 3.5 User’s Guide*.

The tabs and information available in the Hosts view is listed in Table 3–1.

Information about every container instance that is associated with a host is listed in the Containers table. This table is available from the Containers tab after selecting a host name in the navigation window. The Containers table provides information about each container, detailing one container per row. The Containers table provides the following data:

Container Name	Name of the container.
Status	State of the container: active and inactive
Resource Pool Name	Resource pool to which the container is bound.
CPU Reservation (CPUs)	Minimum CPU reservation set for the container.
CPU Usage (CPUs)	Amount of CPU the container is using.
Memory Cap (MB)	Maximum memory limit in megabytes.
Memory Usage	Memory used by the container in megabytes.

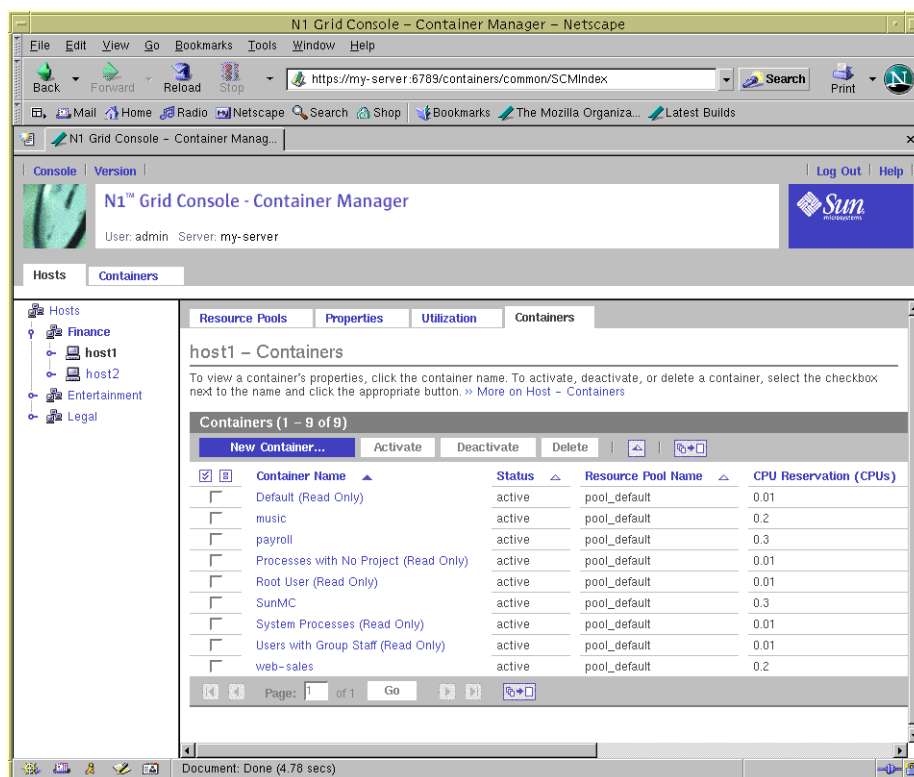


FIGURE 3-3 Sample: Hosts View Showing the Container Table

Containers View

The Containers view organizes information from the container perspective. All container definitions and containers appear in the navigation window. Since container definitions can be used repeatedly to make new containers, you can readily access the definitions from this view, as well as perform other management tasks.

After installation and setup are complete, the Containers view automatically adds the Containers group as a default. Container definitions are managed from the Containers view.

The information available in the Containers view is listed in Table 3-1.

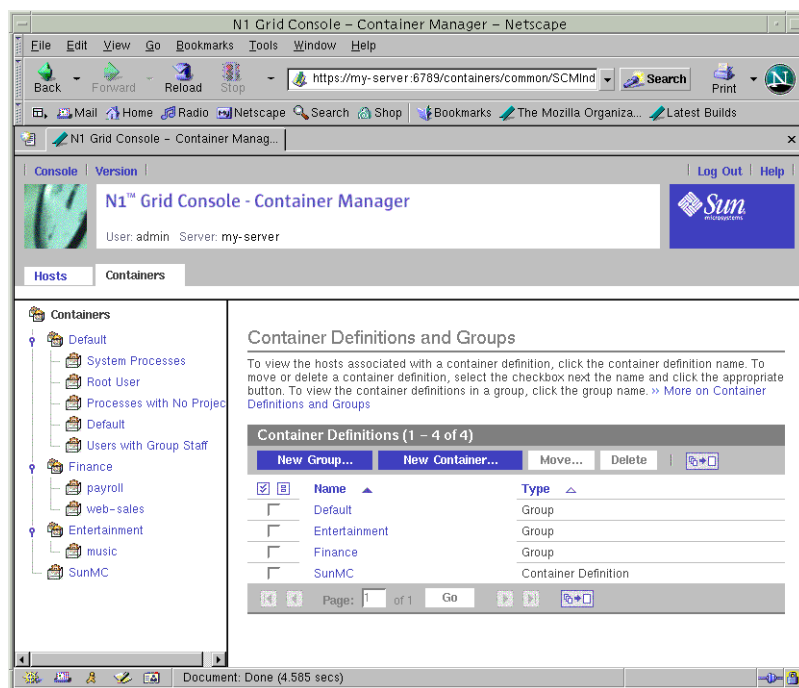


FIGURE 3-4 Sample: Containers View with Container Definitions Table Showing

Organizing Hosts and Containers With Groups

The Hosts view contains the default group Hosts. All hosts discovered after installation of the software are placed in this group. Likewise, the Containers view has a default group named Default in which all the default containers of a host are placed. You can create additional groups in each view for organizing the hosts and containers as you like.

▼ To Create a Container Group or Host Group

1. If the Container Manager GUI is not already open, access it as described in “To Launch the Container Manager GUI” on page 44.
2. Select the appropriate view from the navigation window.
 - For a new container group, select the Containers view. The Container Definitions table is displayed in the right pane.

- For a new host group, select the Hosts view. The Hosts and Groups table is displayed in the right pane.
3. **Click the New Group button.**
A dialog box appears.
 4. **Provide a name for the group, and click OK.**
The name cannot exceed 32 characters.
The new group appears in the selected view.

▼ To Move a Container or Host to a Different Group

1. **If the Container Manager GUI is not already open, access it as described in “To Launch the Container Manager GUI” on page 44.**
2. **Select the appropriate view from the navigation window.**
 - To move a container to a different group, select the Containers view. The Container Definitions table is displayed in the right pane.
 - To move a host to a different group, select the Hosts view. The Hosts and Groups table is displayed in the right pane.
3. **To enable the Move button in the table, select the checkbox for the container or host that is to be moved.**
4. **In the right pane, click the Move button.**
A dialog box appears listing the available groups.
5. **Select the group to which the container or host is to be moved.**
6. **Click OK.**
The container or host is moved to the selected group.

Default Containers

After the software is set up, the Containers view is initially loaded with a group titled Default. This group holds the following five default containers on a host running the Solaris 9 Operating System (OS):

- Default
- Processes with No Project
- Root User

- System Processes
- Users with Group Staff

Each of the five default containers has a corresponding entry in the `/etc/project` file. Specifically, the five entries correspond to `default`, `noproject`, `user.root`, `system`, and `group.staff`.

Note – On a host running the Solaris 8 release, the Users with Group Staff (`group.staff`) container does not exist. Otherwise, the default containers are the same.

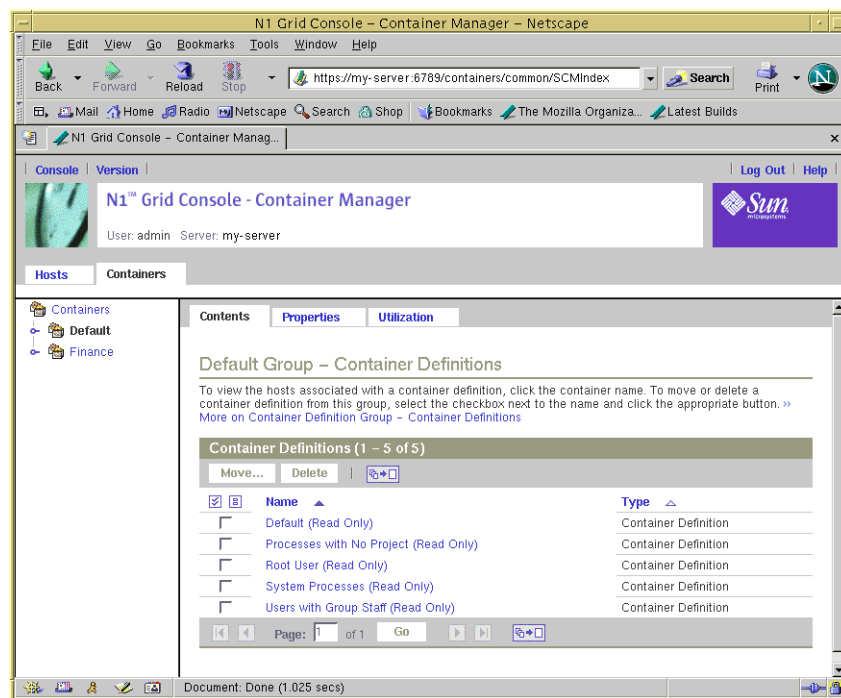


FIGURE 3-5 Sample: Default Containers Group With Container Definitions Showing

Each default container is in the active state, and the boundaries are set at .01 minimum CPU reserved and no memory cap. A default container is always bound to the default resource pool (`pool_default`) of the host. You can monitor the resource utilization and run reports on each default container if you have Performance Reporting Manager installed.

These default containers cannot be deactivated, edited, or deleted. Each is labeled Read Only accordingly.

Every UNIX user is assigned to a default project, and is correspondingly assigned to a default container. Initially, the default containers hold all processes that are running on the system. As you create custom containers, processes are moved from the corresponding default container into the container you create.

About Container Creation

Every container starts with a container definition. A container can be one of three types, depending upon the project type selected during its creation. The project type determines how processes are tracked.

Container Types

When creating a new container definition, you must select the project type. A project is a network-wide administrative identifier (ID) for related work. All processes running in a container have the same project ID, and a container tracks the resources being used with the project ID. The container type is based on which project-type is selected when creating the container definition. For more information about projects and resource management, see “Projects and Tasks” in *System Administration Guide: Resource Management and Network Services*.

Every container definition has a project name that is a permanent part of its information. When a container is activated on a host, this project name is added to that host's `/etc/project` file. This entry remains as long as the container is active on that host.

It is not possible to have two containers with the same project name active on a host at the same time. This is because processes running in a container are tracked with the project ID, so every project name on a host must be unique.

When creating user and group-based containers, the user or group name becomes part of the project name. For user-based containers, the project name becomes `user.username`. For group-based containers, the project name becomes `group.groupname`. Therefore, when creating user or group-based containers, you cannot use a user or group name that duplicates the `/etc/project` entries for the default containers. For more information, see “Default Containers” on page 50.

You provide a project name of your choosing as part of the creation process for application-based containers. The Container Creation wizard will accept duplicate project names for different application-based container definitions. But two application-based containers that have the same project name cannot be active on the same host at the same time. If you want to reuse project names when creating application-based containers, do this only if you plan to activate these containers on different hosts. If you try to activate a second container on a host that already has an active container with the identical project name, the activation will fail.

The following table provides details about the three project types available and what changes occur based on the selection.

TABLE 3-2 Project Type Details

Project Type	OS Version	Details
User-Based	Solaris 8	<p>Only type of project supported in the Solaris 8 release.</p> <p>The project name in the <code>/etc/project</code> file becomes <code>user.username</code>. The project becomes the user's primary default project.</p>
User-Based	Solaris 9	<p>The project name in the <code>/etc/project</code> file becomes <code>user.username</code>, with a list of UNIX users who can join this project.</p> <p>Valid forms are <i>username</i>.</p>
Group-Based	Solaris 9	<p>The project name in the <code>/etc/project</code> file becomes <code>group.groupname</code>.</p> <p>Valid form is <i>groupname</i>.</p>
Application-Based	Solaris 9	<p>The project name can be the application name or any other name chosen. The name provided is added to the <code>/etc/project</code> file.</p> <p>A match expression can be provided for automatically moving the matching processes to the project name. This expression is case sensitive.</p> <p>The corresponding <i>username</i> or <i>groupname</i> under which the processes currently run must be provided.</p>

About Making Resource Reservations

Before you begin using containers to manage an application's resources, it is important that you first know the resource trends for the application. The performance of certain applications, such as ORACLE®, will be significantly degraded if the amount of the

memory cap is inadequate. Every active container must have resource reservations set: a minimum CPU reservation, and optionally, a maximum memory reservation (*memory cap*). You should only begin using containers to manage these reservations after you have established the resource requirements for the applications.



Caution – Do not set a physical memory cap for a container that is less than what the application typically uses. This practice will affect the application’s performance adversely and might result in significant delays due to higher paging and swapping as the application is required to use more virtual memory.

You must have your server consolidation plan finalized before you start using containers to manage system resources. An important related task is to trend the resource consumption of the applications you are considering including in your consolidation plan. It is recommended that you trend resource utilization of the application for at least a month in your test environment before implementing your plan in your production environment. Once you have established the CPU and memory consumption trends, you should allow at least a few percentage points above the typical memory requirement.

When making a reservation for the amount of CPU resources needed by the container, you assign the amount of CPU in integer or decimal units. For example, .25, 1, and 3.75 are all valid amounts. Container Manager uses the fair share scheduler (FSS) to ensure the minimum CPU reservation you set. The convention used by the software is 1 CPU equals 100 shares. Likewise, .25 CPU equals 25 shares, and so on. CPU shares are not the same as CPU percentages. Instead, the number of shares defines the relative importance of the project when compared to others. FSS only limits the CPU resource allotment when there is competition for those resources. For example, if there is only one active container on a system at the time, then the corresponding application can utilize all of the CPU resources regardless of the number of shares it has. For more information about the fair share scheduler, see *System Administration Guide: Resource Management and Network Services*.

You can use Container Manager in your test environment as a tool to help trend application resource consumption by doing the following:

1. Install and set up the Container Manager software along with any required software.

For information, see Chapter 2.

2. Install Performance Reporting Manager on all agent machines you want to monitor.

For more information, see Chapter 2 and *Sun Management Center 3.5 Performance Reporting Manager User’s Guide*.

3. Create an active application-based container for the application you want to trend. In the New Creation wizard, make a minimum CPU reservation only. Do not set a memory cap.

For more information, see “Creating an Application-Based Container” on page 64 and “To Create an Active Application-Based Container” on page 70.

4. Monitor the resources used for a couple of weeks with daily, weekly, or real-time graphs. Two graphs, one for CPU and memory resources used, are available for the container running on an individual host. You can also view the Processes table to monitor processes running in the application.

For more information, see “To Request a Resource Utilization Report for an Active Container” on page 102 and “Viewing Container Processes” on page 82.

5. Once you have established the maximum physical memory requirement for the application, modify the container’s properties to include a memory cap. Be sure not to set a cap that is less than the maximum memory the application has been using.

For more information, see “To Modify a Container Using a Property Sheet” on page 89.

6. Set an alarm so you are notified if the memory used starts to exceed the memory cap set. Make any adjustments to the memory cap using the Properties sheet.

For more information, see “To Set an Alarm Threshold” on page 96 and “To Modify a Container Using a Property Sheet” on page 89.

After you have established resource utilization trends by using Container Manager or other suitable resource management software, you are ready to begin using containers as a tool for implementing the server consolidation plan in your production environment.

For more information about how to plan and execute a server consolidation, you can read the Sun Blueprints book *Consolidation in the Data Center* by David Hornby and Ken Pepple. For more information about server consolidation on systems running the ORACLE database, you can read the Sun white paper *Consolidating Oracle RDBMS Instances Using Solaris Resource Manager Software* available at <http://www.sun.com/software/resourcemgr/wp-oracle/>.

Creating Containers

You can create custom containers in addition to the default containers that are available after the software has been installed and set up. The combined use of both types of containers aids you in the implementation of your server consolidation plan.

Use the New Container wizard to create custom containers. You have the option to create just the container definition and save that to the Containers view. Or, you can complete all wizard steps in order to create an active container. The same wizard is used for both situations.

If you choose to create just the container definition, the name will be saved in the Containers view. You can use the container definition to create one or more active containers at a later time. For more information about how to activate a container definition, see “Activating or Deactivating Containers” on page 79.

If you choose to create an active container, you also make a container definition as part of the process. After you finish creating the active container, the container definition is saved to the navigation window of the Containers view. You can use this same definition to create additional containers that are associated with multiple hosts. The definition for all these containers, including the name and project type, will be the same for each of the hosts. You can vary the resource reservations of the container per host, or you can make them all the same. This flexibility is provided so you can meet resource needs as conditions vary. For more information, see “About Container Definitions” on page 41.

The New Container wizard guides you through the container creation process. You should have the following information available when creating an active container in order to move readily through the wizard:

- The name and description for the container.
- The project type the container will be assigned. For more information, see Table 3–2.
- The name of the host to which the container will be associated.
- The name of the resource pool to which the container will be bound.
- The resource boundaries that the container will be assigned, namely the minimum CPU reservation and memory cap amounts.

This wizard is accessible from three different places in the GUI, but always from the New Container button. Depending upon where in the GUI you access the wizard, you might not need to provide all this information. Again, certain information might be completed for you depending upon the entry point.

▼ To Launch the New Container Wizard

The New Container wizard can be accessed from three places in the GUI. Depending upon the access point to the wizard, you might not be required to complete all its panels because certain information will be completed automatically.

1. **If the Container Manager GUI is not already open, access it as described in “To Launch the Container Manager GUI” on page 44.**
2. **In the navigation window, determine the relationship of the container definition you want to create.**
 - To place the container definition in the navigation tree under a specific group name, select the group name from the Containers view. The Container Definitions table appears in the right pane.

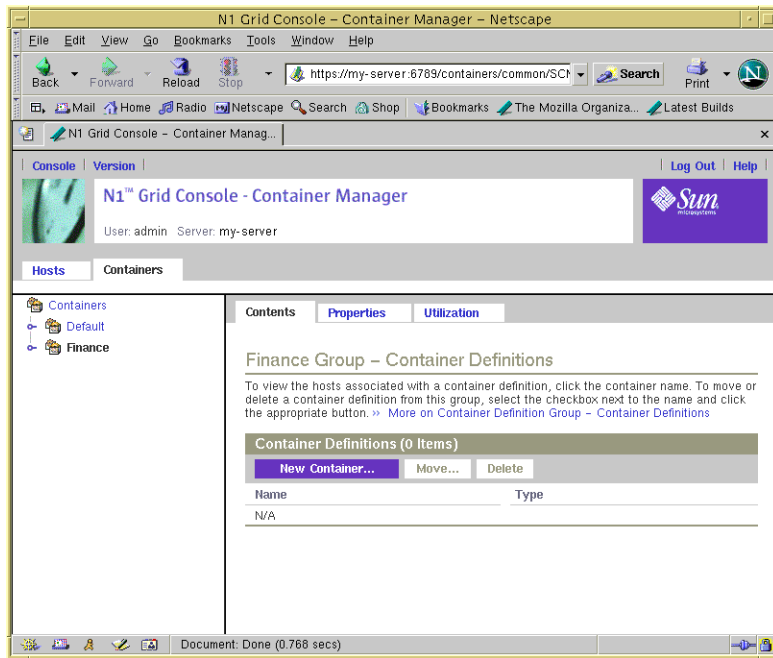


FIGURE 3-6 Sample: Accessing the New Container Button From a Group Name

- To automatically associate a specific host with the container:
 - a. Select the host name in the navigation window from the Hosts view.
If needed, click the host group name in order to expand the list.
 - b. Select the Containers tab located in the right pane.

The Containers table appears You will not be required to select a host during the container creation process using this method.

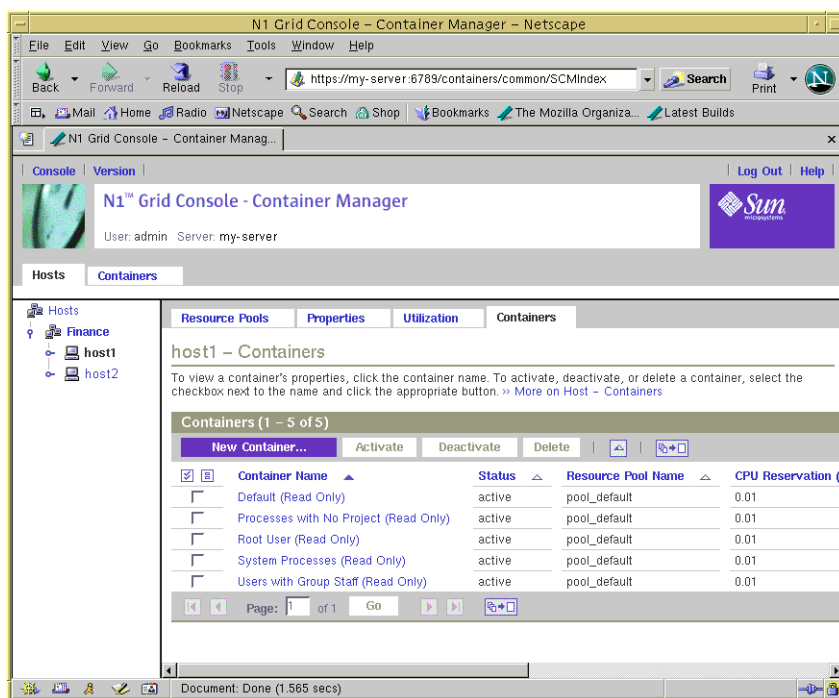


FIGURE 3-7 Sample: Accessing New Container Button From a Host Name

- To automatically bind a container to specific resource pool:
 - a. Select the resource pool name from the navigation window in the Hosts view.

If needed, click the key symbol next to the host name in order to expand the list and the resource pools assigned to the host are displayed.
 - b. Select the Containers tab located in the right pane.

The Containers table appears. You will not be required to assign a resource pool as part of the container creation process.

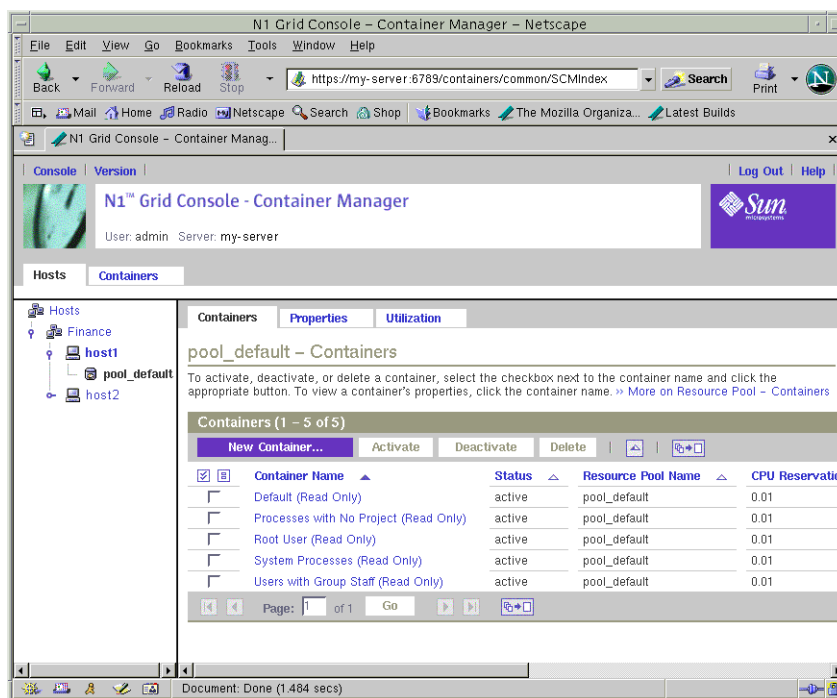


FIGURE 3-8 Sample: Accessing New Container Button From a Resource Pool

3. Click the New Container button.

Note – The New Container button is always available from a table appearing in the right pane, regardless of which of the three methods you selected.

The New Container wizard is displayed. The Overview panel is the first to appear.

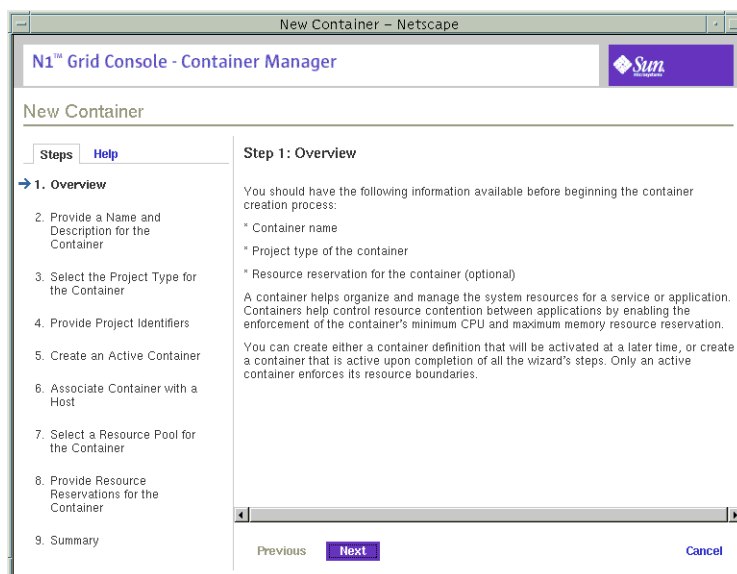


FIGURE 3-9 Sample: New Container Wizard Overview Panel

For more samples of the New Container wizard, see “Creating an Application-Based Container” on page 64.

Creating a User-Based or Group-Based Container

Note – Only the user-based container type is available if you are running the Solaris 8 release.

If you want the container to manage processes that are identified by either a UNIX user or UNIX group name, you should create a user-based or group-based container. The project-type selected during the creation process will determine whether the finished container definition or container is user-based or group-based.

▼ To Create a User-Based or Group-Based Container Definition

1. **Launch the New Container wizard, as described in “To Launch the New Container Wizard” on page 56.**

The Overview panel appears. Use the Next button to move through the wizard. Use the Previous button to return to any panel in the wizard to make any changes.

2. Provide a name for the container.

The name must be unique and not exceed 32 characters. This name will identify the container in the navigation window, status tables, and resource utilization reports. If a duplicate name is entered, the creation of the container definition will fail.

A container name cannot be changed after the creation procedure is finished.

3. (Optional) Provide a description for the container.

4. Select User or Group as the project type for the container.

A container with a user-based project type tracks processes with the same UNIX user name.

A container with a group-based project type tracks processes with the same UNIX group name.

Note – In the Solaris 8 OS, only the user-based container type is supported.

5. Provide project type identifiers according to the following:

- **User-Based Project** - You must provide a valid UNIX user name in the first field. UNIX user names of those users that can join the project can be added in the second field. UNIX group names of those groups that can join the project can be added in the third field. Separate multiple entries with a comma.

Do not provide a user name that is being used in another user-based container or in a Default Container in the first field.

- **Group-Based Project** - You must provide a valid UNIX group name in the first field. UNIX group names of those groups that can join the project can be added in the second field. UNIX user names of those users that can join the project can be added in the third field. Separate multiple entries with a comma.

Do not provide a group name that is being used in another group-based container or in a Default Container in the first field.

For additional information regarding this project type, see Table 3–2.

6. Select Later in the Create an Active Container panel.

All the required information to create the container definition has been supplied.

7. Review the information in the Summary panel.

Use the Previous button to move backward through the wizard to make any changes.

8. Click Finish.

The container definition is saved in the navigation window in the Containers view. The wizard is dismissed.

▼ To Create a User-Based or Group-Based Active Container

1. **Launch the New Container wizard, as described in “To Launch the New Container Wizard” on page 56.**

The Overview panel appears. Use the Next button to move through the wizard. Use the Previous button to return to any panel in the wizard to make any changes.

2. **Provide a name for the container.**

The name must be unique and not exceed 32 characters. This name will identify the container in the navigation window, status tables, and resource utilization reports. If a duplicate name is entered, the creation of the container definition will fail.

A container name cannot be changed after the creation procedure is finished.

3. **(Optional) Provide a description for the container.**

4. **Select User or Group as the project type for the container.**

A container with a user-based project type tracks processes with the same UNIX user name.

A container with a group-based project type tracks processes with the same UNIX group name.

Note – In the Solaris 8 OS, only the user-based container type is supported.

5. **Provide project type identifiers according to the following:**

- **User-Based Project** - You must provide a valid UNIX user name in the first field. UNIX user names of those users that can join the project can be added in the second field. UNIX group names of those groups that can join the project can be added in the third field. Separate multiple entries with a comma.

Do not provide a user name that is being used in another user-based container or in a Default Container in the first field.

- **Group-Based Project** - You must provide a valid UNIX group name in the first field. UNIX group names of those groups that can join the project can be added in the second field. UNIX user names of those users that can join the project can be added in the third field. Separate multiple entries with a comma.

Do not provide a group name that is being used in another group-based container or Default Container in the first field.

For additional information regarding this project type, see Table 3–2.

6. **Select Now in the Create an Active Container panel.**

7. **Depending upon the entry point from which you launched the wizard, choose from the following actions:**

- If you accessed the wizard from a host name in the navigation window of the Hosts view, the container is automatically associated with that host. Continue with Step 11.
 - If you accessed the wizard from a location other than the host name, you must associate this container with a host. Continue with Step 8.
- 8. The container must be associated with a host that supports its resource reservation. Select from the following options:**
- If the name of the desired host is already known, select Enter the Host Name. Type the host name in the text field. Continue with Step 11.
 - To initiate a search for all available hosts that meet the reservation requirements, select Search For a Host. Continue with Step 9.

9. To begin the search for available hosts, provide the following information.

Name	Default is '*' for searching all hosts. If you want to specify a particular host, you can provide the name here.
Operating System	Select an operating system from this drop-down menu. Default is ALL.
Platform	Select a platform from this drop-down menu. Default is ALL.
Total Processors	Provide an integer that specifies the minimum number of processors required. The results returned will be hosts that have an equivalent, or more, number of CPUs.
Total Physical Memory (MB)	Provide an integer that specifies the minimum amount of required memory in Mbytes. The results returned will be hosts that have an equivalent, or more, amount of total physical memory.
Clock Speed	Provide an integer that specifies the minimum required processor clock speed in MHz. The results returned will be hosts that have at least that clock speed.

A list is returned of all hosts that meet the search criteria.

10. Make your selection from the list of the matching hosts.

The container is now associated with this host.

11. Assign a resource pool that supports the resource requirements of the container.

New processes started in a project are bound to the corresponding resource pool. Once the container is activated, the new processes the container is holding are bound to its resource pool.

- To assign a new resource pool:
 - a. Select Create a New Resource Pool.
 - b. Provide a name for the resource pool.
The name must be alphanumeric and contain no spaces. The characters dash (-), underscore (_), and dot (.) are allowed.
 - c. Assign the number of CPUs.
The number of CPUs must be an integer not less than one and cannot exceed the number of CPUs available on the host. The total number of CPUs on the host and the number that are currently available are shown.
- To assign an existing pool:
 - a. Select Use an Existing Resource Pool.
A list of available resource pools is displayed.
 - b. Select the radio button next to the pool's name in the list.
The total number of CPUs assigned to each resource pool is given, as well as the amount of unreserved CPU still available in each pool. The container is bound to the selected resource pool.

12. Provide the resource reservations for the container.

The amount of unreserved CPU and memory resources available on the host is provided.

The minimum CPU reservation is required, and must be provided in integer or decimal units. Decimal units up to 100th decimal place are accepted. If you provide a value at 1000th decimal place, the value will be treated as zero. For example, a CPU reservation of 0.002 is treated as zero. A container with a CPU reservation of zero receives CPU resources only when no processes are running in any other container that is associated with the same host.

The memory cap is optional, and must be provided in Mbytes.

13. Review the information in the Summary panel.

Use the Previous button to move backward through the wizard to make any changes.

14. Click Finish.

The selections are saved, and the container is now active. The Solaris kernel begins enforcing the container's resource reservations.

Creating an Application-Based Container

Note – In the Solaris 8 OS, only the user-based container type is supported.

Use an application-based container to manage the processes that run in a particular software application. You can create an application-based container definition that moves the processes automatically, or one that allows you to move the processes manually.

If you can provide a match expression that is truly unique to the application, you can add this expression to the container definition. You must also provide the UNIX user or UNIX group ID under which the processes will run. Additional users or groups that have the right to join the container at a later time can be added as well. To automatically move processes into the container, you must provide all required project identifiers when the corresponding wizard panel appears. The software will then move all matching processes automatically for all the containers that are based upon this definition.

If the application does not create truly unique identifiers, then you will want to move the processes manually or start the application inside the container. If you want to move the processes manually, create the container definition with only the UNIX user or UNIX group ID under which the processes will run. Additional users or groups that have the right to join the container at a later time can be added as well. Then move the processes with the `newtask -p` command. For more information, see “Moving or Starting Processes in a Container” on page 76.

▼ To Determine the Match Expression for an Application

Use this procedure to determine the correct match expression to identify the processes corresponding to the application you want to manage. This expression is required in the New Container wizard to move processes automatically into a container.

1. **From a terminal window, launch the application that the application-based container will manage.**
2. **To see a list of all processes running, in a terminal window type:**

```
% ps -cafe
```

3. **In the CMD column, locate the corresponding executable name.**

Choose the expression that will uniquely identify the application’s processes.

EXAMPLE 3-1 Determining a Match Expression For Mozilla

The following is an example of output from the `ps - cafe` command when searching for Mozilla:

```
% ps -cafe
      UID  PID  PPID  CLS PRI   STIME TTY      TIME CMD
      ...
username 8044 7435   IA  50 19:47:09 pts/11  0:00 /bin/ksh -p /usr/sfw/lib/mozilla/mozilla
```

EXAMPLE 3-1 Determining a Match Expression For Mozilla (Continued)

In this example, the unique executable name is mozilla. Likewise, a correct match expression is mozilla.

EXAMPLE 3-2 Determining a Match Expression for Tomcat Server

When you know the name of the application, you can use the `grep` command in conjunction with `ps -cafe` to locate the correct match expression. The following is an example of output from the `ps -cafe | grep tomcat` command when searching for Tomcat server. This example has been trimmed for space, leaving the relevant information.

```
% ps -cafe | grep tomcat
nobody 27307 /usr/j2se/bin/java -classpath //usr/apache/tomcat/bin/bootstrap.jar:/usr/j2se/1
```

In this example, the executable name is java. However, the correct match expression is tomcat. In this case the match expression is the argument instead of the executable name as java does not uniquely identify the Tomcat processes.

EXAMPLE 3-3 Verifying a Match Expression for Tomcat Server

The following is an example of how to use the `pgrep` command to find the PID, in order to verify that you have identified the unique match expression for finding the desired process:

```
% pgrep -f tomcat
27307
```

The PID for Tomcat server is 27307. This matches the PID from Example 3-2. This confirms that the match expression tomcat corresponds to the Tomcat server process.

▼ To Create an Application-Based Container Definition

1. Launch the New Container wizard, as described in “To Launch the New Container Wizard” on page 56.

The Overview panel appears. Use the Next button to move through the wizard. Use the Previous button to return to any panel in the wizard to make any changes.

2. Provide a name for the container.

The name must be unique and not exceed 32 characters. This name will identify the container in the navigation window, status tables, and resource utilization reports. If a duplicate name is entered, the creation of the container definition will fail.

A container name cannot be changed after the creation procedure is finished.

3. (Optional) Provide a description for the container.

4. Select Application as the project type for the container.

The application-based project container tracks processes associated with the application. For more information about this project type, see Table 3-2.

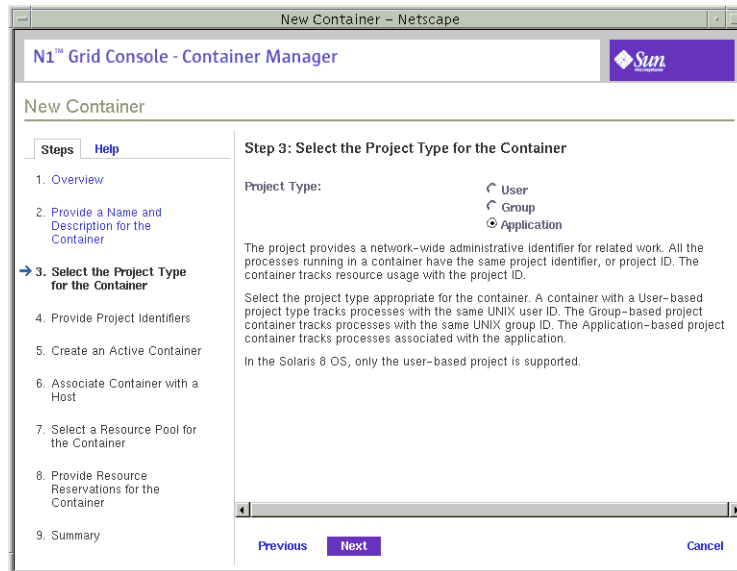


FIGURE 3-10 Sample: Project Type Panel Showing Selected Type as Application

5. Provide the project name in the Project Name field.

A project name is required. You can choose the name of the application itself, or any other name that is suitable for your needs. A corresponding project name is added to the `/etc/project` file on the host when the container is activated.

If you want to provide a project name that is already being used by another application-based container, both containers cannot be activated on the same host. For more information, see "Container Types" on page 52.

6. Determine whether you want to move the application processes under the container automatically when the container is activated or to move them yourself from the command line.

- To indicate that you want to move the application processes yourself from the command line, select the checkbox Do Not Use Match Expression.
- To move application processes under the container automatically when the container is activated, provide an expression in the Match Expression field. The match expression must be supplied in order to automatically move the application's processes to the container. This expression is case sensitive. To determine the correct match expression, see "To Determine the Match Expression for an Application" on page 65.

If a match expression is not provided at this time, the application's processes will not be moved automatically to this container until this expression is supplied.

7. Provide the UNIX user names or UNIX group names under which the application's processes will run.

The UNIX user names or UNIX group names under which the application's processes will run must be supplied. If these are not provided, the corresponding processes will not be moved under the container upon activation until they are supplied. Separate multiple entries with a comma.

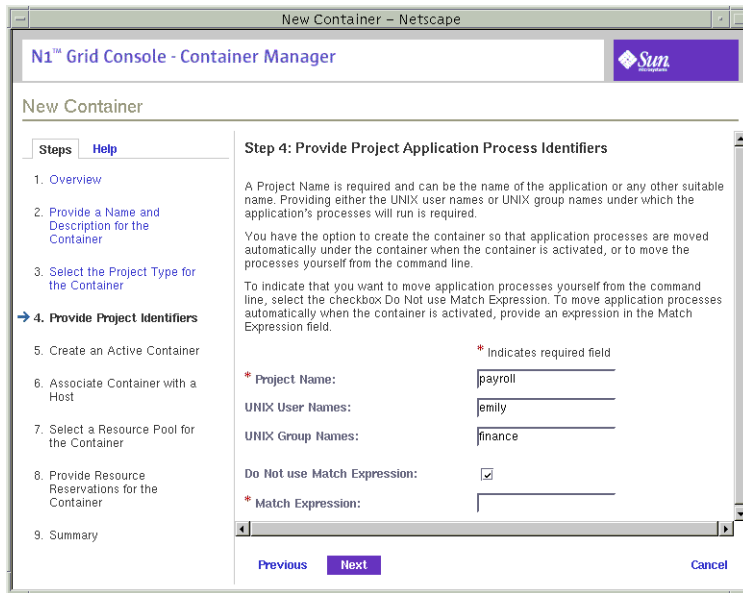


FIGURE 3-11 Sample: Completed Project Identifiers Panel Without a Match Expression

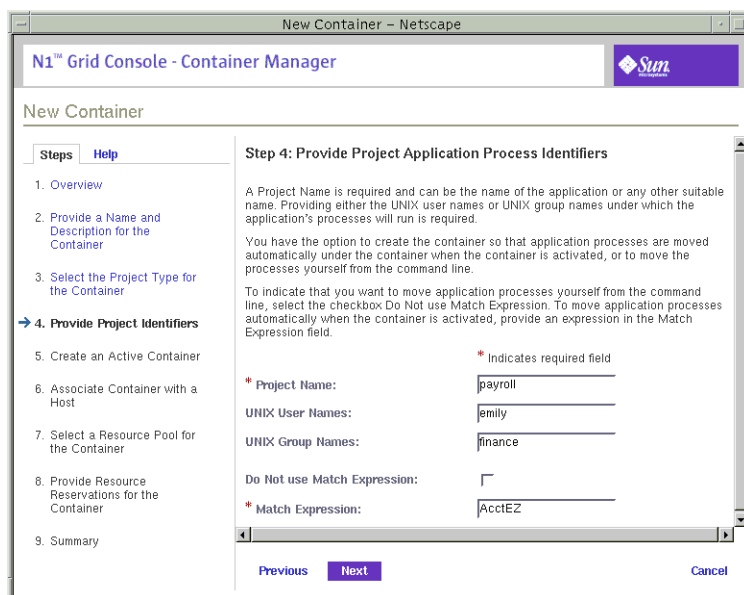


FIGURE 3-12 Sample: Completed Project Identifiers Panel With a Match Expression

8. Select Later in the Create an Active Container panel.

All the required information to create the container definition has been supplied.

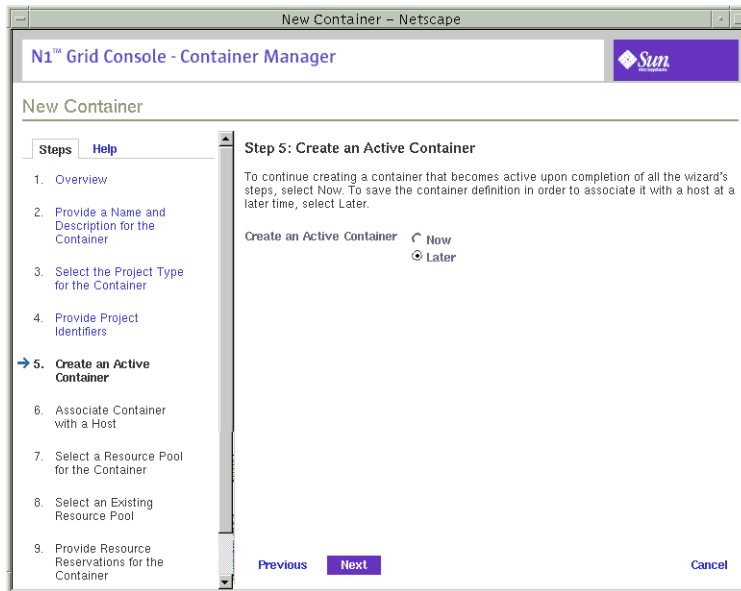


FIGURE 3–13 Sample: Creating Active Container Later Panel

9. Review the information in the Summary panel.

Use the Previous button to move backward through the wizard to make any changes.

10. Click Finish.

The container definition is saved in the navigation window in the Containers view. The wizard is dismissed.

▼ **To Create an Active Application-Based Container**

1. Launch the New Container wizard, as described in “To Launch the New Container Wizard” on page 56.

The Overview panel appears. Use the Next button to move through the wizard. Use the Previous button to return to any panel in the wizard to make any changes.

2. Provide a name for the container.

The name must be unique and not exceed 32 characters. This name will identify the container in the navigation window, status tables, and resource utilization reports. If a duplicate name is entered, the creation of the container definition will fail.

A container name cannot be changed after the creation procedure is finished.

3. (Optional) Provide a description for the container.

4. Select Application as the project type for the container.

The application-based project container tracks processes associated with the application. For more information about this project type, see Table 3–2.

5. Provide the project name.

A project name is required. You can choose the name of the application itself, or any other name that is suitable for your needs. A corresponding project name is added to the `/etc/project` file on the host when the container is activated.

If you want to provide a project name that is already being used by another application-based container, both containers cannot be activated on the same host. For more information, see “Container Types” on page 52.

6. Determine whether you want to move application processes under the container automatically when the container is activated or to move them yourself from the command line.

- To indicate that you want to move application processes yourself from the command line, select the checkbox Do Not Use Match Expression.
- To move application processes under the container automatically when the container is activated, provide an expression in the Match Expression field.

The match expression must be supplied in order to automatically move the application’s processes to the container. This expression is case sensitive. To determine the correct match expression, see “To Determine the Match Expression for an Application” on page 65.

If a match expression is not provided at this time, the application’s processes will not be moved under this container until this expression is supplied.

7. Provide either the UNIX user names or UNIX group names under which the application’s processes will run.

The UNIX user names or UNIX group names under which the application’s processes will run must be supplied. If these are not provided, the corresponding processes will not be moved under the container until they are supplied. Separate multiple entries with a comma.

8. Select Now in the Create an Active Container panel.

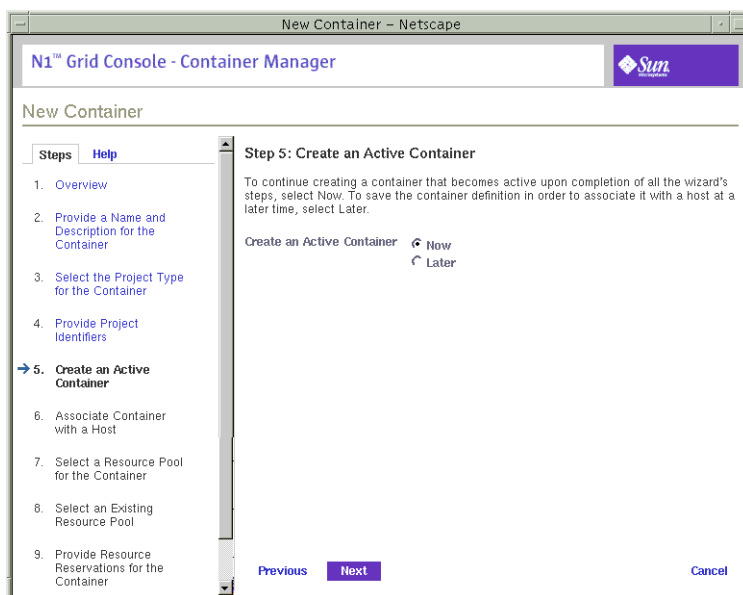


FIGURE 3-14 Sample: Creating an Active Container Now

9. Depending upon the entry point from which you launched the wizard, choose from the following actions:

- If you accessed the wizard from a host name in the navigation window of the Hosts view, the container is automatically associated with that host. Continue with Step 13.
- If you accessed the wizard from a location other than the host name, you must associate this container with a host. Continue with Step 10.

10. The container must be associated with a host that supports its resource reservation. Select from the following options:

- If the name of the desired host is already known, select Enter the Host Name. Type the host name in the text field. Continue with Step 13.
- To initiate a search for all available hosts that meet the reservation requirements, select Search For a Host. Continue with Step 11.

11. To begin the search for available hosts, provide the following information.

- | | |
|------------------|--|
| Name | Default is '*' for searching all hosts. If you want to specify a particular host, you can provide the name here. |
| Operating System | Select an operating system from this drop-down menu. Default is ALL. |

Platform	Select a platform from this drop-down menu. Default is ALL.
Total Processors	Provide an integer that specifies the minimum number of processors required. The results returned will be hosts that have an equivalent, or more, number of CPUs.
Total Physical Memory (MB)	Provide an integer that specifies the minimum amount of required memory in Mbytes. The results returned will be hosts that have an equivalent, or more, amount of physical memory.
Clock Speed	Provide an integer that specifies the minimum required processor clock speed in MHz. The results returned will be hosts that have at least that clock speed.

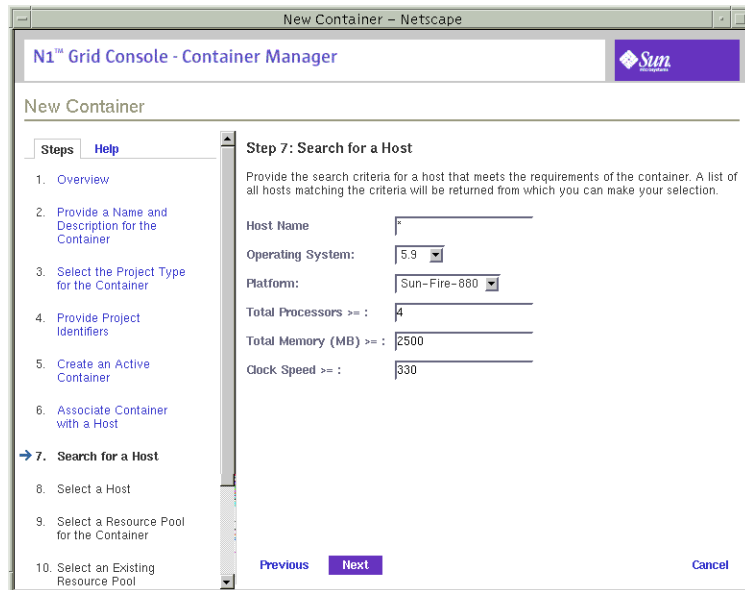


FIGURE 3–15 Sample: Completed Search For a Host Panel

A list is returned of all hosts that meet the search criteria.

12. Make your selection from the list of the matching hosts.

The container is now associated with this host.

13. Assign a resource pool that supports the resource requirements of the container.

New processes started in a project are bound to the corresponding resource pool. Once the container is activated, the new processes being held in the container are bound to its resource pool.

- To assign a new resource pool:
 - a. Select Create a New Resource Pool.

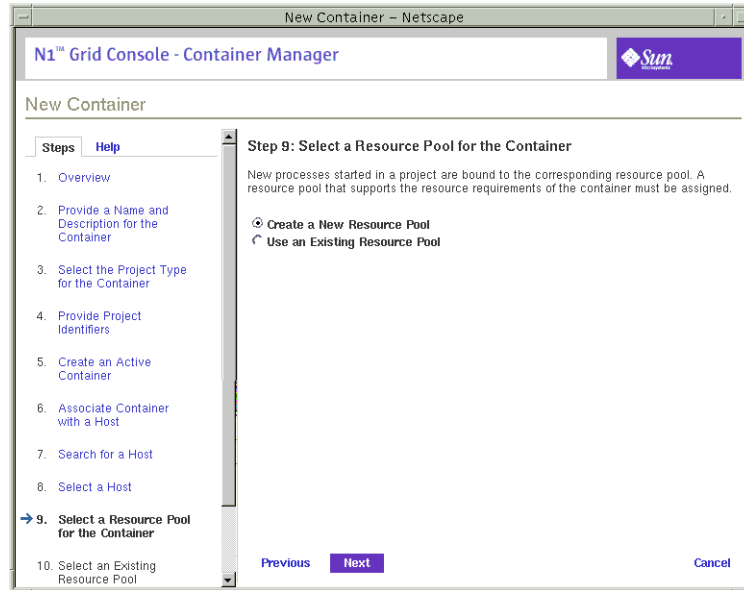


FIGURE 3-16 Sample: Selecting Create a New Resource Pool

- b. Provide a name for the resource pool.

The name must be alphanumeric and contain no spaces. The characters dash (-), underscore (_), and dot (.) are allowed.
 - c. Assign the number of CPUs.

The number of CPUs must be an integer not less than one and cannot exceed the number of CPUs available on the host. The total number of CPUs on the host and the number that are currently available are shown.
- To assign an existing pool:
 - a. Select Use an Existing Resource Pool.

A list of available resource pools is displayed.
 - b. Select the radio button next to the pool's name in the list.

To total number of CPUs assigned to each resource pool is given, as well as the amount of unreserved CPU still available in each pool. The container is bound to the selected resource pool.

14. Provide the resource reservations for the container.

The amount of unreserved CPU and memory resources available on the host is provided.

The minimum CPU reservation is required, and must be provided in integer or decimal units. Decimal units up to 100th decimal place are accepted. If you provide a value at 1000th decimal place, the value will be treated as zero. For example, a CPU reservation of 0.002 is treated as zero. A container with a CPU reservation of zero receives CPU resources only when no processes are running in any other container that is associated with the same host.

The memory cap is optional, and must be provided in Mbytes.

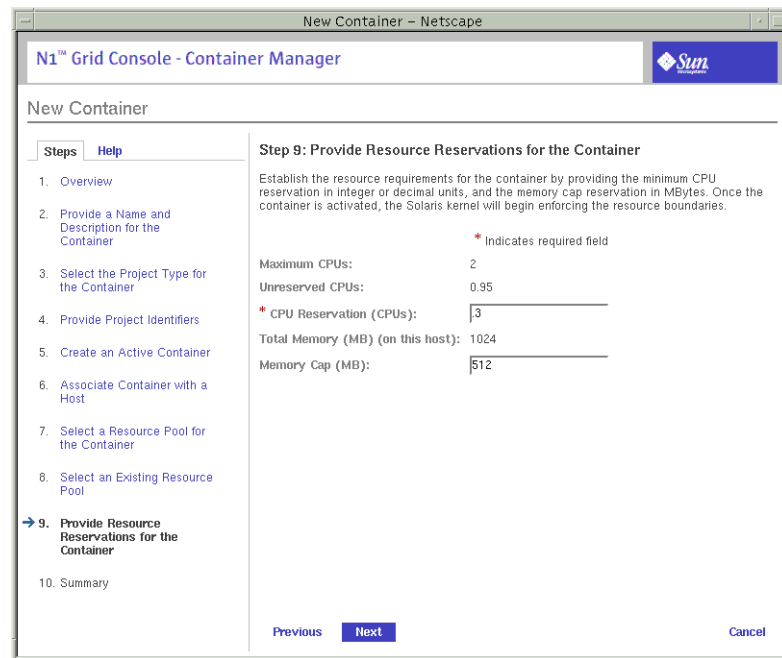


FIGURE 3-17 Sample: Completed Resource Reservations Panel

15. Review the information in the Summary panel.

Use the Previous button to move backward through the wizard in order to make any changes.

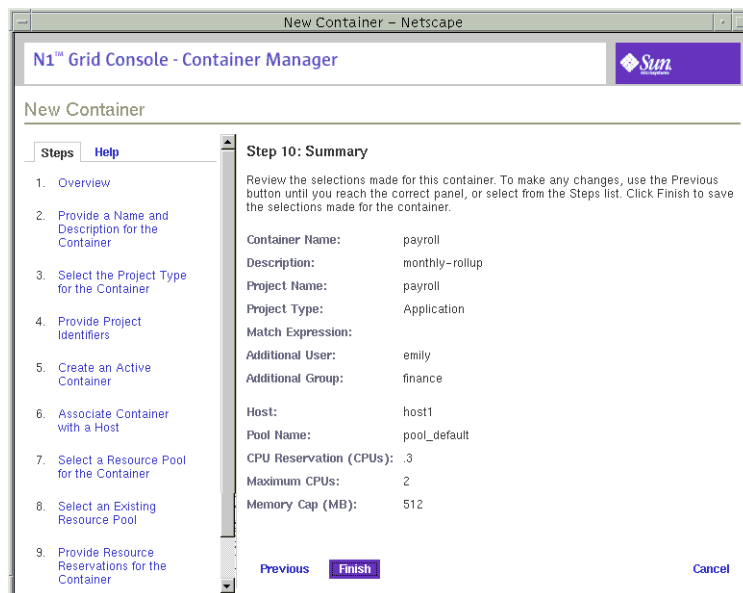


FIGURE 3–18 Sample: Summary Panel

16. Click Finish.

The selections are saved, and the container is now active. The Solaris kernel begins enforcing the container's resource reservations.

Moving or Starting Processes in a Container

If the application being managed by the container does not have a unique executable name, then you will want to move processes into the container manually. This method ensures you track only the processes of the desired application. You have the following options for moving processes into a container:

- You can start the application and move the processes individually, one at a time. The owner of the processes must be specified in the container definition to move the processes.
- You can start the application inside the container with the `newtask -p` command. This causes all corresponding processes to be placed under the container without need to move them individually. The owner of the processes must be specified in the container definition to move the processes.

▼ To Move Processes Into an Application-Based Container Individually

Use this procedure if you did not provide a match expression for an application-based container definition and want to move the application's processes into the container individually.

1. **Create an application-based container definition for managing the application. Select the checkbox Do Not Use Match Expression.**

For detailed steps, see “To Create an Application-Based Container Definition” on page 66.

2. **Review the `/etc/project` file to determine the project name for the container by typing:**

```
% cat /etc/project
```

You will need this project name in Step 5.

3. **If needed, start the application in a terminal window.**

4. **Determine the processes corresponding to the application.**

For examples of how to do this, see Example 3–1, Example 3–2, and Example 3–3.

5. **Move the corresponding processes by typing:**

```
# newtask -p project_name -c pid
```

where *project_name* is the corresponding name found in the `/etc/project` file and *pid* is the process ID of the process to be moved.

You must move each process one at a time.

6. **Repeat Step 5 until all processes are moved.**

EXAMPLE 3–4 Moving ORACLE Processes Individually

The following example shows how to use the command `ps` with `egrep` to identify ORACLE processes associated with an application named `AcctEZ`. These three processes (17773, 17763, 17767) will be moved into a container named `Accounting` with the `newtask -p` command. The project name for this container is named `payroll`, which has been verified in the `/etc/project` file.

```
% ps -cafe | egrep 'UID|ora_'
  UID  PID  PPID  CLS PRI   STIME TTY      TIME CMD
smcorau 17773    1  FSS  28 14:55:25 ?        0:00 ora_reco_AcctEZ
smcorau 17763    1  FSS  59 14:55:24 ?        0:00 ora_pmon_AcctEZ
smcorau 17767    1  FSS  59 14:55:25 ?        0:00 ora_lgwr_AcctEZ
% newtask -p payroll -c 17773
% newtask -p payroll -c 17763
% newtask -p payroll -c 17767
```

EXAMPLE 3-5 Verifying That the Processes Were Moved Into the Container With `ps`

You can use the `ps` command in combination with `grep` to verify that the processes have been moved into a container. The following is an example showing that the processes moved individually in Example 3-4 are now in the container payroll:

```
% ps -ae -o pid,project,comm | grep payroll
17773  payroll ora_reco_AcctEZ
17763  payroll ora_pmon_AcctEZ
17767  payroll ora_lgwr_AcctEZ
```

EXAMPLE 3-6 Verifying That the Processes Were Moved Into the Container With `prstat`

You can use the command `prstat` to verify that the processes were moved into a container if you know the project name. In this example, the project name is payroll.

```
% prstat -J payroll
  PID USERNAME  SIZE  RSS STATE PRI NICE   TIME    CPU PROCESS/NLWP
 17773  admin    216M 215M cpu2   1   0  0:05:08  29% ora_reco_AcctEZ/1
 17763  admin    834M 782M sleep  1   0  0:35:02   0% ora_pmon_AcctEZ/1
 17767  admin    364M 352M run    1   0  0:22:05  23% ora_lgwr_AcctEZ/1
```

▼ To Start an Application in a Container

1. **Create an application-based container definition for managing the application. Select the checkbox Do Not Use Match Expression.**

For detailed steps, see “To Create an Application-Based Container Definition” on page 66.

2. **Select from the following according to the OS version:**

- For the Solaris 8 OS, type:

```
% srmuser user_name newtask -p project_name application_name
```

where *user_name* is the UNIX user name, and *project_name* is in the form *user.username*. In the Solaris 8 OS, since only the user-based container is supported, *user_name* and *project_name* will be the same.

- For the Solaris 9 OS, type:

```
% newtask -p project_name application_name
```

where *project_name* is the project associated with the container, and *application_name* is the command that starts the application, including any command arguments.

The application is started in the container.

EXAMPLE 3-7 Starting an Application Inside a Container on Solaris 9 OS

The following is an example of starting an application named tracks inside a container named music:

```
% newtask -p music tracks -z 0 mozart.au
```

where `-z 0 mozart.au` are the command line arguments for the application tracks.

EXAMPLE 3-8 Verifying Which Project an Application is Associated

After the application has been started, you can verify which project the application is associated with by typing:

```
% ps -ae -o pid,project,comm
```

The following is an example of the output from this command:

```
  PID  PROJECT COMMAND
...
17771  default ora_smon_SunMC
16246  system rquotad
26760  group.staff /bin/csh
16266  music   tracks
17777  default ora_d000_SunMC
17775  default ora_s000_SunMC
17769  default ora_ckpt_SunMC
```

In this example, the application named tracks has PID 16266, the project is music, and the executable is tracks. This is the same application started in Example 3-7.

Activating or Deactivating Containers

A container's resource boundaries are not enforced while in a defined or inactive state. You must activate the container to enable this enforcement. Conversely, when you do not want these limits enforced, you must deactivate the active container. An active container can be deactivated without losing the resource boundaries you've established. For more information, see "Container States" on page 42.

An existing container definition can be used to create new active containers with the Associate Host to Container wizard. You activate an inactive container or deactivate an active container with a button.

▼ To Activate a Defined Container

1. If the Container Manager GUI is not already open, access it as described in “To Launch the Container Manager GUI” on page 44.
2. In the Containers view, select the name of the container definition.
If the container definition is part of a group, select the group from the navigation window to display the container definitions in the right pane.
3. Select the Hosts tab in the right pane.

The Hosts Associated with this Container Definition table appears. All hosts that the selected container definition is currently associated with are listed in the table.

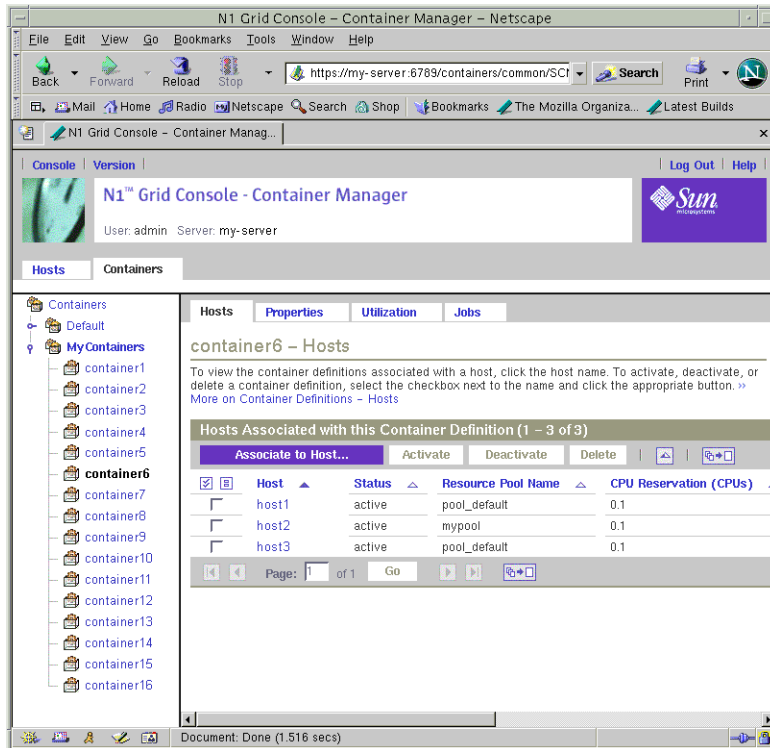


FIGURE 3–19 Sample: Hosts Associated with this Container Definition Table

4. Click the Associate Host to Container button.
The Associate Host to Container wizard appears. This wizard is similar to the New Container wizard.
5. For the remaining steps to finish activating the container, complete steps 8 - 14 of “To Create a User-Based or Group-Based Active Container” on page 62.

▼ To Activate an Inactive Container

1. **If the Container Manager GUI is not already open, access it as described in “To Launch the Container Manager GUI” on page 44.**
2. **In the Hosts view, select the host with which the container is associated.**
3. **Select the Containers tab in the right panel.**
A table appears that lists all containers that are associated with that host.
4. **To enable the Activate button, select the checkbox of the container to be activated.**
5. **(Optional) Select the Properties tab.**
You can modify the properties of the container. For more information, see “Modifying Containers” on page 85.
6. **Click the Activate button.**
The container is activated and the resource boundaries are being enforced by the kernel.

▼ To Deactivate an Active Container

1. **If the Container Manager GUI is not already open, access it as described in “To Launch the Container Manager GUI” on page 44.**
2. **In the Hosts view, select the host with which the container is associated.**
3. **Select the Containers tab in the right panel.**
A table appears that lists all containers that are associated with that host.
4. **To enable the Deactivate button, select the checkbox of the container to be activated.**

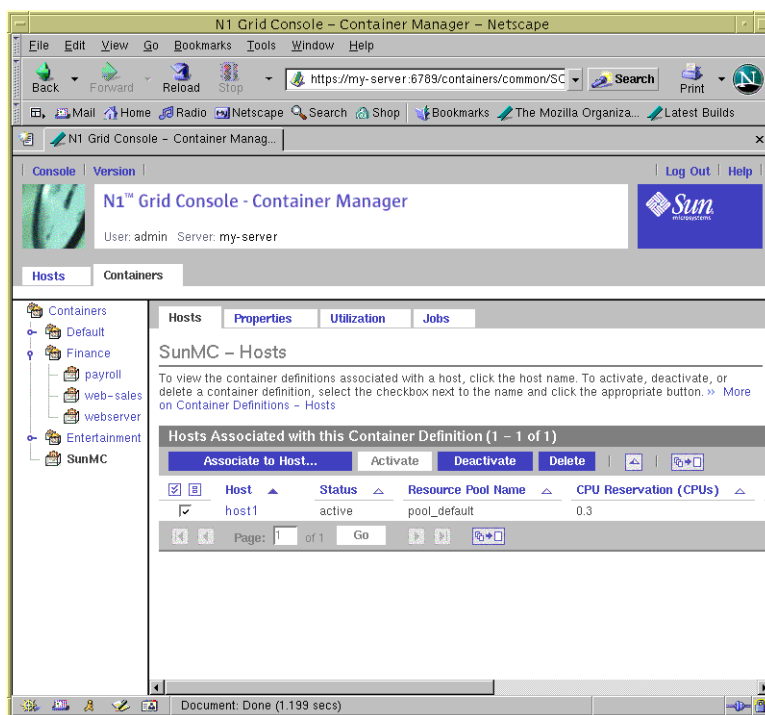


FIGURE 3-20 Sample: Containers View with Deactivate Button Enabled

5. (Optional) Select the Properties tab.

You can modify the properties of the container. For more information, see “Modifying Containers” on page 85.

6. Click the Deactivate button.

The container is activated and the resource boundaries are not being enforced by the kernel.

Viewing Container Processes

Information about the processes running in an active container can be obtained from a table in either the Hosts view or the Containers view. The same Processes table and identical information is provided in both views. Processes are listed one per row and the following information is available:

PID The process ID.

User Name	The owner of the process (the UNIX user name or login name).
SIZE	The total virtual memory size of the process in Mbytes.
RSS	The resident set size of the process in Mbytes.
STATE	The state of the process. Values include: <ul style="list-style-type: none"> ■ <code>cpuN</code> – The process is running on CPU <i>N</i> where <i>N</i> is an integer ■ <code>sleep</code> – The process is sleeping, or waiting ■ <code>run</code> – The process is running ■ <code>zombie</code> – The process is terminated ■ <code>stop</code> – The process is stopped
PRI	The priority of the process. The higher the number, the higher the process.
NICE	Nice value used in priority computation.
Time	The cumulative execution time for the process.
CPU	The percentage of recent time used by the process.
PROCESS/NLWP	The name of the process, which is the name of executed file. The number of light weight processes (lwps) in the process.

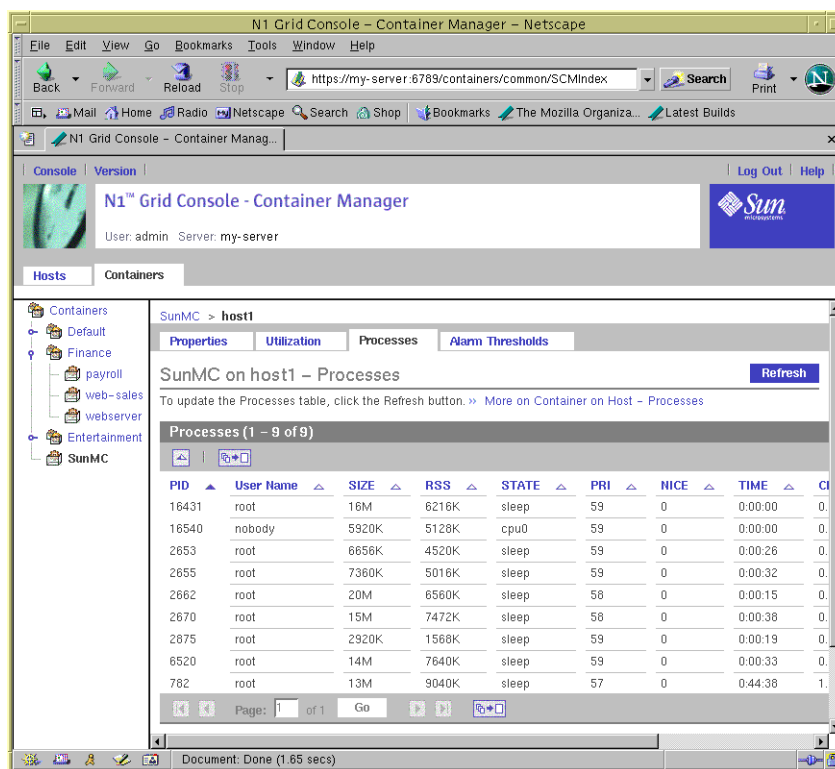


FIGURE 3–21 Sample: Processes Table For an Active Container

▼ To View the Processes Running in a Container From the Hosts View

Use this procedure if you know the name of the host to which the container is associated.

1. If the Container Manager GUI is not already open, access it as described in “To Launch the Container Manager GUI” on page 44.
2. Select the Hosts view by clicking the left tab in the navigation window.
3. In the navigation window, select the host with which the container is associated.
4. In the right pane, select the Containers tab.

The Containers table is displayed and lists all the containers that are associated with the host. The list included active and inactive containers. You must select an

active container in order to see information about its processes .

5. Select the container.

The properties page for the container instance on the selected host is displayed.

6. Select the Processes tab.

The processes running inside the container are displayed in the Processes table. The name of the container and the host it is associated with is displayed above the table.

If no processes are listed, you might have selected an inactive container.

▼ To View the Processes Running in a Container From the Containers View

Use this procedure when you know the name of the container and want to select from the list of hosts to which the container is associated.

1. If the Container Manager GUI is not already open, access it as described in “To Launch the Container Manager GUI” on page 44.

2. Select the Containers view by clicking the right tab in the navigation window.

3. In the navigation window, select the desired container.

A table listing all hosts that the container is associated with displays in the right pane.

4. In the table, select the name of the host.

The properties page for the container instance on the selected host appears.

5. Select the Processes tab.

The name of the container and the host it is associated with is displayed in the table title. The processes running inside the container are displayed in the Processes table.

If no processes are listed in the table, you might have selected an inactive container.

Modifying Containers

Two property sheets are available for modifying either a container definition or an active or inactive container. The following table highlights the differences between the property sheets.

TABLE 3-3 Property Sheet Details

Property Sheet	Used For	Accessible From
Container definition	Changes to description, project type, project identifiers (users, groups), match expression.	Properties tab in Containers view after selecting the container definition.
Container instance (active or inactive container)	Changes to resource pool association, CPU reservation, memory cap.	Properties tab in Hosts view or Containers view.

Each container instance has a container definition with which it is associated. Any change made to the container definition will apply to all the container instances using that definition. For example, if you change the project type in a container definition, the project type changes for all container instances using the same definition. Therefore, you can use both property sheets to make all modifications needed.

Each container instance also has a property sheet that is used to change only its own resource pool association or the resource reservations. You can change one container at a time when using this property sheet. For example, you can increase the current minimum CPU reservation or the current memory cap. Changes take effect once the new values have been saved. Modifications made to the resource boundaries on an inactive container have no effect until you reactivate the container.

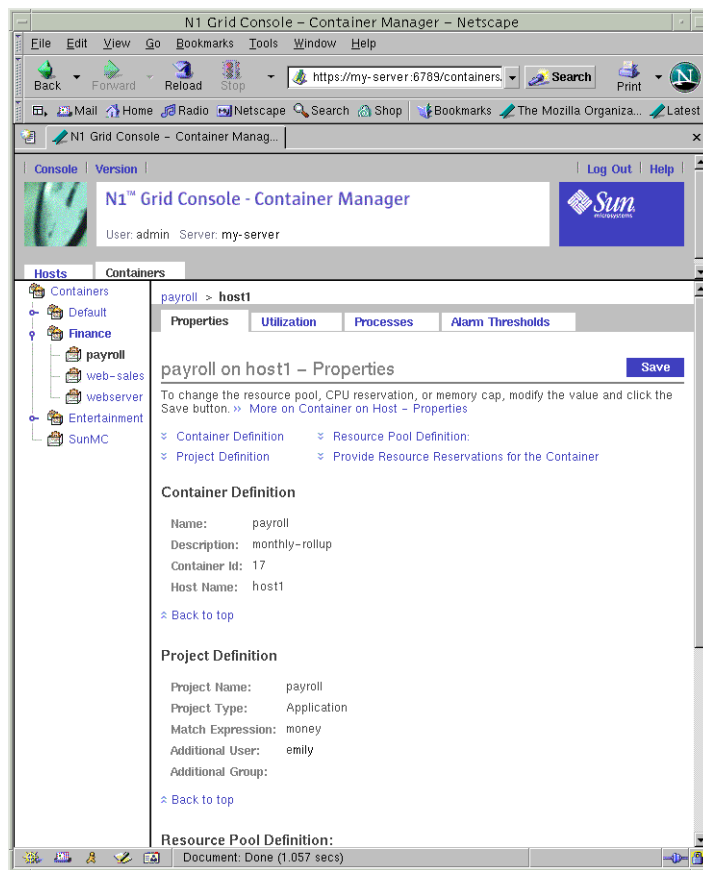


FIGURE 3-22 Sample: Property Sheet For Changing Resource Reservations and Resource Pool

If you need to make resource changes to multiple containers that are active on multiple hosts, you should use the resource change job feature. For more information, see “Modifying Containers With a Resource Change Job” on page 90.

From the Containers view, a separate property sheet is available from which you can modify the container definition. Changes can be made to one container definition at a time. You cannot use the resource change job feature to make changes to multiple container definitions.

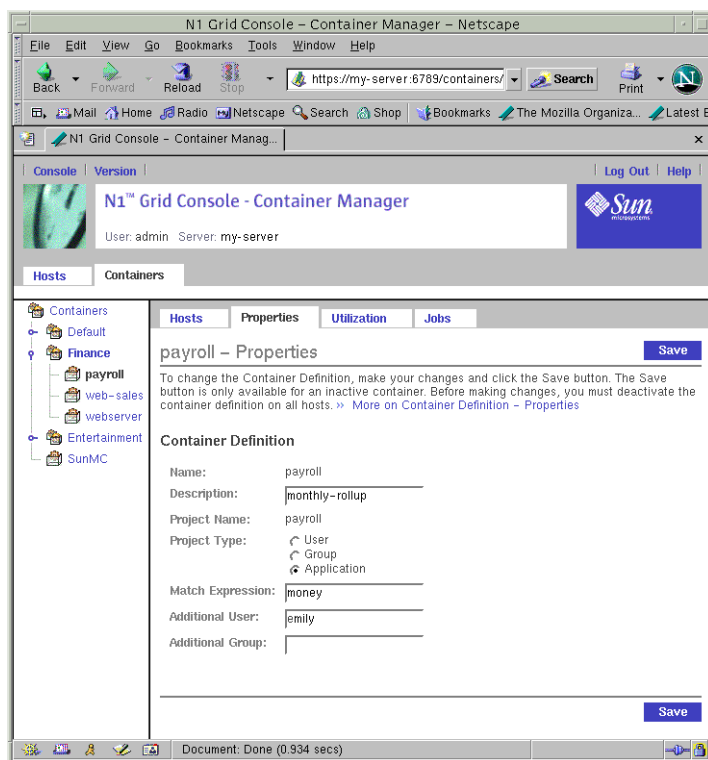


FIGURE 3-23 Sample: Property Sheet For Modifying a Container Definition

You cannot modify the properties of a default container. Therefore, neither property sheet is available if a default container is selected.

Note – Only a container definition or an inactive container can have its properties modified. You must first deactivate an active container from every host that the container is associated with before modifying any properties. Once the changes are saved, you can reactivate the container.

▼ To Modify a Container Definition Using a Property Sheet

1. If the Container Manager GUI is not already open, access it as described in “To Launch the Container Manager GUI” on page 44.
2. Select the Containers view.

3. Select the container definition.

- If the container definition is not currently used for any active container, select the Containers Group from the navigation window. This method displays the Container Definitions and Groups table in the right pane. Select the container definition from the table.
- If the container definition is being used with any active containers, select the container definition from the navigation window. If needed, click the different Container groups to expand the list of individual container definitions. This method displays the Hosts Associated with this Container Definition table from which you can deactivate the container instances.

Note – All container instances that use this container definition must be deactivated before you can change the properties. If any show the status as Active, use the Deactivate button in the Hosts Associated with this Container Definition table after selecting all hosts before continuing.

4. Select the Properties tab from the right pane.

The property sheet for the selected container definition appears. You can make the following changes in the text fields:

- Description – The description of the container definition.
- Project Type – User, Group, or Application.
- Additional User – Change existing entries or provide additional valid UNIX user names. Separate multiple entries with a comma.
- Additional Group – Change existing entries or provide additional valid UNIX group names. Separate multiple entries with a comma.

Note – If the Save button is not available and the text fields are greyed out, the container definition is being used in one or more container instances. Verify that the state is Inactive for all hosts listed in the Hosts Associated with this Container Definition table. If any show status as Active, you must deactivate them.

5. Click Save to save the changes.

The property sheet remains displayed.

▼ To Modify a Container Using a Property Sheet

Use this procedure to make changes to the resource pool or resource reservations for only one container. If you want to make the same change to multiple containers, see “Modifying Containers With a Resource Change Job” on page 90.

1. **If the Container Manager GUI is not already open, access it as described in “To Launch the Container Manager GUI” on page 44.**
2. **Choose from the following methods to select the desired container instance:**
 - If you know the name of the host that the container is associated with, select the host name from the navigation window in the Hosts view. Then select the Containers tab in the right pane to access a table that lists all containers associated with the host.
 - If you know the name of the container, select its name from the navigation window in the Containers view. The Hosts Associated with this Container Definition table appears in the right pane.

Note – All containers that use this container definition must be deactivated before you can change the properties. If any show the status as Active, use the Deactivate button in the table before continuing. The tables in both views have this button.

3. **Select the name of the container or host from the table, depending upon the method selected in the previous step.**

The property sheet for the container instance is displayed.
4. **Make the desired changes.**
 - Resource Pool Definition. To change the pool that the container is associated with, select from the drop-down list.
 - CPU Reservation (CPUs). Provide the new value in the text box in integer or decimal units.
 - Memory Cap (MB). Provide the new value in the text box.
5. **Click Save.**

The requested changes to the resource reservations have been saved.
6. **(Optional) To reactivate the container, return to the table used in Step 3 and click Activate.**

Modifying Containers With a Resource Change Job

Use the resource change job feature to change resource limits on multiple containers that are spread across multiple hosts. These containers must all be using the same container definition. You can either run the resource change job immediately so that the changes are implemented at the same time, or you can schedule the changes to occur later.

Note – Changes to CPU reservations are immediate. Changes to memory caps can take time to write to swap. Any big change to the memory cap will affect system performance while the memory cap is being adjusted.

The following information is available in the Resource Change Job table:

Resource Change Job Name	The name of the job that was provided during job creation.
Hosts	The names of the hosts with which the container is associated.
Schedule	The interval the job is scheduled to run. Options include One Time, Hourly, Daily, Weekly, Monthly.
State	The status of the job. Values include Queued, Succeeded, Failed.

The following example using containers named Webserver and Rollup illustrates how the resource change job feature can be used to manage system resources across the enterprise. In this example, an online store provides order taking from its web site. The Webserver container was created to manage the CPU and memory resources used by the web server across North America. The Rollup container was created to manage the resources required by the database. During the day and early evening hours, web server resource demands are high as people use the web site to place orders. But in the evening, the demand on the webserver typically drops dramatically after midnight. During overnight hours, the database is scheduled to run reports on the day’s sales.

To manage the resources required by these two containers on an 8 CPU system with 6,000 Mbytes of physical memory, you could create a total of four resource change jobs as shown in the following table:

TABLE 3-4 Sample of Resource Change Job Scheduling

Container Name	Resource Change Job Name	Start Time	Interval	Resource Change
Webserver	webserver-day	6:00 am	Daily	CPU: 6 Memory: 2500 MB
Rollup	rollup-day	6:00 am	Daily	CPU: 1 Memory: 2000 MB
Webserver	webserver-night	Midnight	Daily	CPU: 1 Memory: 2000 MB

TABLE 3-4 Sample of Resource Change Job Scheduling (Continued)

Container Name	Resource Change Job Name	Start Time	Interval	Resource Change
Rollup	webserver-night	Midnight	Daily	CPU: 6 Memory: 2500 MB

Two resource change jobs run every morning at 6:00 am to change the resources for the Webserver and Rollup containers. During the day, the Webserver container is given the majority of CPU and physical memory resources as the demand of the webserver is high. Then at midnight each day a second set of resource change jobs run, and they reallocate the system's resources to accommodate the changing need: the database requires the resources to tally the daily sales while the web server requires fewer resources as demand is low.

This feature is similar to the job management feature found in Sun Management Center, but you should use the Container Manager GUI to administer all Container Manager jobs. For more information about the Sun Management Center job feature, see "Job Management Concepts" in *Sun Management Center 3.5 User's Guide*.

▼ To Modify a Container Using a Resource Change Job

1. **If the Container Manager GUI is not already open, access it as described in "To Launch the Container Manager GUI" on page 44.**
2. **Select the Containers view.**
3. **In the navigation window, select the container name.**
The container must be associated with a host in order to proceed.
4. **Select the Jobs tab from the right pane.**
The Resource Change Job table is displayed.

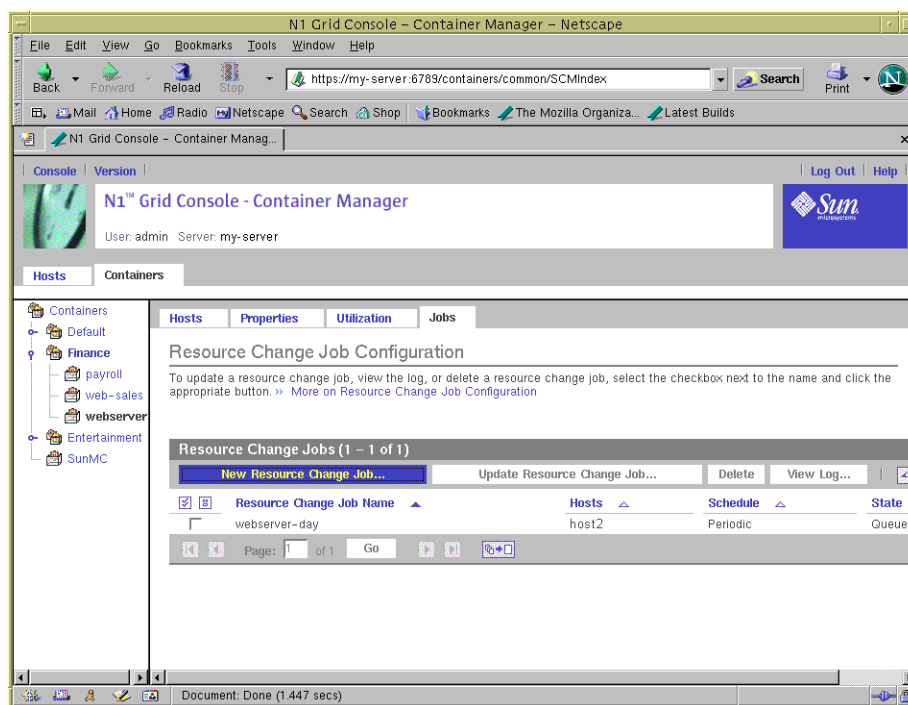


FIGURE 3–24 Sample: Resource Change Jobs Table

5. **Click the New Resource Change Job button located in the table.**
 The Resource Change Job wizard appears. The Overview panel is the first. Move through the wizard by providing information as requested, and clicking the Next button when finished with each panel.
6. **Provide a name for the resource change job. Providing a description is optional.**
 Length of the name cannot exceed 32 characters. Spaces, dash (-), underscore (_), and dot (.) are all accepted. A space will be converted to an underscore (_).
 The Select Hosts panel appears. The names of all the hosts for which the selected container is associated with appears in the Available list. You can change the resource limits for one or more hosts by selecting them from this window.
7. **Select each host from the Available list, and click Add to move each to the Selected list. Or click Add All to move all hosts.**
 The host names move to the Selected field.
8. **Provide a new minimum CPU reservation. A memory cap is optional.**
 The new resource limits will apply to all the hosts selected in the previous step. Use the Previous button to return to make any changes.

9. **Provide a start date, start time, and interval for the resource change job.**
The changes to the resource limits will take effect at the requested time.
10. **Review your selections in the Summary panel. Use the Previous button to return to make any corrections. When done, click Finish.**

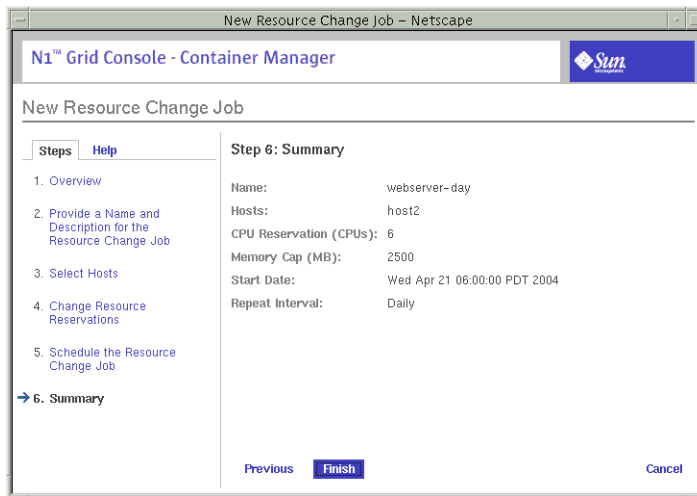


FIGURE 3–25 Sample: Summary Panel in Resource Change Job Wizard

The wizard is dismissed. The job is added to the Jobs table. The status is listed as Queued until the day and time when the Job is scheduled to run. The changes to the resource limits will take effect at the time requested.

▼ To Edit a Pending Resource Change Job

Use this procedure to make changes to a pending job whose status still shows as Queued in the Jobs table.

1. **If the Container Manager GUI is not already open, access it as described in “To Launch the Container Manager GUI” on page 44.**
2. **Select the Containers view in the navigation window.**
3. **Select the Jobs tab from the right pane.**
4. **From the Resource Change Job table, select the job to be changed by selecting the checkbox next to the name.**
A checkmark appears in the box.
5. **To launch the Update Resource Change Job wizard, click the Update Resource Change Job button.**

Move through the wizard by changing information as needed, and clicking the Next button when finished with each panel. For a detailed description of the steps to move the panels, see “To Modify a Container Using a Resource Change Job” on page 92.

6. When done, click Finish.

The wizard is dismissed. The edits made to the job have been saved.

▼ To View a Resource Change Job Log

Use this procedure to view the log for a change job that has completed. If the job included changes to multiple hosts, the status for the jobs per host is located in the log.

1. If the Container Manager GUI is not already open, access it as described in “To Launch the Container Manager GUI” on page 44.

2. Select the Containers view in the navigation window.

3. Select the Jobs tab from the right pane.

4. From the Resource Change Jobs table, select the completed job whose log you want to view by selecting the checkbox next to the name.

A checkmark appears in the box.

5. Click the View Log button.

The log file for the resource change job appears.

Alarm Management

You can set alarm thresholds for a container’s use of CPU and physical memory resources. Three levels of alarms are available: Critical, Major, and Minor. You can also request that an email be sent when alarms are generated. The alarms are displayed as icons in the navigation window and the Containers table. Each icon displays a tool tip containing alarm details when the cursor is placed over it.

The Container Manager GUI displays only those alarms generated by its own module. Alarms generated by the Container Manager module are visible in both the Sun Management Center Java and Web consoles in addition. If you will use Sun Management Center to view the Container Manager alarms, the alarm names match up according to the following table.

TABLE 3-5 Alarm Threshold Names

Container Manager	Sun Management Center
Critical	Critical
Major	Alert
Minor	Information

▼ To Set an Alarm Threshold

1. **If the Container Manager GUI is not already open, access it as described in “To Launch the Container Manager GUI” on page 44.**
2. **In the Hosts view, select the host with which the container is associated.**
3. **Select the Containers tab in the right panel.**
A table appears that lists all containers that are associated with that host.
4. **In the table, select the name of the container for which you want to set an alarm.**
The Properties page for the container appears.
5. **Click the Alarm Thresholds tab.**
The alarm setting page appears. Three levels of alarms are available: Critical, Major, Minor.
6. **Locate the level of alarm to be set, and provide the alarm values in the text fields.**
Three alarm settings are available:
 - CPU Threshold Less Than – Provide an integer or decimal value. The alarm is triggered when the CPU level goes below the level.
 - Memory Threshold Greater Than – Provide an integer in Mbytes. The alarm is triggered when the memory level exceeds this level.
 - Mail To – Provide a valid email address. An email alert is sent to this address once the alarm is triggered.

Note – You can set one, two, or three levels of alarms at once. If more than one alarm is triggered, the alarm with the highest value appears as an icon in the GUI. Likewise, an email alert is sent for the alarm with the highest value.

7. **Click Save.**
The alarm is now set.

▼ To Remove an Alarm Threshold

1. **If the Container Manager GUI is not already open, access it as described in “To Launch the Container Manager GUI” on page 44.**
2. **In the Hosts view, select the host with which the container is associated.**
3. **Select the Containers tab in the right panel.**
A table appears that lists all containers that are associated with that host.
4. **In the table, select the name of the container for which you want to remove an alarm.**
The Properties page for the container appears.
5. **Click the Alarm Thresholds button.**
The alarm setting page appears. The values for the alarms set for the container are displayed.
6. **Remove the alarm values from the text fields.**
7. **Click Save.**
The alarm is no longer set.

Resource Utilization Reports and Extended Accounting Data

If you have the Performance Reporting Manager software installed, you can generate reports that detail the CPU and the memory resources used per container, host, or resource pool. Both of these graph reports are available from the Utilization tab located in the Container Manager GUI. These graph reports become available in the GUI two hours after the Performance Reporting Manager software is installed. This waiting period is needed to allow data to be collected and stored in the database for use in the graph reports. The waiting period for weekly and monthly graphs is 24 to 48 hours.

The following six types of resource usage graph reports are available from the Container Manager GUI.

Container Definition	Data returned is the average of the resources used by all containers, which can include both active and inactive containers. Historical data is provided for inactive containers. The addition of historical data enables you to determine whether your containers are controlling resource
----------------------	---

	consumption effectively. The data is represented as a percentage of the resource reservations for minimum CPU and memory cap for all active containers. This percentage compares the actual resources used to the resources reserved.
Active Container	Data returned is the number of CPUs and memory currently being used for the selected active container.
Container Group	Data returned is the average of the resource used for all containers in the selected group. This percentage compares the actual resources used to the resources reserved for the selected containers.
Host	Data returned is the aggregation of all active containers on the selected host.
Host Group	Data returned is the average resource utilization of all hosts located in that group. The data is represented as a percentage used of the total host resources.
Resource Pool	Data returned is the aggregation of all the active containers in the selected resource pool.

If the requested graph is for multiple containers across different hosts, the data returned is the average of the percentage being used on each host.

Report data can also be exported to a text file in comma-separated values (CSV) format for an active container, resource pool, or host. The text file can be used as an interface file for a billing and accounting application, for example. A report in CSV format is available 2 hours after installation of the Performance Reporting Manager software. This waiting period enables report data to be collected and stored in the database for use in a CSV report. The exported data is more detailed and granular than the data that appears in the graph reports. Data for the last 24 hours is available in a CSV report.

The exported CSV reports contains the following categories of information:

Host name	Name of the host with which the container is associated
Timestamp	Date and time for the record.
CPU Reservation	CPU reservation of the container
CPU Usage	Combined CPU usage of all processes in the container
CPU Return of Investment	CPU utilization compared to CPU reserved, expressed as a percentage.
CPU Extended Accounting Information	CPU extended accounting information
Memory Cap	Physical memory cap

Memory Usage	Physical memory used
Percentage of Memory Used	Physical memory utilized of the host expressed as a percentage
Memory Return of Investment	Memory utilized compared to memory reserved, expressed as a percentage.
Container Project ID	Project ID of the container
Project Name	Project name of the container

Data Collection Process

Container Manager uses the Performance Reporting Manager data collection service, which is located on the server layer. This data collection service in turn uses the history logging capabilities of Sun Management Center, which is located on the agent layer. The data collection service on the server layer collects the data from the agent machines and stores it in the database. Additionally, data collected by Performance Reporting Manager is summarized, or “rolled-up,” at predefined intervals. The minimum, maximum, and average values for data are calculated and are stored as hourly data, weekly data, or monthly data. Finally, the minimum, maximum, and average values are calculated for these same intervals.

The reports generated with Container Manager can incorporate any of this data, depending upon the report request parameters. For more information about Performance Reporting Manager data collection methods, see “Data Collection Process” in *Sun Management Center 3.5 Performance Reporting Manager User’s Guide*.

Requesting a Report

Both CPU and memory resource utilization reports are available per host, container, container definition, or resource pool. Before trying to view a report, be sure to set the browser’s cache to refresh every time. For a list of the six types of reports available, see “Resource Utilization Reports and Extended Accounting Data” on page 97. Reports for CPU and memory resources used are available for the following intervals:

- Daily – Shows data for the last 24 hours, one point per hour
- Weekly – Shows data for the last 7 days, one point per day
- Monthly – Shows data for the last 30 days, one point per day
- Real Time - Shows data every 30 seconds per graph point. Available for active containers only.

You must wait two hours after installation of the Performance Reporting Manager software for the daily graph reports to become available. Data first must be collected and stored in the database from which the report can be drawn. You can also view CPU and memory resource utilization reports for inactive containers and container definitions that are based on historical data.

Real time reports for CPU and memory resources being used are available for active containers only.

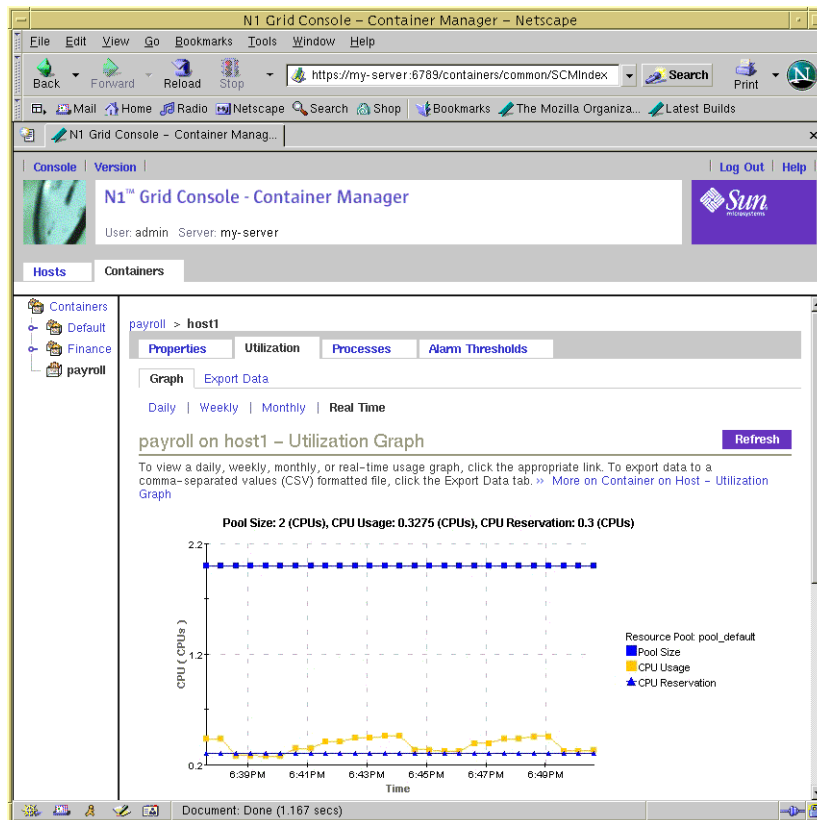


FIGURE 3-26 Sample: Real Time CPU Utilization Graph Report For an Active Container

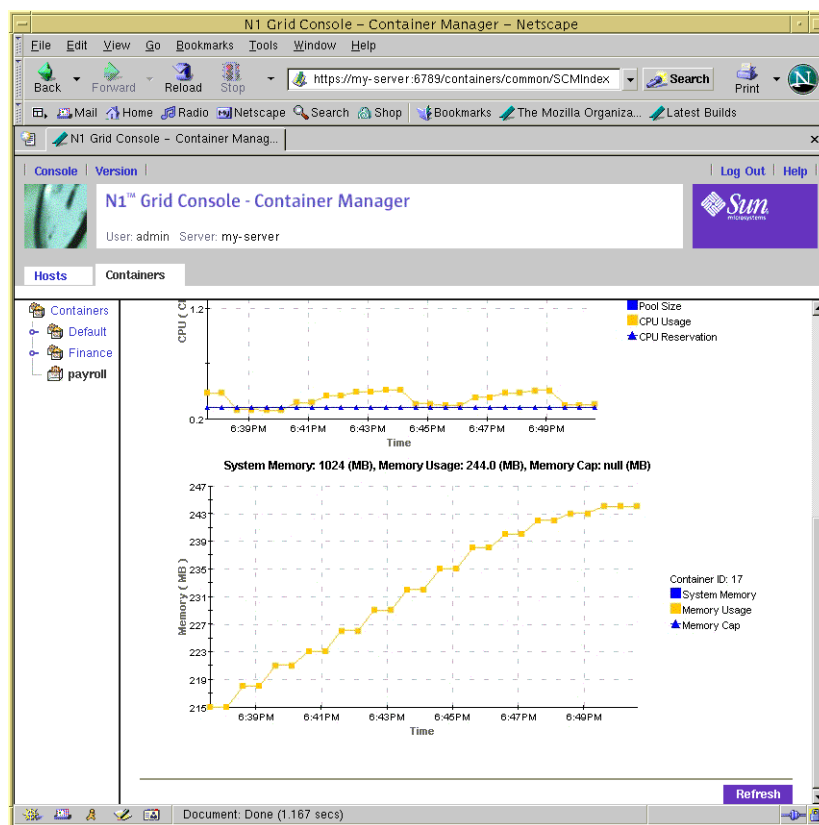


FIGURE 3-27 Sample: Real Time Memory Utilization Graph Report For an Active Container

▼ To Request a Resource Utilization Report For a Host

Use this procedure if you want to obtain a daily, weekly, or monthly report for a host.

1. Set the browser's cache to refresh every time.
2. In the Hosts view, select the host from the navigation window.
3. Select the Utilization tab.
4. Select the desired report: daily, weekly, monthly.
Real time reports are not available for a host. The graphs for CPU and memory resources used by the selected host appears.
5. (Optional) To export the last 24 hours of data to a CSV file, click Export Data.

You must wait at least 2 hours after installation of the Performance Reporting Manager software for a CSV report to be available. Data must first be collected and stored in the database from which the report can be drawn. You cannot preview this data in a graph.

Data exported contains the hourly data for the container for the last 24 hours. Therefore, it is not identical to the data obtained from a daily graph.

▼ To Request a Resource Utilization Report for an Active Container

- 1. Set the browser's cache to refresh every time.**
- 2. In the Containers view, select the container from the navigation window.**

The Hosts Associated with this Container Definition table appears. All the hosts that the container is associated with are listed in the table.
- 3. Select the host for which you want a report by clicking the name.**

The Properties sheet for the container on this host appears.
- 4. Select the Utilization tab.**
- 5. Select the desired report: daily, weekly, monthly, real time.**

The CPU and memory resource utilization graphs appear. If a Real Time report was selected, use the Refresh button to see more real time data.
- 6. (Optional) To export the last 24 hours of data to a CSV file, click Export Data.**

You must wait at least 2 hours after installation of the Performance Reporting Manager software for a CSV report to be available. Data must first be collected and stored in the database from which the report can be drawn. You cannot preview this data in a graph.

Data exported contains the hourly data for the container for the last 24 hours. Therefore, it is not identical to the data obtained from a daily graph.

▼ To Request a Resource Utilization Report for a Container Definition

Use this procedure to request CPU and memory utilization reports for a container definition. The data is based on historical data and is an average of the resources used by active containers that are based on the container definition.

- 1. Set the browser's cache to refresh every time.**
- 2. In the Containers view, select the container definition.**

3. **Select the Utilization tab in the right panel.**
4. **Select the desired report: daily, weekly, monthly.**
The CPU and memory resource utilization graphs appear.

▼ To Request a Resource Utilization Report for a Resource Pool

1. **In the Hosts view, select the host to which the resource pool is bound.**
A list of all resource pools bound to this host appears in the Resource Pools table in the right pane.
2. **Select the name of the resource pool in the table.**
A table listing all containers that are bound to this resource pool appears.
3. **Select the Utilization tab in the right panel.**
4. **Select the desired report: daily, weekly, monthly.**
The CPU and memory resource utilization graphs appear.
5. **(Optional) To export the last 24 hours of data to a CSV file, click Export Data.**
You must wait at least 2 hours after installation of the Performance Reporting Manager software for a CSV report to be available. Data must first be collected and stored in the database from which the report can draw from. You cannot preview this data in a graph.
Data exported contains the hourly data for the container for the last 24 hours. Therefore, it is not identical to the data obtained from a daily graph.

Deleting Containers

You can delete a container and its definition when both is no longer needed. Before deleting, you must first remove the container from all the hosts with which it is associated. Deletion removes the container definition from the database, and the data previously collected for the container is no longer stored. Therefore, you can not obtain any historical data for a deleted container as all data for the container is removed from the database. Being deleted is not considered a container state because the record and all historical data has been removed.

You cannot delete a container on the Solaris 8 OS unless all processes running in that container have been stopped.

When a container is deleted, the following happens depending on the Solaris version you are running:

Solaris 8 OS The `lnode` is deleted, followed by the project.

Solaris 9 OS Processes running in the container are moved to the default project, and the entry is deleted from the `/etc/project` database.

▼ To Delete a Container Definition

1. If the Container Manager GUI is not already open, access it as described in “To Launch the Container Manager GUI” on page 44.
2. Verify that no inactive or active containers exist for the container definition.
3. Select the Containers view in the navigation window.
4. Select the container definition that is to be deleted.
5. Click Delete.

The container definition is removed from the Containers view, and is removed from the database.

Managing Resource Pools

This chapter contains procedures for creating, using, and managing resource pools using N1 Grid Console - Container Manager 1.0 (Container Manager).

The following topics are discussed:

- “Resource Pool Overview” on page 105
- “Creating New Resource Pools” on page 106
- “Deleting Resource Pools” on page 107

Resource Pool Overview

In the Solaris 9 release, a resource pool, or pool, is a configuration mechanism that is used to partition the resources of a host. Every host has a default pool, and all processes are initially bound to this pool. Newly created pools take their processors from the default pool. A host can be partitioned into more than one pool. Additionally, each entry in the `/etc/project` file has an associated pool. If the `/etc/project` entry does not have a pool specified, then that entry is bound to the default pool. Otherwise, the project is bound to the specified pool. New processes started in a project are bound to the corresponding pool. For more information about resource pools in Solaris software, see “Resource Pools” in *System Administration Guide: Resource Management and Network Services*.

If you are running the Solaris 8 release, only one resource pool is available. The container is automatically assigned to the `pool_default`. Because resource pools do not exist in this OS version, the `pool_default` is created artificially. All of the CPUs on a host running the Solaris 8 release are considered to be in one single pool by convention.

After installation of the software, the database is populated with information about the existing resource pools on the system. Container Manager enables you to manage and create resource pools through its GUI. Use the Hosts view to manage resource pools on a host. To access a pool from the navigation window, click the key symbol next to a host. The tree expands and lists the corresponding pools under the host name.

Creating New Resource Pools

After the Container Manager software is installed on a host, all existing resource pools are discovered and loaded into the module's management information base (MIB) table. Newly created pools take their processors from the host's default pool, which is called `pool_default`. One full CPU is always assigned to the default pool. Therefore, the number of available CPUs for creating new pools is always the total number of available CPUs less one.

The Resource Pools table is located in the Hosts view under the Resource Pools tab. Information about a pool is listed in a single row in this table. The following information is available for each resource pool:

Resource Pool Name	The name of the resource pool
CPUs	Total number of CPUs contained in the pool
Unreserved CPUs	The number of CPUs available, or currently available for container creation

▼ To Create a New Resource Pool

- 1. If the Container Manager GUI is not already open, access it as described in "To Launch the Container Manager GUI" on page 44.**
- 2. Select the Hosts view by clicking the left tab in the navigation window.**
A list of hosts is displayed in the navigation window.
- 3. Select the host name.**
The Resource Pools table is displayed in the right pane.
- 4. Click the New Resource Pool button.**
The New Resource Pool dialog is displayed. The Total Number of CPUs on the host is listed, as well as the Available CPUs.
- 5. Provide a name for the new pool in the Resource Pool Name field.**

6. Provide the number of in the CPUs.

This number must be less than or equal to the number given in the Available CPUs field, and must be an integer.

7. Click OK to save your changes.

The information in the Resource Pools table is updated with the new pool.

Modifying Resource Pools

Note – You cannot modify the default resource pool.

▼ To Modify a Resource Pool

- 1. If the Container Manager GUI is not already open, access it as described in “To Launch the Container Manager GUI” on page 44.**
- 2. Select Hosts view by clicking the left tab in the navigation window.**
A list of hosts is displayed in the navigation window.
- 3. Locate the desired host in the list, and click the key symbol next to the name.**
The tree expands and all resource pools bound to the host are displayed.
- 4. Select the resource pool by clicking its name.**
- 5. Select the Properties tab.**
- 6. Make the changes in the Number of CPUs field.**
- 7. Click Save.**

Deleting Resource Pools

You cannot delete a host’s default resource pool. A resource pool cannot be deleted if any container is still associated with it.

▼ To Delete a Resource Pool

1. **If the Container Manager GUI is not already open, access it as described in “To Launch the Container Manager GUI” on page 44.**
2. **Select Hosts view by clicking the left tab in the navigation window.**
A list of hosts is displayed in the navigation window.
3. **Select the host name.**
The Resource Pools table is displayed in the right pane.
4. **To enable the Delete button, select the checkbox next to the resource pool.**
If the Delete button does not become active, then there are containers still using this pool and you cannot delete it.
5. **Click the Delete button.**
The selected resource pool is deleted and its name is removed from the tree.

Installing Using the Command Line

This appendix contains procedures for installing, setting up, and removing the N1 Grid Console - Container Manager 1.0 (Container Manager) software using the command line. Command-line installation is an alternative to using the installation wizard.

For the latest information about installing, setting up, and using the software, see *N1 Grid Console - Container Manager 1.0 Release Notes*.

For information using the installation wizard, see Chapter 2.

- “Installing Container Manager Software” on page 109
- “Setting Up Container Manager” on page 112
- “Removing the Container Manager Software” on page 115

Installing Container Manager Software

Installation of Container Manager using the command line follows the standard Sun Management Center add-on software installation procedures. For more information about installation of add-on software using the command line, see “Using the Command Line for Uninstall, Install, and Setup” in *Sun Management Center 3.5 Installation and Configuration Guide*.

For a list of all installation tasks, see Table 2–1.

Container Manager must be installed on the following layers of Sun Management Center 3.5 Update 1:

- Server layer
- Agent layer, on all hosts for which you want to generate reports

The interactive `es-inst` installation script installs the correct Container Manager software packages on the server and agent layers. For all layers, the packages, module configuration files, and libraries are installed in standard Sun Management Center 3.5 Update 1 locations. For more information about the supported platforms and installation requirements, see “Container Manager Software Description” on page 27.

The Container Manager software can be installed at the following times:

- At the same time that you install the Sun Management Center 3.5 Update 1 software.
- At the same time that you upgrade your existing Sun Management Center 3.5 installation to Update 1 as part of the upgrade procedure.
- After you have completed your installation of, or upgraded to, Sun Management Center 3.5 Update 1. In this case, you install the Container Manager software individually.

The Performance Reporting Manager software must also be installed if you want to use the performance and accounting data features of Container Manager. For more information about installation and setup of this software using the command line, see “Installing Using the Command Line” in *Sun Management Center 3.5 Performance Reporting Manager User’s Guide*. If you do not intend to use these features, you do not need to install this add-on software.

▼ To Install Container Manager During Sun Management Center Installation

- For more information and detailed steps using the command line, see “Using the Command Line for Uninstall, Install, and Setup” in *Sun Management Center 3.5 Installation and Configuration Guide*. You can also install additional add-on software, such as Performance Reporting Manager, at the same time.

▼ To Install Container Manager During Upgrade to Sun Management Center 3.5 Update 1

- For more information and detailed steps, see “Upgrading Previous Versions of SyMON and Sun Management Center on the Solaris Platform” in *Sun Management Center 3.5 Installation and Configuration Guide*. You can also install additional add-on software, such as Performance Reporting Manager, at the same time.

▼ To Install Container Manager Individually

1. As superuser (`su -`), run the Sun Management Center 3.5 Update 1 installation script by typing:

```
# /opt/SUNWsymon/sbin/es-inst
```

where /opt is the directory in which Sun Management Center 3.5 Update 1 is installed. Substitute the name of the actual directory if it is different on your system.

2. Provide the source directory of the Container Manager files when prompted.

Please enter the source directory:

- On SPARC systems, choose from the following:

- a. If installing from the software CD-ROM, type:

```
# /cdrom/cdrom0/image
```

- b. If installing from a directory to which the software has been copied, type:

```
# disk1/image
```

where *disk1* is the location where the software was copied.

- On x86 systems, choose from the following:

- a. If installing from the software CD-ROM, type:

```
# /cdrom/cdrom0/x86/image
```

- b. If installing from a directory to which the software has been copied, type:

```
# disk1/x86/image
```

where *disk1* is the location where the software was copied.

3. To install the Container Manager software, answer “Yes” when prompted.

The following is an example of the output you might see:

```
Installation destination directory: /opt
```

```
You can install the product documentation.
```

```
The documentation will get installed in the languages chosen previously.
```

```
Install Product Documentation. (y|n|q) n
```

```
Reading Add-On products from image. Please wait...
```

```
This can take approximately 3 minutes to complete.
```

```
Found: N1 Grid Console - Container Manager
```

```
Checking for applicable products. Please wait...
```

```
This can take approximately 2 minutes to complete.
```

```
The following Add-On Products are applicable for installation.
```

```
N1 Grid Console - Container Manager
```

```
Select the products you want to install:
```

```
N1 Grid Console - Container Manager (y|n|q) y
```

The `es-inst` script installs Container Manager. The `es-inst` script then automatically displays `setup` prompt.

4. Determine whether you want to set up Container Manager now or at a later time.

The following is an example of the output you might see:

```
You must perform setup before using Sun Management Center 3.5 Update 1.  
Do you want to run setup now (y|n|q)
```

- To set up the software at a later time, answer `n` for “No”. When you are ready to run the setup process, see “To Set Up Container Manager Individually” on page 35.
- To set up the software now, answer `y` for “Yes”. The Sun Management Center 3.5 Update 1 software is not setup again.

Setting Up Container Manager

After installation is complete, you must run the Container Manager `setup` script to configure the server and agent layers. As with installation of the software, you can run the setup process at the time you setup the Sun Management Center 3.5 Update 1 installation or upgrade. You can also set up the software individually, at a later time.

The same configuration file changes take place during the setup process when initiated from the command line as that occur when using the setup wizard. For example the scheduling class is still set to fair share scheduler (FSS). For more information, see “Setting Up Container Manager Software” on page 34.

▼ To Set Up Container Manager During Sun Management Center Installation or Upgrade

- For more information and detailed steps, see “Using the Command Line for Uninstall, Install, and Setup” in *Sun Management Center 3.5 Installation and Configuration Guide*.

▼ To Set Up Container Manager Individually

Note – This procedure assumes that you chose not to set up Container Manager at the end of the installation process.

1. Run the Sun Management Center 3.5 Update 1 setup script as superuser (su -). Choose one of the following options:

- To run setup on all components that are not yet set up, type:

```
# /opt/SUNWsymon/sbin/es-setup
```

- To run setup on the Container Manager add-on software only, type:

```
# /opt/SUNWsymon/sbin/es-setup -p SCM
```

where /opt is the directory in which Sun Management Center 3.5 Update 1 is installed. Substitute the name of the actual directory if it is different on your system.

The following is an example of the output you might see:

```
-----  
This script will help you to setup Sun (TM) Management Center 3.5 Update 1.  
-----
```

```
Setting up Addon[s]...
```

```
-----  
Starting N1 Grid Console - Container Manager Setup  
-----
```

```
Setup for N1 Grid Console - Container Manager - Agent Layer
```

```
FSS is made as the scheduling class of all the pools
```

```
The memory capping packages are not available on this host.  
The setup will not be able to configure memory capping  
functionality
```

```
Task based extended accounting is successfully enabled  
Processes under TS and IA scheduling class are moved under FSS
```

```
Entry for scm-container successfully added  
Setup for N1 Grid Console - Container Manager - Server Layer
```

```
Setup for N1 Grid Console - Container Manager - Web Console
```

2. Review the list of components that must be stopped for the set up process to continue.

3. Confirm that Container Manager is the product to be set up.

4. When setting up the agent layer, if processor sets are detected on the system that are not associated with a resource pool, please select from the following:

- Yes – These particular processor sets will be deleted from the system. In order for Container Manager to function correctly, any processor set that is not associated with a resource pool must be removed as they will cause problems with pool management. After this selection, these processor sets are automatically deleted for you, and the setup process continues.
- No – These particular processor sets will not be deleted from the system. After this selection, the setup script exits and the Container Manager software is not setup on the system. You are unable to use the Container Manager software on any host on which exists processor sets that are not associated with a resource pool.
- Cancel – The setup script exits. The Container Manager software is not setup on the system.

5. If you have previously completed the set up process for other Sun Management Center products, indicate whether you want to run setup again for all software or just the newest add-on software.

6. When setting up a server layer installation, provide the full path to a directory that has at least 300 MB free disk space for the database.

7. Indicate whether or not you want to start the Sun Management Center agent and server components by answering Y or N.

The following is an example of the output you might see:

```
Do you want to start Sun Management Center agent and server components now (y|n|q)
```

8. You receive confirmation when the software is set up.

Once the setup procedure is complete, you have the option to start the Sun Management Center processes. For more information, see “Starting and Stopping Sun Management Center” in *Sun Management Center 3.5 Installation and Configuration Guide*.

EXAMPLE A-1 Example Output After Set Up is Complete

The following is an example of the output you see after set up is complete and the Sun Management Center agent and server layers have been started:

```
Do you want to start Sun Management Center agent and server components now (y|n|q) y
```

```
Java server started successfully.  
Grouping service started successfully.  
Agent started successfully.  
Topology service started successfully.  
Trap-handler service started successfully.  
Configuration service started successfully.  
Event-handler service started successfully.  
Metadata Service started successfully.  
Hardware service started successfully.
```

EXAMPLE A-1 Example Output After Set Up is Complete (Continued)

```
Web server started successfully.

Setup of Sun Management Center is complete.
Setup logfile is : /var/opt/SUNWsymon/install/setup_host_name.040408141450.12822

Install logfile is : /var/opt/SUNWsymon/install/install_host_name.040408140547.10929

                End of Installation

Exiting Sun Management Center installation.

#
```

Removing the Container Manager Software

The `es-uninst` script removes the Container Manager add-on software. The script removes the Container Manager packages, and all the data and configuration changes made during setup. The following is removed in addition to the software packages: the module entry from `base-modules-d.dat` and the application registration from Sun Web Console. You have the option to retain or delete the data stored in the database during the removal process. System resource configuration changes made during installation are not removed when the Container Manager software is uninstalled.

▼ To Remove Container Manager Using `es-uninst`

1. As superuser (`su -`), type:

```
# /opt/SUNWsymon/sbin/es-uninst
```

where `/opt` is the directory in which Sun Management Center 3.5 Update 1 is installed. Substitute the name of the actual directory if it is different on your system.

2. Select Container Manager from the list of add-on software.

The following is an example of the type of output you will see:

```
This script will help you to uninstall the Sun Management Center software.
```

Following Sun Management Center Products are installed:

PRODUCT	DEPENDENT PRODUCTS
Production Environment	All Addons
Advanced System Monitoring	None
Performance Reporting Manager	None
Workgroup Server	None
N1 Grid Console - Container Manager	None

Do you want to uninstall Production Environment (y|n|q) n
Do you want to uninstall Advanced System Monitoring (y|n|q) n
Do you want to uninstall Performance Reporting Manager (y|n|q) n
Do you want to uninstall Workgroup Server (y|n|q) n
Do you want to uninstall N1 Grid Console - Container Manager (y|n|q) y

The following product[s] will be removed:

N1 Grid Console - Container Manager.

3. Indicate whether to preserve the data files.

The following is an example of the output you will see:

Select Save Data to save all user and configuration data. Your data is saved and can be restored when you re-install Sun Management Center.

Do you want to preserve data (y|n|q)

Once the es-uninst script is finished, the Container Manager packages and configuration files are removed. If you chose not to preserve the data files, they are removed as well.

The following is an example of the output you will see:

Status of uninstallation:

PRODUCT	STATUS
N1 Grid Console - Container Manager	Removed

Uninstall logfile is : /var/opt/SUNWsymon/install/uninstall_*machine_name*.040408134328.5604
#

Glossary

active container	A container that has been associated with a host and whose minimum CPU reservation and memory cap have been set. An entry for the active container exists in the <code>/etc/project</code> file on the host with which it is associated. The kernel enforces the resource boundaries of an active container. An active container can also be referred to as being deployed, in the sense that the container has been pushed out and is now active on a host.
associate	To bind a container to a host. One step in the two-step process in order to activate a container.
container	An abstraction layer that helps organize and manage the collection of physical system resources.
defined container	A container which has been created, named, and saved for future use. The container has not been associated with a host, nor have the resource boundaries been set.
deployed	See <i>active container</i> .
fair share scheduler (FSS)	A scheduling class that allows you to allocate CPU time that is based on shares. Shares define the portion of the system's CPU resources that are allocated to a project.
inactive container	A container that has been associated with a host and for which resource boundaries are set, but the kernel is not currently enforcing these boundaries.
limit node (lnode)	In the Solaris 8 release, the mechanism by which per-user data is held.
match expression	When creating an application-based container with the New Container Wizard, this expression identifies the processes that are associated with the application. If the match expression is part of the container definition, the matching processes are automatically moved under the project name for the container.
pool	See <i>resource pool</i> .

project	In the Solaris 9 release, the project provides a network wide administrative identifier for related work.
project identifier (ID)	The means by which the Solaris kernel tracks resource usage. All the processes running in a container have the same project ID.
resource	In resource management, an aspect of the computing system that can be manipulated with the intent to change application behavior.
resource management	A functionality that enables you to control how applications use available system resources.
resource pool	In resource management, a configuration mechanism that is used to partition machine resources. Also referred to as a pool.

Index

A

- activating a container, 79
- active containers
 - application-based, 64
 - duplicate project names, 53
 - overview, 43
 - user-based or group-based, 62
 - viewing processes, 82
- agent discovery, 47
- agent update, 37
- alarm thresholds
 - overview, 95
 - removing, 97
- Alarm Thresholds tab, 45
- application-based container definition,
 - creating, 66
- application-based containers
 - creating, 70
 - moving processes individually, 77
 - overview, 52, 64
- associate with host, 43

B

- backup and restore, 37
- before installing, 24
- browsers, list of supported, 44

C

- Caution
 - inadequate memory cap, 54
 - using resource management commands, 35
- configuration changes during set up, 34
- container activation, failed, 53
- container boundaries, creating, 22
- container creation, overview, 52
- container definitions
 - advantages of, 40
 - creating a new container, 79
 - creating application-based, 66
 - creating user-based or group-based, 60
 - elements of, 41
 - modifying, 87
 - resource change jobs, 90
- container management, overview, 39
- Container Manager GUI
 - launching, 44
 - tabs overview, 45
- container types, 52
- containers
 - activating or deactivating, 79
 - active, 43
 - application-based, 64, 70
 - creating, 55
 - creating user-based or group-based, 60
 - default, 50
 - definitions, 43
 - deleting, 104
 - deployed, 43
 - features of, 39
 - group.staff, 51

- containers (Continued)
 - inactive, 43
 - information needed for creating, 56
 - instances, 41
 - modifying with property sheets, 85
 - modifying with resource change jobs, 90
 - moving processes individually, 77
 - organizing resources, 17
 - real time reports, 99
 - resource consumption, 39
 - starting an application inside, 78
 - states, 42
 - tracking resources, 52
 - viewing processes, 82
- Containers tab, 45
- Containers table, 47
- Containers view
 - accessing Processes Table, 85
 - overview, 48
- CPU
 - available for resource pool, 106
 - minimum reservation, 17
- CPU reservations, relationship to shares, 54
- CSV reports, 98

D

- data collection process, 99
- database, requirements, 30
- deactivating a container, 79
- default containers
 - list of in Solaris 8 OS, 51
 - list of in Solaris 9 OS, 50
 - overview, 50
 - resource reservations, 51
- default pool, 105
- default project, 52
- defined container, overview, 43
- deleted container, 103
- deleting a container, 104
- deleting a resource pool, 107
- deployed container, 43
- discovery of agents, 47
- documentation, viewing after installation, 33

E

- es-guiinst script, 32
- es-guisetup script, 35
- es-inst script, 110
- es-setup script, 113
- es-uninst script, 115
- esusers file, 44
- /etc/pooladm.conf, changes to, 34
- /etc/project file
 - activating containers, 43
 - deactivating containers, 43
 - default containers, 50
 - project names, 52
- exporting a CSV report, 98
- extended accounting data, 24
- extended accounting files, changes to, 34

F

- failed container activation, 53
- FSS (fair share scheduler), CPU reservations, 54

G

- graph reports
 - availability, 97
 - Performance Reporting Manager
 - requirement, 24
- group-based container definition, creating, 60
- group-based containers, overview, 52
- group.staff container, 51
- groups, using, 49

H

- hardware platforms, list of, 30
- historical data, deleted container, 103
- hosts, search for, 72
- Hosts tab, 45
- Hosts view
 - accessing Processes Table, 84
 - overview, 46

I

- inactive container, overview, 43
- installation
 - of additional software, 28
 - of Performance Reporting Manager, 29, 31
 - of product documentation, 33
 - of Solaris Resource Manager 1.3, 29
 - of Sun Management Center 3.5 Update 1, 28
 - of Sun Web Console, 28
 - of Tomcat server, 28
 - overview, 27
 - patches, 28
 - Sun Management Center layers, 27
 - task map, 28
- installing Container Manager
 - command-line overview, 109
 - during Container Manager upgrade, 32
 - during Sun Management Center installation, using wizard, 32
 - individually using command line, 110
 - individually using wizard, 32
 - options, 31

J

- JDK version, 29

K

- kernel, enforcement, 39

L

- launching
 - Associate Host to Container wizard, 80
 - Container Manager GUI, 44
 - New Container wizard, 56
 - Resource Change Job wizard, 92
 - Sun Web Console, 44
 - Update Resource Change Job wizard, 94
- lnode, definition, 21
- loading module, 31

M

- match expressions
 - description of, 43
 - determining, 65
 - moving processes automatically, 65
 - moving processes without using one, 76
 - using `ps -cafe` command, 65
- memory cap
 - definition, 18
 - inadequate level and performance, 53
- memory reservation, 17
- MIB table, 106
- modifying a resource pool, 107
- Move button, enabling of, 50
- moving processes manually, overview, 76

N

- N1 Grid Container model, overview, 19
- New Container button, accessing, 56
- New Container wizard
 - information needed beforehand, 56
 - launching, 56
- `newtask -p` command
 - moving processes individually, 77
 - overview, 76
 - starting an application in a container, 78
- Note
 - changes to resource reservations, 91
 - container type available on Solaris 8 OS, 60
 - deactivating containers before modifying, 88
 - default containers in Solaris 8 OS, 51
 - installation of Solaris Resource Manager 1.3, 29
 - installing additional software, 28
 - loading module, 31
 - requirement for database, 30
 - sizing of Performance Reporting Manager, 29
 - Sun Management Center server context, 47

P

- packages, list of, 30
- patches, installation of, 28

- Performance Reporting Manager
 - data collection service, 99
 - installation of, 29
 - requirement for reports, 24
 - server sizing requirements, 29
- pool_default, 23, 105
- processes
 - default containers, 52
 - moving individually, 77
 - moving manually, 65, 76
 - moving with a match expression, 65
 - project IDs, 52
 - starting an application inside a container, 78
 - starting in a container, 65, 76
- Processes tab, 45
- Processes table
 - description of fields, 82
 - no processes listed, 85
- processor sets, existing, 36
- project
 - default, 52
 - definition, 21
 - tracking resources, 39
- project IDs
 - tracking by kernel, 21
 - tracking processes, 52
- project names
 - according to container type, 52
 - duplicates, 53
- project type
 - details of, 53
 - providing identifiers, 62
- projects
 - relationship to container type, 52
 - tracking resources, 39
- Properties tab, 45
- property sheets
 - changing resource pool or resource reservations, 86
 - description of fields, 89, 90
 - differences between, 85
- ps -cafe command, using, 65

R

- rcapd daemon, 18
- real time reports, availability, 99
- reports
 - daily, weekly, monthly, real time, 99
 - exporting to CSV, 98
 - intervals, 99
 - requesting, 99
 - types of, 97
- resource, definition, 21
- Resource Change Job log, 95
- Resource Change Job tab, 45
- resource change jobs
 - modifying, 94
 - overview, 90
 - Sun Management Center jobs, 92
 - using to manage system resources, 91
- Resource Change Jobs table, fields in, 91
- resource consumption
 - assessing needs, 24
 - controlling, 39
- resource contention, limiting, 17
- resource controls, 23
- resource management, overview, 21
- resource management commands, using, 35, 44
- resource pool
 - creation overview, 106
 - definition, 22
 - deleting, 107
 - existing, 106
 - location in navigation window, 106
 - modifying, 107
 - number of containers, 22
 - partitioning resources, 105
 - relationship with containers, 22
 - Solaris 8, 105
- resource pools
 - changing with a property sheet, 86
 - creating a new pool during container creation, 73
- Resource Pools tab, 45
- Resource Pools table, 106
- resource reservations
 - balancing system resources, 39
 - changing with a property sheet, 86
 - enforcement by kernel, 42
 - inadequate memory and performance, 53
 - initial settings, 54
 - memory cap, 18
 - overview, 53
 - unused CPU resources, 18

resource set, definition, 22

resource utilization

reports, 97

tracking, 40

S

scheduling resource change jobs, 91

searching for available hosts, 72

server consolidation plan

benefits of, 18

tasks, 24

trending application resource utilization, 54

server context, 37, 47

service

definition, 19

relationship with resources, 19

setting an alarm, 95

setting up Container Manager

configuration changes, 34

during Sun Management Center installation
or upgrade, 35

individually, using a GUI, 35

individually, using the command line, 113

overview, command line, 112

overview of GUI, 34

Solaris 8, resource pool, 23

Solaris OS version

product features, 30

project type, 53

Solaris Resource Manager 1.3, installation

of, 29

starting processes in a container, overview, 76

states, container, 42

Sun Management Center 3.5 Update 1,

installation of, 28

Sun Management Center console, 31

Sun Web Console

installation of, 28

launching, 44

removing registration, 37

restarting, 45

T

table

Container Definitions, 48

Containers, 47

Hosts Associated with this Container
Definition, 80

MIB, 106

Processes, 82

Resource Change Jobs, 91

Resource Pools, 106

task map, installation, 28

Tomcat server, installation of, 28

trending resource utilization, 53

U

uninstalling Container Manager

using a wizard, 37

using the command line, 115

Update Resource Change Job wizard, 94

user-based container definition, creating, 60

user-based containers, overview, 52

Utilization tab, 45

W

wizard

Associate Host to Container, 79

New Container, 56

Resource Change Job, 92

Update Resource Change Job, 94

workload, customizing environment, 17

