Performance Tuning Guide

Sun™ ONE Application Server

Version 7

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Contents

About This Guide

Overview

Sun ONE Application Server 7 is a J2EE 1.3 specification-compatible application server which supports Java Web Services standards as well as standard HTTP server programming facilities. Three editions of the application server are offered to suit a variety of needs for both production and development environments:

- Platform Edition
- Standard Edition
- Enterprise Edition

Platform Edition

Platform Edition forms the core of the Sun ONE Application Server 7 product line. This, free for production use, product offers a high-performance, small-footprint J2EE 1.3 specification-compatible runtime environment that is ideally suited for basic operational deployments, as well as for embedding in third-party applications. Web-services ready, the Platform Edition includes technologies derived from the Sun ONE Web Server, Sun ONE Message Queue, and the J2EE Reference Implementation.

Platform Edition deployments are limited to single application server instances (i.e. single virtual machines for the Java platform ("Java virtual machine" or "JVM™")). Multi-tier deployment topologies are supported by the Platform edition, but the web server tier proxy does not perform load balancing. In Platform Edition, administrative utilities are limited to local clients only.

Platform Edition is integrated into Solaris 9.

Standard Edition

The Standard Edition layers enhanced, remote-management capabilities on top of the Platform Edition. Enhanced management capabilities, remote command-line, and web-based administration are all included as part of the Standard Edition. This edition also includes the ability to partition web application traffic through a web server tier proxy. Standard Edition supports configuration of multiple application server instances (JVMs) per machine.

Enterprise Edition

Enterprise Edition enhances the core application server platform with greater high availability, load balancing, and clustering capabilities suited for the most demanding J2EE-based application deployments. The management capabilities of the Standard Edition are extended in Enterprise Edition to account for multi-instance and multi-machine deployments.

Clustering support includes easy-to-configure groups of cloned application server instances to which client requests can be load balanced. Both external load balancers and load balancing web tier-based proxies are supported by this edition. HTTP session, stateful session bean instance, and Java Message Service (JMS) resource failover are included in the Enterprise Edition. The patented “Always On” highly available database technology forms the basis for the HA persistence store in the Enterprise Edition.

For more product information, see the Sun ONE Application Server page at http://www.sun.com/software/products/appsrvr/home_appsrvr.html.

Using the Documentation

The Sun ONE Application Server documentation is available as online files in Portable Document Format (PDF) and Hypertext Markup Language (HTML) formats at:

`http://docs.sun.com/`

The following table lists tasks and concepts described in the Sun ONE Application Server documentation. The left column lists the tasks and concepts, and the right column lists the corresponding document.

Table 1 Sun ONE Application Server Documentation Roadmap

For information about	See the following
Late-breaking information about the software and the documentation	Release Notes
Supported platforms and environments	Platform Summary
Introduction to the application server, including new features, evaluation installation information, and architectural overview.	*Getting Started Guide*
Installing Sun ONE Application Server and its various components (sample applications, Administration interface, Sun ONE Message Queue).	*Installation Guide*
Creating and implementing J2EE applications that follow the open Java standards model on the Sun ONE Application Server 7. Includes general information about application design, developer tools, security, assembly, deployment, debugging, and creating lifecycle modules.	*Developer's Guide*
Creating and implementing J2EE applications that follow the open Java standards model for web applications on the Sun ONE Application Server 7. Discusses web application programming concepts and tasks, and provides sample code, implementation tips, and reference material.	*Developer's Guide to Web Applications*
Creating and implementing J2EE applications that follow the open Java standards model for enterprise beans on the Sun ONE Application Server 7. Discusses EJB programming concepts and tasks, and provides sample code, implementation tips, and reference material.	*Developer's Guide to Enterprise JavaBeans Technology*
Creating clients that access J2EE applications on the Sun ONE Application Server 7	*Developer's Guide to Clients*
Creating web services	*Developer's Guide to Web Services*
J2EE features such as JDBC, JNDI, JTS, JMS, JavaMail, resources, and connectors	*Developer's Guide to J2EE Features and Services*
Creating custom NSAPI plugins	*Developer's Guide to NSAPI*

Table 1 Sun ONE Application Server Documentation Roadmap *(Continued)*

For information about	See the following
Performing the following administration tasks: • Using the Administration interface and the command line interface • Configuring server preferences • Using administrative domains • Using server instances • Monitoring and logging server activity • Configuring the web server plugin • Configuring the Java Messaging Service • Using J2EE features • Configuring support for CORBA-based clients • Configuring database connectivity • Configuring transaction management • Configuring the web container • Deploying applications • Managing virtual servers	*Administrator's Guide*
Editing server configuration files	*Administrator's Configuration File Reference*
Configuring and administering security for the Sun ONE Application Server 7 operational environment. Includes information on general security, certificates, and SSL/TLS encryption. HTTP server-based security is also addressed.	*Administrator's Guide to Security*
Configuring and administering service provider implementation for J2EE CA connectors for the Sun ONE Application Server 7. Includes information about the Administration Tool, DTDs and provides sample XML files.	J2EE CA Service Provider Implementation Administrator's Guide
Migrating your applications to the new Sun ONE Application Server 7 programming model from the Netscape Application Server version 2.1, including a sample migration of an Online Bank application provided with Sun ONE Application Server	*Migrating and Redploying Server Applications Guide*
Using Sun ONE Message Queue.	The Sun ONE Message Queue documentation at: http://docs.sun.com/?p=/coll/S1_MessageQueue_30

Documentation Conventions

This section describes the typographical conventions used throughout this guide:

- General Conventions
- Conventions Referring to Directories

General Conventions

The following general conventions are used in this guide:

- **File and directory paths** are given in UNIX® format (with forward slashes separating directory names). For Windows versions, the directory paths are the same, except that backslashes are used to separate directories.
- **URLs** are given in the format:

  http://*server.domain*/*path*/*file*.html

  In these URLs, *server* is the server name where applications are run; *domain* is your Internet domain name; *path* is the server's directory structure; and *file* is an individual filename. Italic items in URLs are placeholders.
- **Font conventions** include:
  - The `monospace` font is used for sample code and code listings, API and language elements (such as function names and class names), file names, pathnames, directory names, and HTML tags.
  - *Italic* type is used for code variables.
  - *Italic* type is also used for book titles, emphasis, variables and placeholders, and words used in the literal sense.
  - **Bold** type is used as either a paragraph lead-in or to indicate words used in the literal sense.
- **Installation root directories** for most platforms are indicated by *install_dir* in this document. Exceptions are noted in "Conventions Referring to Directories" on page 12.

  By default, the location of *install_dir* on various product distributions are:
  - Solaris 8 non-package-based Evaluation installations:

    user-specified directory`/sun/appserver7`

- Solaris unbundled, non-evaluation installations:

  `/opt/SUNWappserver7`

- Windows, all installations:

  `C:\Sun\AppServer7`

For the platforms listed above, *default_config_dir* and *install_config_dir* are identical to *install_dir*. See "Conventions Referring to Directories" on page 12 for exceptions and additional information.

- **Instance root directories** are indicated by *instance_dir* in this document, which is an abbreviation for the following:

  default_config_dir`/domains/`*domain*`/`*instance*

- **UNIX-specific descriptions** throughout this manual apply to the Linux operating system as well, except where Linux is specifically mentioned.

Conventions Referring to Directories

By default, when using the Solaris 8 and 9 package-based installation and the Solaris 9 bundled installation, the application server files are spread across several root directories. These directories are described in this section.

- **For Solaris 9 bundled installations**, this guide uses the following document conventions to correspond to the various default installation directories provided:
  - *install_dir* refers to `/usr/appserver/`, which contains the static portion of the installation image. All utilities, executables, and libraries that make up the application server reside in this location.
  - *default_config_dir* refers to `/var/appserver/domains`, which is the default location for any domains that are created.
  - *install_config_dir* refers to `/etc/appserver/config`, which contains installation-wide configuration information such as licenses and the master list of administrative domains configured for this installation.
- **For Solaris 8 and 9 package-based, non-evaluation, unbundled installations**, this guide uses the following document conventions to correspond to the various default installation directories provided:

- *install_dir* refers to `/opt/SUNWappserver7`, which contains the static portion of the installation image. All utilities, executables, and libraries that make up the application server reside in this location.
- *default_config_dir* refers to `/var/opt/SUNWappserver7/domains`which is the default location for any domains that are created.
- *install_config_dir* refers to `/etc/opt/SUNWappserver7/config`, which contains installation-wide configuration information such as licenses and the master list of administrative domains configured for this installation.

Product Support

If you have problems with your system, contact customer support using one of the following mechanisms:

- The online support web site at:

  `http://www.sun.com/supportraining/`
- The telephone dispatch number associated with your maintenance contract

Please have the following information available prior to contacting support. This helps to ensure that our support staff can best assist you in resolving problems:

- Description of the problem, including the situation where the problem occurs and its impact on your operation
- Machine type, operating system version, and product version, including any patches and other software that might be affecting the problem
- Detailed steps on the methods you have used to reproduce the problem
- Any error logs or core dumps

This guide is intended for advanced administrators of Sun ONE Application Server. This guide helps you tune Sun ONE Application Server for maximum performance and reliability. It is recommended that you backup your configuration files, before changing the configuration settings on Sun ONE Application Server.

What's in this Guide

This guide discusses the various subsystems, features, and tools inside the Sun ONE Application Server and how to tune them for maximum performance and reliability. This guide is intended for server administrators, J2EE developers, network administrators, and evaluators.

What You Should Know

Before you begin, you should already be familiar with the following topics:

- Internet and World Wide Web
- Java programming
- J2EE application model
- Application Servers
- Solaris™ or Windows NT/2000 operating systems

How This Guide is Organized

This guide is organized as follows:

"About Sun ONE Application Server" gives an overview of Sun ONE Application Server features and components.

"About Sun ONE Application Server Performance" describes the techniques and processes involved in tuning Sun ONE Application Server.

"Tuning Your Application" describes practices and configuration settings you can use with your applications to ensure maximum performance."Tuning Sun ONE Application Server" describes how you can configure the application server for your needs."Tuning the Java Runtime System" describes how you can configure the Java Virtual Machine to work optimally with the Sun ONE Application Server.

"Tuning Operating System" describes how you can configure your operating system to work optimally with the Sun ONE Application Server.

"Common Performance Problems" describes common performance problems users face when the Sun ONE Application Server is used as a classic web server.An "Index" is provided for quick reference lookups to key performance terms.

Chapter 1

About Sun ONE Application Server

Sun ONE Application Server provides a reliable and scalable web services deployment platform. Application programmers can focus on implementing business logic with well-engineered software components and rely on the services offered by Sun ONE Application Server for production scale deployment.

This chapter includes the following topics:

- Server Components
- Server Architecture
- Server Tools

Server Components

Sun ONE Application Server includes various components that need to interact with each other. These components can be tuned for optimum performance in both production and development environments.

This section describes the following topics:

- Application Server Processes
- Databases

Application Server Processes

The Sun ONE Application Server runs within a single process called `appservd`.

The Sun ONE Application Server process is invoked by running the `startserv` script which reads the configuration information specified in the `server.xml` and launches the server instance and starts:

- the built-in ORB
- the built-in HTTP server
- Any deployed applications and components are loaded to their respective containers
- the logging service

Databases

Oracle, Sybase, Informix and DB2 are some of the databases supported by Sun ONE Application Server. Using Sun ONE Application Server, you can also configure third party JDBC drivers for databases. For more information on configuring the datasources and connection pools, refer to the *Sun ONE Application Server Administration Guide.*

Server Architecture

Figure 1-1 Sun ONE Application Server Component Architecture

The Sun ONE Application Server provides the foundation for high performance web request handling, security, and administration. The main components within the application server are shown in the above figure.

Application Server instances form the basis of an application server deployment. J2EE 1.3 web and EJB containers are included in each application server instance. A proven, high performance HTTP server is positioned in front of the web container while a built in ORB forms the underpinning of the EJB container. In support of access to backend systems, applications can leverage J2EE Connector Architecture support and third party Resource Adapters; JMS with either the built-in JMS provider or third-party providers; and any combination of popular third-party JDBC drivers. Access to backend systems can be managed within the scope of distributed transactions using the built-in, all-Java Transaction Manager.

The Administrative Server houses the core administrative application and an SNMP agent. All remote management activity flows through the administrative server. Both command-line and web browser based administrative clients access the administrative server directly through HTTP or securely through HTTPS.

Web Sever Proxy Plugins enable you to deploy the application server behind one or more web servers housed in a demilitarized zone (DMZ) that is bracketed by one or more layers of firewalls. The plugins provide a means for the front-end web server tier to direct incoming HTTP/S traffic received from the internet to one or more application servers housed in a backend application server tier.

A variety of client applications can access business services deployed to the application server. Web services and browser-based clients can use either HTTP or HTTPS to access the Java Web Services and J2EE web applications. Java application clients can be deployed in a standalone mode or within a standard Application Client Container. They can use Java Remote Method Invocation over Internet Inter-ORB Protocol Technology (Java RMI-IIOP Technology) to access EJBs deployed to the application server. C++ language clients can use Java IDL/IIOP to access EJBs as well.

The basic component of Sun ONE Application server is the `appservd` process which is managed by a watchdog process. The Application code runs in the multi-threaded process created by the `appservd` process. The Java Virtual Machine (VM) is also started within the `appservd`.

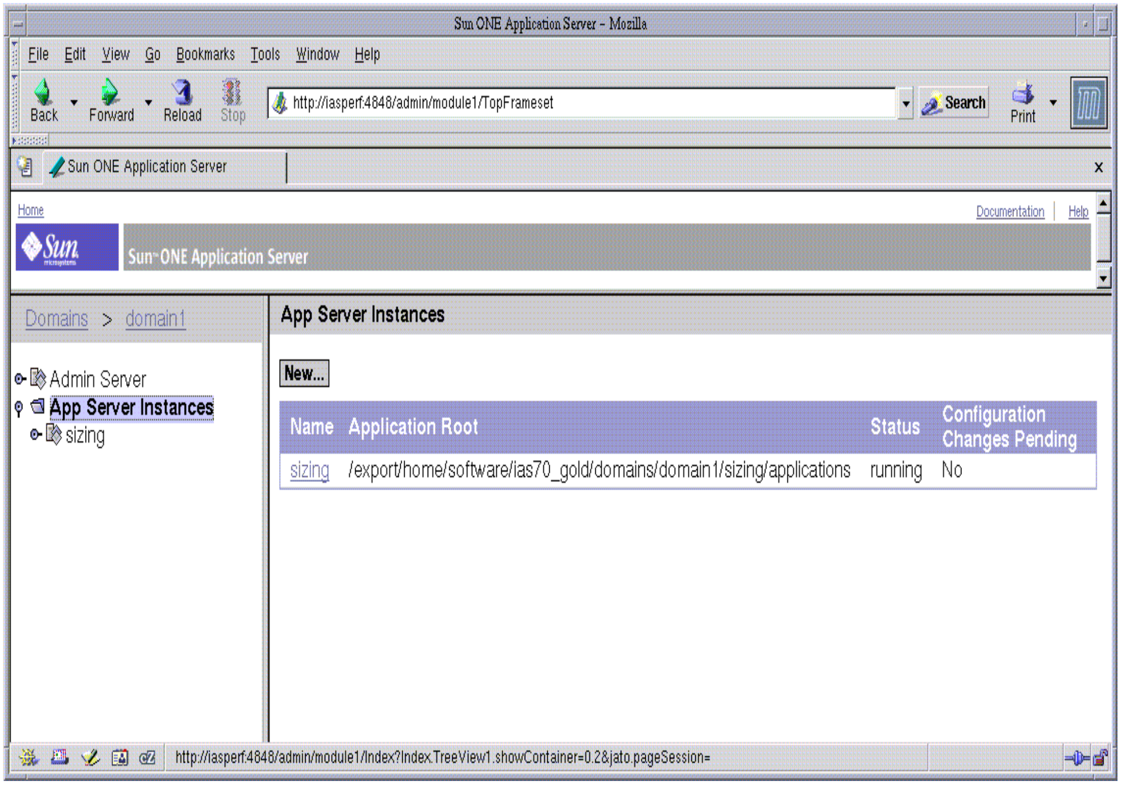
The system is managed through the Administration Server. There is also a facility available to configure a web server installed on a separate system to act as a proxy and forward the requests to the application server instance.

Server Tools

The Sun ONE Application Server provides two tools for administering and deploying applications to the application server. The Administration interface is available as a web-based tool. Additionally, there is a command line interface (CLI) to administer the server through the command-line. Both the web-based tool and the CLI provide all the administration capabilities.

Sun ONE Studio 4, when configured with the Sun ONE Application Server, provides application assembly and deployment capabilities.

Server Administration Interface

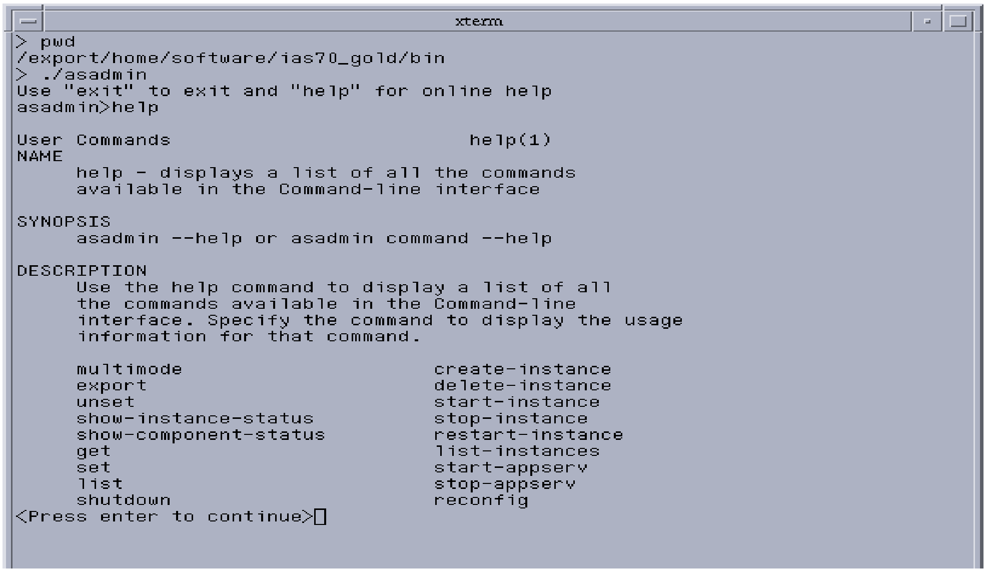

Sun ONE Application Server - Mozilla
File Edit View Go Bookmarks Tools Window Help
Back
Forward
Reload
Stop
http://iasperf:4848/admin/module1/TopFrameset
Search
Print
Sun ONE Application Server
Home
Documentation
Help
Sun ONE Application Server
Domains > domain1
Admin Server
App Server Instances
sizing
App Server Instances
New...
http://iasperf:4848/admin/module1/Index?Index.TreeView1.showContainer=0.2&jato.pageSession=

Name	Application Root	Status	Configuration Changes Pending
sizing	/export/home/software/ias70_gold/domains/domain1/sizing/applications	running	No

Figure 1-2 Sun ONE Application Server Administration interface

The Sun ONE Application Server Administration interface, as shown in the above figure, runs as a web application deployed in the administration server instance and can be accessed from anywhere using a browser. This allows the user to configure the application server instance.

As shown in the following figure, the Administration server can also be accessed through the Command-line interface (CLI). The CLI allows the user to configure the application server instance through the command-line instead of through the web-based interface.



```
> pwd
/export/home/software/ias70_gold/bin
> ./asadmin
Use "exit" to exit and "help" for online help
asadmin>help

User Commands                                help(1)
NAME
     help - displays a list of all the commands
     available in the Command-line interface

SYNOPSIS
     asadmin --help or asadmin command --help

DESCRIPTION
     Use the help command to display a list of all
     the commands available in the Command-line
     interface. Specify the command to display the usage
     information for that command.

     multimode                      create-instance
     export                         delete-instance
     unset                          start-instance
     show-instance-status           stop-instance
     show-component-status          restart-instance
     get                            list-instances
     set                            start-appserv
     list                           stop-appserv
     shutdown                       reconfig
<Press enter to continue>
```

Figure 1-3 Command-line interface for the Sun ONE Application Server

This chapters guide discusses how to use the Sun ONE Application Server Administration interface to tune server processes and application deployment descriptors to enhance performance. Refer to the *Sun ONE Application Server 7 Administration Guide* for further details on using the Administration interface.

Sun ONE Studio 4

The Sun ONE Studio 4 Integrated Development Environment (IDE) is used to develop, assemble, and deploy Java 2 Enterprise Edition (J2EE) applications to the Sun ONE Application Server. Within Sun ONE Studio, J2EE application components are archived into modules according to the container that will receive them upon deployment. You can archive these J2EE application components into an EJB JAR module (archived with a .JAR extension), or a Web Application module (archived with a WAR extension). Each module contains a J2EE descriptor and a Sun ONE Application Server specific deployment descriptor saved to XML files. Refer to the *Sun ONE Studio 4 Developer Guide* for further details.

When using Sun ONE Studio with the Sun ONE Application Server, enterprise developers benefit from many features that combine to give seamless integration between the IDE and the application server:

Table 1-1 Seamless Integration between Sun ONE Studio and the Sun ONE Application Server

Studio Feature	Sun ONE Application Server Extension
CMP Mapping	Developers can browse database tables, select related tables and automatically generate Container Managed Persistence (CMP) EJBs.
Server Runtime Control	Developers can easily register both local and remote application servers and start and stop application server instances.
Resource Configuration	Before deploying applications, developers can register J2EE resources in any of the registered application servers. JDBC resources and connection pools, JMS resources, and a variety of other resources can be configured from within the Studio
Application Deployment	Developers can select from the list of registered application servers and leverage the dynamic ("hot") deployment and redeployment features supported in Sun ONE Application Server 7.
Debugging and Log Viewing	Debugging against deployed applications on both local and remote application server instances is simple. No manual configuration of the application servers is necessary. While debugging their applications, developers can also view the server event log files from within the Studio.

Chapter 2

About Sun ONE Application Server Performance

In this chapter, the following topics are discussed:

Why Tune Application Server?

Performance can be significantly enhanced by adjusting a few deployment descriptor settings or server configuration file modifications. However, it is important to understand the environment and performance goals. An optimal configuration for a production environment may not necessarily be optimal for a development environment. This guide helps you to understand the tuning and sizing options available, providing you the capabilities and practices to obtain the best performance out of your Sun ONE Application Server.

The process architecture of Sun ONE Application Server is represented in the following figure:

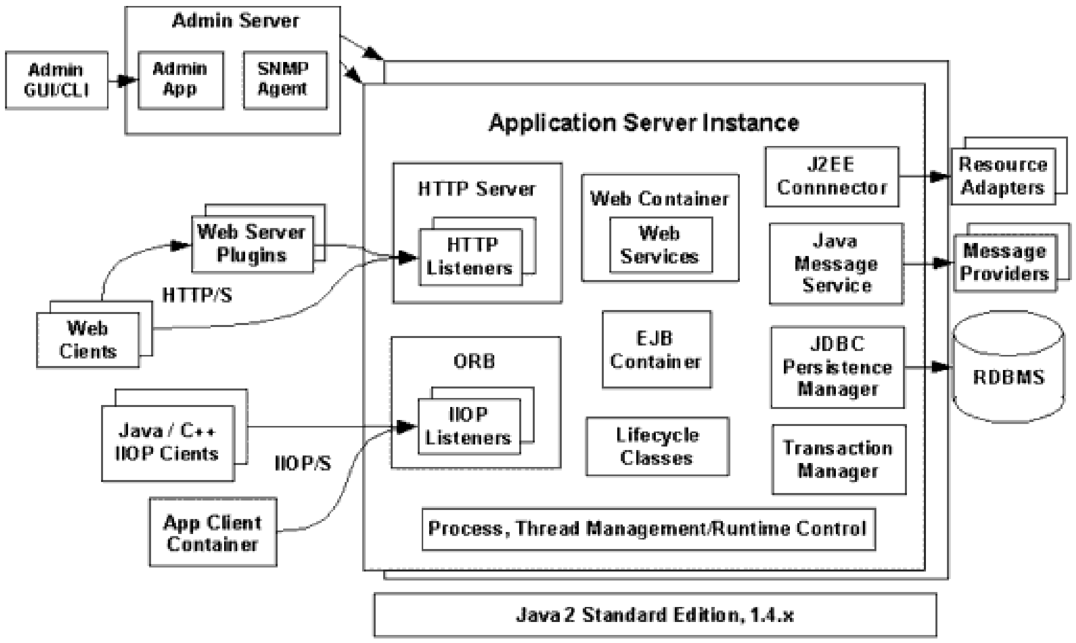


Figure 2-1 Sun ONE Application Server Process Architecture for a Single Domain

Understanding Operational Requirements

Before you begin to deploy and tune your application on the Sun ONE application Server, it is important to clearly define the operational environment. The operational environment is determined by high-level constraints and requirements such as:

- Application Architecture
- Security Requirements
- Application Usage
- Hardware Resources
- Administration

Application Architecture

The J2EE Application model, as shown in the following figure, is very flexible; allowing the application architect to split application logic functionally into many tiers. The presentation layer is typically implemented using servlets and JSPs and executes in the web container.

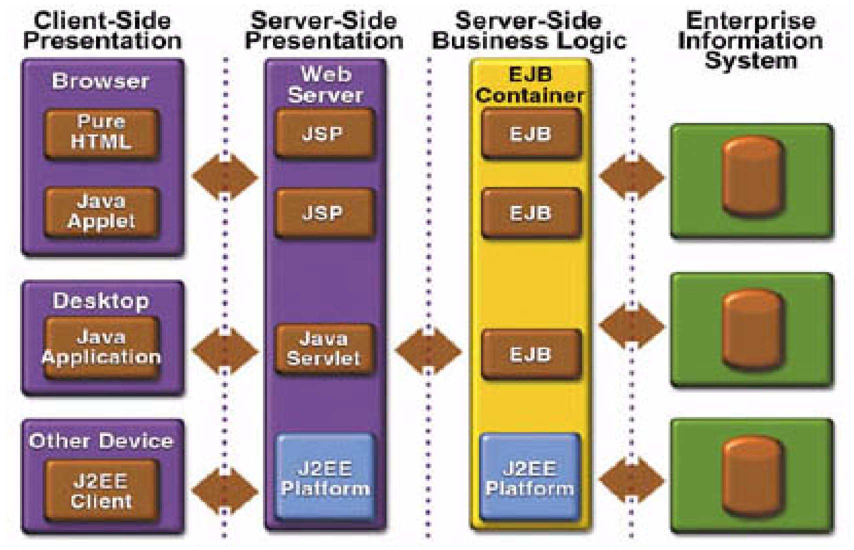


Figure 2-2 J2EE Application Model

It is not uncommon to see moderately complex enterprise applications developed entirely using Servlets and JSPs. More complex business applications are often implemented using EJBs. The Sun ONE Application Server integrates the web and EJB containers, in a single process. Local access to EJBs from Servlets is very efficient. However, some application deployment may require EJBs to execute in a separate process; and be accessible from standalone client applications as well as servlets. Based on the application architecture, the server administrator can employ Sun ONE Application Server in multiple tiers, or simply host both the presentation and business logic on a single tier.

It is important that the server administrator understand the application architecture before designing a new application server deployment, or while deploying a new business application to an existing application server deployment.

Security Requirements

Most business applications require security. The various security considerations and available choices are discussed in this section.

User Authentication and Authorization

Application users must be authenticated. Sun ONE Application Server provides three different choices for user authentication.

The default file based security realm is suitable for developer environments, where new applications are being developed and tested. At deployment time, the server administrator can choose between the LDAP or Unix security realms.

LDAP stands for Lighweight Directory Access Protocol. Many large enterprises use LDAP based directory servers to maintain employee and customer profiles.

Small to medium enterprises that do not already use a directory server, may also find that it is advantageous to leverage their investment in Solaris security infrastructure.

More information on how to integrate with various security realms, can be found in the *Sun ONE Application Server Administrator's Guide to Security*.

The type of authentication mechanism chosen may require additional hardware for the deployment. Typically a Directory server executes on a separate server, and may also require, a backup for replication and high availability. Refer to Sun ONE Directory Server documentation for more information on deployment, sizing, and availability guidelines.

An authenticated user's access to various application functions may also need authorization checks. If the application uses the role based J2EE authorization checks, some additional checking is performed by the application server. This places additional overheads, which need to be accounted for while doing capacity planning.

Encryption

For security reasons, sensitive user inputs and application output must be transmitted in an encrypted form. Most business oriented web applications encrypt all or some of the communication flow between the browser and Application server, if required. Online shopping applications, typically do not encrypt traffic, except when the user is completing a purchase or supplying private data. Portal applications such as news and media typically do not employ encryption. SSL is the most common security framework on internet, and is supported by many browsers and application servers.

Sun ONE Application Server supports SSL 2.0 and 3.0 and contains software support for various cipher suites. It also supports integration of hardware encryption cards for even higher performance. Security considerations, particularly when using the integrated software encryption, will impact hardware sizing and capacity planning. While considering the encryption needs for a deployment, the administrator needs to consider the following:

- What is the nature of the applications, with respect to security? Do they encrypt all or only a part of the application inputs and output? What is the percentage of information that needs to be securely transmitted?
- Are the applications going to be deployed on an application server that is directly connected to the internet? Will a Web server exist in a demilitarized zone (DMZ) separate from the application server tier and backend enterprise systems? A DMZ style deployment is recommended when the deployment has high security requirements. It is also useful when the application has a significant amount of static text and image content (which need not be encrypted in most cases and is served from the web server deployed in DMZ) and has a small but significant amount of business logic which executes on the Application server, behind the most secure firewall. Secure reverse proxy plugins are supplied with Sun ONE Application Server to enable popular web servers to integrate with Sun ONE Application Server. Since Sun ONE Application Server is also a full fledged web server, it can be deployed and used as a web server in DMZ.
- Is encryption required between the Web servers in the DMZ and application servers in the next tier? The Reverse Proxy Plugins supplied with Sun ONE Application Server support SSL encryption between the web server and application server tier. If this is enabled the administrator needs to perform hardware capacity planning based on the encryption policy and mechanisms.
- If software encryption is to be employed, what is the expected performance overhead, at every tier in the system, given the security requirements.
- If hardware encryption is to be employed, what are the performance and throughput characteristics of various choices?

NOTE For information on how to encrypt the communication between Web servers and Sun ONE Application Server, please refer to *Sun ONE Application Server Administrator's Guide*.

Application Usage

Every application user will have some expectations with respect to application performance. Often they can be numerically quantified. The server administrator must understand these expectations clearly, and use them in capacity planning to ensure that the deployment will meet customer needs, when completed.

With regard to performance, you need to consider the following:

- What are the required average response times expected by the end users for various interactions with the application? What are the most frequent interactions? Are there any extremely time critical interactions? What is the length of each transaction, including think time? In many cases, empirical user studies may need to be performed to come up with good estimates.
- What are the anticipated steady state and peak user loads? Are there are any particular times of the day, week or year when load peaks are observed? While there may be several million registered customers for an online business, typically only a fraction of them are logged in and performing business transactions, at any point in time. A common mistake during capacity planning is to use the total size of customer population as the basis and not the average and peak numbers for concurrent users. The number of concurrent users, also may exhibit interesting time based patterns.
- What is the average and peak amount of data transferred per request? This is also very application specific. Good estimates for content size, combined with other usage patterns, will help the administrator anticipate network capacity needs.
- What is the expected growth in user load over the next 12 months? Planning ahead for the future, will help avoid crisis situations and system downtimes for upgrades.

Hardware Resources

The type and quantity of hardware resources at the disposal of the administrator greatly influence performance tuning and site planning.

Sun ONE Application Server provides excellent vertical scalability. It can scale to efficiently utilize up to 12 high performance CPUs, using just one application server process. The smaller number of application server instances provides ease of maintenance and lowered administration costs. Also, deploying several related applications on fewer application servers, can lead of performance improvements, due to better data locality, and reuse of cached data between collocated applications.Such servers must also contain large amounts of memory, disk and network capacity in order to cope with increased load.

Sun ONE Application Server can also be deployed on large “farms” of smaller hardware units. Business Applications can be partitioned across various server instances. By employing one or more external load balancers, user access can be efficiently spread across all the application server instances. A horizontal scaling approach may improve availability, lower hardware costs and is certainly suitable for certain types of applications. However, greater number of application server instances and hardware nodes need to be administered

Administration

A single Sun ONE Application Server installation on a server can be used to created several instances. One or more instances are administered by a single Administration Server, and this grouping of the Administration server and administered instances is called a “Domain.” Several administrative domains can be created to permit different people to independently administer groups of application server instances.

A single instance domain may be created to create a “sandbox” for a particular developer in a developer environment. In this scenario, each developer administers his/her own application server, without interfering with other application server domains. A small development group may choose to create multiple instances in a shared administrative domain, for collaborative development.

In a deployment environment, the server administrator could create administrative domains based on application and business function. For example, internal Human Resources applications may be hosted on one or more servers in one Administrative domain, while external customer applications are hosted on several administrative domains, in a server farm.

Sun ONE Application Server supports Virtual Server capability for web applications. A web application hosting service provider, may wish to host different URL domains on a single Sun ONE Application Server process, for efficient administration. The server administrator must determine, if they need to or want to use this capability.

At this point, the server administrator should be able to list all the applications, and their broad performance characteristics, security requirements and sketch the deployment environment, at a high level. The next step is to understand how to predict performance and do capacity planning.

Capacity Planning

The previous discussion guides the administrator towards defining a preferred deployment architecture. However, the actual size of the deployment is determined by a process called capacity planning.

How does one predict either the capacity of a given hardware configuration or predict the hardware resources required to sustain a specified application load and customer criteria? This is done by a careful performance benchmarking process, using the real application and with realistic data sets and workload simulation.The basic steps are briefly described below.

1. Determine performance on a single CPU

   You need to first determine the largest load that can be sustained with a known amount of processing power. You can obtain this figure by measuring the performance of the application on a uniprocessor machine. You can either leverage the performance numbers of an existing application with similar processing characteristics or, ideally, use the actual application and workload, in a testing environment. Make sure that the application and data resources are configured in a tiered manner, exactly as they would be in the final deployment.

2. Determine vertical scalability

   You need to know exactly how much additional performance is gained when you add processors. That is, you are indirectly measuring the amount of shared resource contention that occurs on the server for a specific workload. You can either obtain this information based on additional load testing of the application on a multiprocessor system, or leverage existing information from a similar application that has already been load tested. Running a series of performance tests on one to eight CPUs, in incremental steps, generally provides a sense of the vertical scalability characteristics of the system. Make sure that the application, application server and backend database resources, operating system etc., are properly tuned so that they not skew the results of this study.

3. Determined horizontal scalability

   If sufficiently powerful hardware resources are available, a single hardware node may meet the performance requirements. However for better service availability, two or more systems may be clustered. Employing an external load balancers and workload simulation, determine the performance benefits of replicating one well tuned application server node, as determined in step (2).

The following table describes the steps in capacity planning:

Table 2-1 Factors That Affect Performance - Applying Concepts

Concept	Applying the Concept	Measurement	Value Sources
User Load	Concurrent Sessions at Peak Load	Transactions Per Minute (TPM) Web Interactions Per Second (WIPS)	((Number of Concurrent Users at Peak Load) * Expected Response Time) / (Time between clicks) For example, (100 Concurrent Users * 2 seconds Response Time) / (10 seconds between clicks) = 20.

Table 2-1 Factors That Affect Performance - Applying Concepts *(Continued)*

Application Scalability	Transaction Rate measured on one CPU	TPM or WIPS	Measured from workload benchmark. Needs to be performed at each tier.
	Scalability within a server (additional performance for additional CPU)	Percentage gain per additional CPU	Based on curve fitting from benchmark. Perform tests while gradually increasing the number of CPUs. Identify the “knee” of the curve, where additional CPUs are providing uneconomical gains in performance. Requires tuning as described in later chapters of this guide. Needs to be performed at each tier and iterated if necessary. Stop here if this meets performance requirements.
	Scalability within a cluster (additional performance for additional server)	Percentage gain per additional server process and/or hardware node.	Use a well tuned single application server instance, as in previous step. Measure how much each additional server instance and/or hardware node improves performance.
Safety Margins	High Availability Requirements.	If system should cope with failures, size the system to meet performance requirements assuming that one or more application server instances are non functional	Different equations used if High Availability is required.
	Slack for unexpected peaks	It is desirable to operate a server at less than its benchmarked peak, for some safety margin	80% system capacity utilization at peak loads, may work for most installations. Measure your deployment under real and simulated peak loads.

Performance Tuning Sequence

Tuning a deployment may be performed in the following sequence:

- Tuning Your Application
- Tuning Sun ONE Application Server
- Tuning the Java Runtime System
- Tuning Operating System

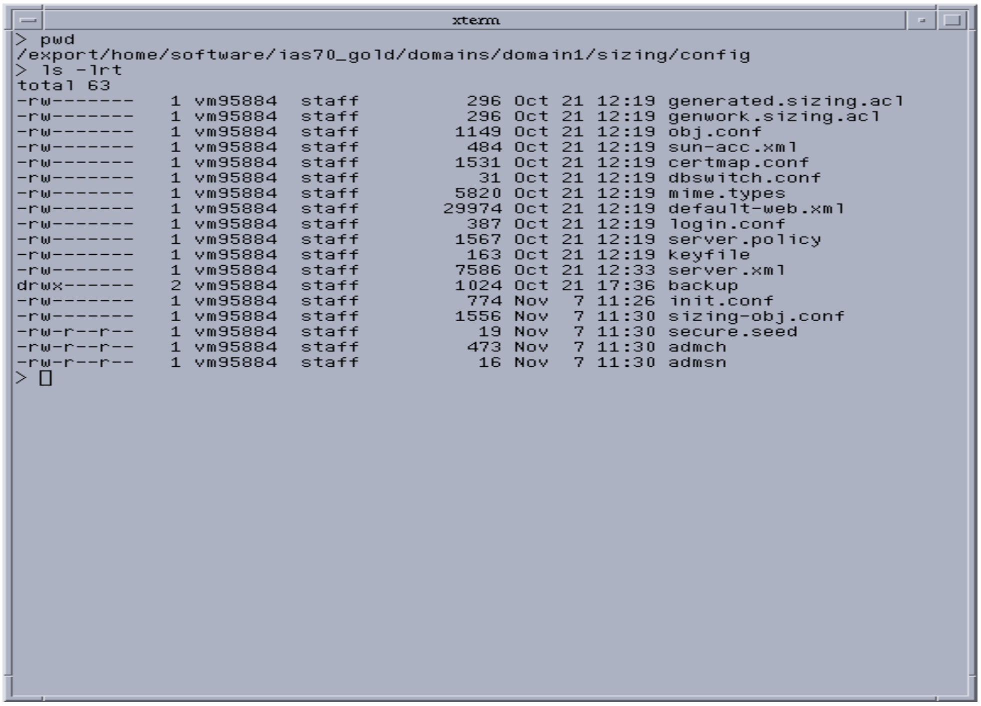
Configuration Files

The files `init.conf`, `obj.conf`, and `server.xml` are Sun ONE Application Server configuration files containing many attributes that can be modified to improve performance. They are frequently mentioned within this guide and can be found in the directory:

```
<APPSERVER_HOME>/appserv/domains/<DOMAIN_NAME>/<SERVER_NAME>/con
fig/
```

`APPSERVER_HOME` is the installation directory for the Sun ONE Application Server. `DOMAIN_NAME` and `SERVER_NAME` refer to the domain and server names for the server instance to be configured.

The following figure shows the configuration file for a given instance.



```
> pwd
/export/home/software/ias70_gold/domains/domain1/sizing/config
> ls -lrt
total 63
-rw-------   1 vm95884  staff         296 Oct 21 12:19 generated.sizing.acl
-rw-------   1 vm95884  staff         296 Oct 21 12:19 genwork.sizing.acl
-rw-------   1 vm95884  staff        1149 Oct 21 12:19 obj.conf
-rw-------   1 vm95884  staff         484 Oct 21 12:19 sun-acc.xml
-rw-------   1 vm95884  staff        1531 Oct 21 12:19 certmap.conf
-rw-------   1 vm95884  staff          31 Oct 21 12:19 dbswitch.conf
-rw-------   1 vm95884  staff        5820 Oct 21 12:19 mime.types
-rw-------   1 vm95884  staff       29974 Oct 21 12:19 default-web.xml
-rw-------   1 vm95884  staff         387 Oct 21 12:19 login.conf
-rw-------   1 vm95884  staff        1567 Oct 21 12:19 server.policy
-rw-------   1 vm95884  staff         163 Oct 21 12:19 keyfile
-rw-------   1 vm95884  staff        7586 Oct 21 12:33 server.xml
drwx------   2 vm95884  staff        1024 Oct 21 17:36 backup
-rw-------   1 vm95884  staff         774 Nov  7 11:26 init.conf
-rw-------   1 vm95884  staff        1556 Nov  7 11:30 sizing-obj.conf
-rw-r--r--   1 vm95884  staff          19 Nov  7 11:30 secure.seed
-rw-r--r--   1 vm95884  staff         473 Nov  7 11:30 admch
-rw-r--r--   1 vm95884  staff          16 Nov  7 11:30 admsn
> 
```

Figure 2-3 Sun ONE Application Server Configuration Files

The `config/backup` directories contain a replica of the server configuration files. These files are created by the administration server instance. In general, users should not change these files by hand. If the `config` files are edited by hand, make a copy of the files and place them in the `backup` directory. Additionally, the server instance should be restarted.

Logging and Performance

The Sun ONE Application Server produces log messages and exception stack trace output that gets written to the log file. These log messages and exception stacks can be found in the `logs` directory of the instance. Naturally, the volume of log activity can impact server performance; particularly in benchmarking situations.

By default, the log level is set to INFO. The log level can be set for all the server subsystems by changing the attribute level in the log_service element. You can override the logging level by adjusting it at a particular subsystem. For example, mdb_container can produce log messages at a different lever than server default by adjusting the log_level attribute under the mdb_container element. To get more debug messages, set the log level to FINE, FINER, or FINEST. Under benchmarking conditions, it may be appropriate to set the log level to SEVERE.

Chapter 3

Tuning Your Application

The following sections provide a comprehensive guide to tuning your applications for maximum performance. A complete guide to writing high performance Java and J2EE applications is beyond the scope of this document.

The following topics are discussed in this chapter:

- Java Programming Guidelines
- J2EE Programming Guidelines

Java Programming Guidelines

This section covers issues related to Java coding and performance. The guidelines outlined are not specific to Sun ONE Application Server, but are general rules that are useful in many situations. For a complete discussion of Java coding best practices, refer to the Java BluePrints at
http://java.sun.com/blueprints/performance/index.html.

- Avoid serialization and deserialization, if possible

  In Java, serialization and deserialization of objects is a CPU-intensive procedure and is likely to slow down your application. Use the `transient` keyword to reduce the amount of data serialized. Customized `readObject()` and `writeObject()` methods may be beneficial, in some cases.

- Use `StringBuffer.append()` instead of the "+" operator

  In Java, Strings are immutable — they never change after creation. For example, the following sequence

  ```
  String str = "testing";

  str = str + "abc";
  ```

is understood by the compiler as:

```
String str = "testing";

StringBuffer tmp = new StringBuffer(str);

tmp.append("abc");

str = tmp.toString();
```

Therefore, copying is inherently expensive and can become a significant factor in hindering performance in case it is overused. Instead, the use of `StringBuffer.append()` is recommended.

- Explicitly assign a null value to variables which are no longer needed

  Doing this helps the garbage collector to easily identify the parts of memory that can be safely reclaimed. While Java automates memory management, it does not prevent usage of excessive amounts of memory or memory leaks. An application may induce memory leaks by holding on to objects without releasing references. This prevents the Java garbage collector from reclaiming those objects, and results in increasing amounts of memory being used. Explicitly nullifying references to unnecessary variables, after each transaction, allows the garbage collector to reclaim memory. One way to detect memory leaks is to employ profiling tools and take memory snapshots after each transaction. A memory leak free application, in steady state, will show a steady active heap memory, after garbage collections.

- Only when necessary, declare methods as `final`. Modern optimizing dynamic compilers can perform inlining and other inter-procedural optimizations, even if Java methods are not`final`. Use the keyword as it was originally intended i.e., for program architecture and maintainability reasons. If you are absolutely certain that a method must not be overridden, use the `final` keyword.
- Use `static final` when declaring constants. The dynamic compiler can perform some constant folding optimizations easily, when the hint is provided.
- Adding finalizers to your code makes the garbage collector more expensive and unpredictable. The virtual machine does not guarantee the time at which finalizers are run. Finalizers may not always be executed, before the program exits. Releasing critical resources in `finalize()` methods may lead to unpredictable application behavior.
- Declare method arguments `final` if they are not modified in the method. In general, declare all variables `final` if they are not modified after being initialized or set to some value.

- Don't synchronize code blocks or methods unless synchronization is required. Keep synchronized blocks or methods as short as possible to avoid scalability bottlenecks. Use the Java Collections Framework for unsynchronized data structures instead of more expensive alternatives such as`java.util.HashTable`.

J2EE Programming Guidelines

The J2EE model defines a framework for enterprise application development. It defines containers for the basic software components (JSPs, servlets and EJBs) and container services (JAAS, JDBC, JNDI, and JTA for example). While all parts of the J2EE model have their uses, the following sections discuss issues to keep in mind while designing the application architecture.

Servlet and JSP Programming Guidelines

Many applications running on the Sun ONE Application Server are serviced by JSPs or servlets in the presentation tier. Servlets and JSPs are entry points to EJBs, on which more complex transactional business logic is implemented. It is not uncommon to see moderately complex transactional business applications coded entirely using Servlets and other J2EE APIs.

- In the case of the servlet multithread model which is the default model, a single instance of a servlet is created for each application server instance. All requests for a servlet on that application instance share the same servlet instance. This can lead to thread contention, if there are synchronization blocks in the servlet code. So, the use of shared modified class variables should be avoided as it creates the need for synchronization.
- Session creation is not for free. If a session is not required do not create one. Invalidate sessions when they are no longer needed.
- Use the directive `<%page session="false"%>` to prevent HTTP Sessions from being automatically created when they are not necessary in JSPs.
- Do not store large objects graphs inside an `HttpSession.` This forces Java serialization and adds computational overhead.

- Note that `HttpSession` access is not transactional. Do not use it as a cache of transactional data, which is typically kept in the database and accessed using Entity beans. Transactions will rollback, upon failures, to their original state. However, stale and inaccurate data may remain in `HttpSession` objects. Sun ONE Application Server provides "read-only" bean managed persistence entity beans for more cached access to read only data.

EJB Programming Guidelines

The following guidelines can improve performance of EJB components in J2EE Applications. For more information, see *Sun ONE Application Server Developer's Guide to Enterprise Java Beans Technology*.

- To avoid a JNDI lookup for every request, cache EJB references at the servlet.
- Cache the EJBHomes in the servlet's `init()` method. Repeated lookups to an often use home interface and can be expensive.
- Use the `setSessionContext()` or `ejbCreate()` method to cache bean specific resources. This is again an example of using bean lifecycle methods to perform application actions, only once, where possible. Do not forget to place code to release acquired resources in the `ejbRemove()` method.
- Reduce the database transaction isolation level when appropriate. Reduced isolation levels reduce work in the database tier, and could lead to better application performance. However, this must be done after carefully analyzing the database table usage patterns. Sun ONE Application Server allows database isolation level to be set under `<jdbc-connection-pool>` in server configuration file. For more details on server configuration see the *Sun ONE Application Server Administrators Guide* and the *Sun ONE Application Server Administrator's Configuration File Reference*.
- The Sun ONE Application Server ORB provides a mechanism for optimizing calls made from clients which are co-hosted in the same Java Virtual Machine as the server. For example, a servlet code calls an Enterprise Java Bean or one Enterprise Java Bean calling another enterprise bean located on the same server instance. When the servlets and EJB's are running in the same Java virtual machine, run the `rmic` compiler *without* the `-nolocalstubs` flag. This is the default setting i.e `-nolocalstubs` does not appear in the server configuration file.

If the application architecture is such that EJBs are hosted on a remote Application Server, the default behavior must be changed. This can be done via the administration command-line interface `asadmin`, on the server instance where the application is going to be deployed. The `rmic` options appear under the JVM Settings tab of the browser based administration interface. Use of local stubs gives significant performance enhancements and is the default behavior of the stub generator.

- If the application developer is sure about the access paths to the underlying data, then the beans can be configured to use *pass by reference*. This avoids argument copying on method invocations and result copying on method return. However, problems will arise if the data is modified by another source, during the invocation. This value can be set in the `sun-ejb-jar.xml` deployment descriptor as follows: `<pass-by-reference>true</pass-by-reference>`, on a per EJB granularity.
- Remove Stateful session beans when they are no longer needed. This avoids passivation of the Stateful Session beans, and disk I/O operations.

EJB types are listed below, from the highest performance to the lowest:

- Stateless Session Beans and Message Driven Beans
- Stateful Session Beans
- Entity Beans, with bean managed persistence, configured as read only
- Entity Beans with Container Managed Persistence (CMP)
- Entity Beans with Bean Managed Persistence (BMP)

EJB Pool and Cache

Both *stateless* session beans and *entity* beans can be pooled to improve server performance. In addition, both *stateful* session beans and *entity* beans can be cached to improve performance.

Table 3-1 Bean Type Pooling or Cacheing

Bean Type	Pooled	Cached
Stateless Session	Yes	No
Stateful Session	No	Yes
Entity	Yes	Yes

The difference between a pooled bean and a cached bean is that pooled beans are all equivalent and indistinguishable from one another. Cached beans, on the contrary, contain conversational state in the case of Stateful Session beans, and are associated with a primary key in the case of Entity beans. Entity beans are removed from the pool and added to the cache on `ejbActivate()` and removed from the cache and added to the pool on `ejbPassivate()`. `ejbActivate()` is called by the container when a needed Entity bean is not in the cache. `ejbPassivate()` is called by the container when the cache grows beyond its configured limits.

Here are some steps you can take when tuning the EJB pool and cache settings:

- The EJB pool is used by Stateless Session and Entity EJBs. Keeping in mind how you use Stateless Session EJBs and the amount of traffic your server handles, tune the pool size to prevent excessive creation and deletion. Refer to the *bean-pool* `sun-ejb-jar.xml` deployment descriptor.
- The Cache is used by Stateful Session EJBs. Keeping in mind how your applications uses Stateful Session EJBs and the amount of traffic your server handles, tune the EJB cache size and time-out settings to minimize the number of activations and passivations. Refer to the *bean-cache* element in the `sun-ejb-jar.xml` deployment descriptor.
- Allow Stateful Session EJB's to be removed from the container cache by explicitly calling of the `remove()` method in the client.
- Entity Beans use both the EJB pool and cache settings. Tune the entity EJB's pool size to minimize the creation and destruction of beans. Prepopulating the pool with a non-zero steady size is useful to get better response for initial requests.
- Use the `setEntityContext()` method to cache bean specific resources and release them from the `unSetEntityContext()` method.
- Use Lazy Loading to avoid unnecessary preloading of child data.
- Configure read-only entity beans for read only operations.

Transactions

Here are some steps you can take when using transactions:

- To avoid resources being held unnecessarily for long periods, a transaction should not encompass user input or user think time.
- Container managed transactions are preferred for consistency, and provide better performance.

- Declare non-transactional methods of session EJB's with '`NotSupported`' or '`Never`' transaction attributes. These attributes can be found in the `ejb-jar.xml` deployment descriptor file. Transactions should span the minimum time possible since they lock database rows.
- For very large transaction chains, use the transaction attribute `TX_REQUIRED.` To ensure EJB methods in a call chain, use the same transaction.
- Use the lowest cost locking available from the database that is consistent with any transaction. Commit the data after the transaction completes rather than after each method call.
- When multiple database resources, connector resources and/or JMS resources are involved in one transaction, a distributed or global transaction needs to be performed. This requires XA capable resource managers and data sources. Use XA capable data sources, only when two or more data source are going to be involved in a transaction. If a database participates in some distributed transactions, but mostly in local or single database transactions, it is advisable to register two `<jdbc-resource>` elements in server configuration file and use the appropriate resource in the application.

JDBC and Database Access

Here are some steps you can take when tuning the JDBC Connection Pool:

- When dealing with large amounts of data, such as searching a large database, use JDBC directly rather than using Entity EJB's.
- Combine business logic with the Entity EJB that holds the data needed for that logic to process.
- To ensure that connections are returned to the pool, always close the connections after use.

JMS

Here are some steps you can take when using JMS:

- Tune the Message-Driven EJB's pool size to optimize the concurrent processing of messages.
- Use the `setMesssageDrivenContext()` or `ejbCreate()` method to cache bean specific resources, and release those resources from the `ejbRemove()` method.

NOTE Keep in mind that decomposing an application into a moderate to large number of separate EJBs can create an application performance degradation and more overhead. EJBs, unlike JavaBeans, are not simply Java objects. EJBs are higher level entities than Java objects. They are components with remote call interface semantics, security semantics, transaction semantics, and properties.

References

- For details on performance guidelines regarding Java, see

  http://java.sun.com/blueprints/performance/index.html

- For details on optimizing EJB's, see

  http://developer.java.sun.com/developer/technicalArticles/ebeans/sevenrules/

Chapter 4

Tuning Sun ONE Application Server

This chapter describes some ways to tune the Sun ONE Application Server for optimum performance. It is separated into the following sections:

- HTTP Server Tuning
- Connection Pool Tuning
- JSP and Servlet Tuning
- Performance Tuning for EJBs
- Performance Considerations for Various Types of EJBs
- ORB Tuning
- Related Considerations
- Tuning the Transaction Manager

HTTP Server Tuning

Monitoring and tuning the HTTP server instances that handle client requests are important parts of ensuring peak Sun ONE Application Server performance. This section covers the following topics related to HTTP Server Tuning:

- Enabling Statistics with stats-xml
- Monitoring Current Activity Using the perfdump Utility
- Using Statistics to Tune Your Server
- Busy Functions
- Using Performance Buckets

- Configuring the File Cache
- Tuning the ACL User Cache
- Using Quality of Service
- Threads, Processes, and Connections
- Improving Java Performance
- Miscellaneous init.conf Directives
- Miscellaneous obj.conf Parameters
- Scaling Your Server

Enabling Statistics with stats-xml

Users must enable statistics with `stats-xml` when they wish to use existing monitoring tools like `perfdump` or create similar customized tools.

To enable the statistics using `stats-xml`, follow these steps:

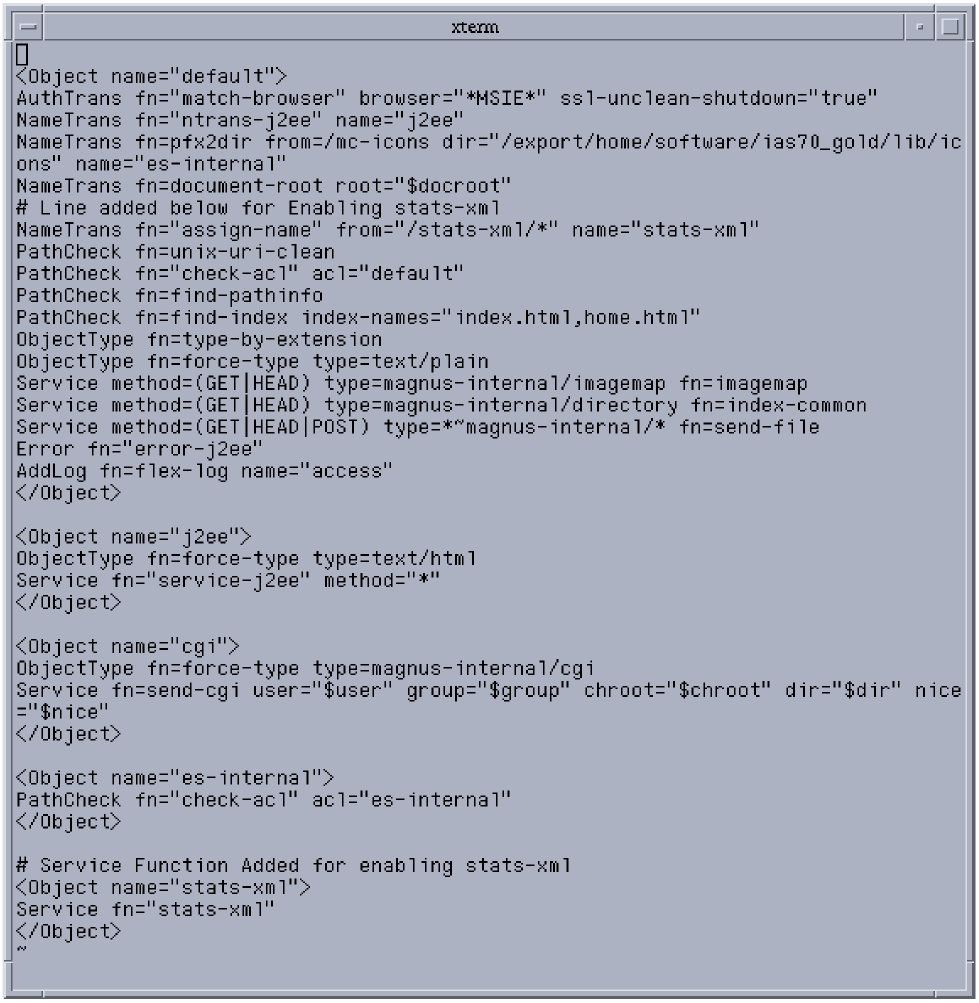
1. Under the default object in `obj.conf`, add the following line:

   ```
   NameTrans fn="assign-name" from="/stats-xml/*" name="stats-xml"
   ```

2. Add the following Service function to `obj.conf`:

   ```
   <Object name="stats-xml">
   Service fn="stats-xml"
   </Object>
   ```

   The following figure shows a sample `init.conf` which has `stats-init` Server Application Function (SAF) included.



```
<Object name="default">
AuthTrans fn="match-browser" browser="*MSIE*" ssl-unclean-shutdown="true"
NameTrans fn="ntrans-j2ee" name="j2ee"
NameTrans fn=pfx2dir from=/mc-icons dir="/export/home/software/ias70_gold/lib/ic
ons" name="es-internal"
NameTrans fn=document-root root="$docroot"
# Line added below for Enabling stats-xml
NameTrans fn="assign-name" from="/stats-xml/*" name="stats-xml"
PathCheck fn=unix-uri-clean
PathCheck fn="check-acl" acl="default"
PathCheck fn=find-pathinfo
PathCheck fn=find-index index-names="index.html,home.html"
ObjectType fn=type-by-extension
ObjectType fn=force-type type=text/plain
Service method=(GET|HEAD) type=magnus-internal/imagemap fn=imagemap
Service method=(GET|HEAD) type=magnus-internal/directory fn=index-common
Service method=(GET|HEAD|POST) type=*~magnus-internal/* fn=send-file
Error fn="error-j2ee"
AddLog fn=flex-log name="access"
</Object>

<Object name="j2ee">
ObjectType fn=force-type type=text/html
Service fn="service-j2ee" method="*"
</Object>

<Object name="cgi">
ObjectType fn=force-type type=magnus-internal/cgi
Service fn=send-cgi user="$user" group="$group" chroot="$chroot" dir="$dir" nice
="$nice"
</Object>

<Object name="es-internal">
PathCheck fn="check-acl" acl="es-internal"
</Object>

# Service Function Added for enabling stats-xml
<Object name="stats-xml">
Service fn="stats-xml"
</Object>
~
```

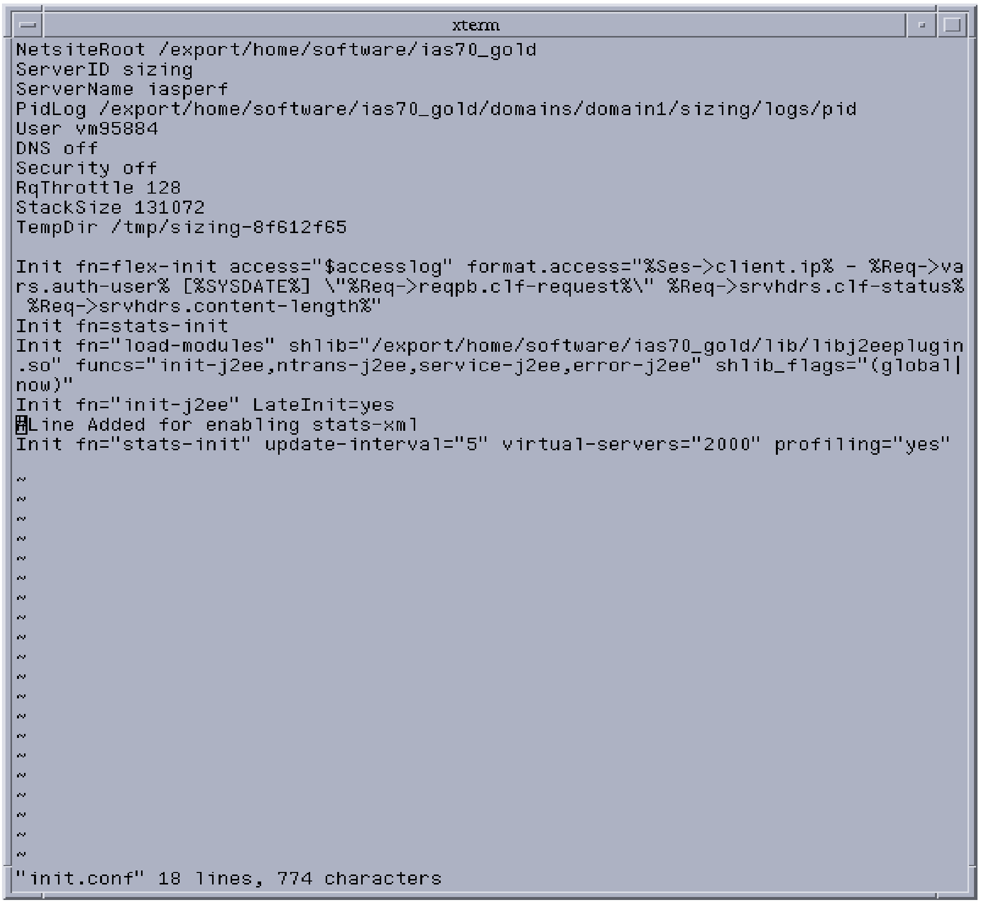
Figure 4-1 `statsxml-obj` in `<instancename>-obj.conf`

3. Add the `stats-init` Server Application Function (SAF) to `init.conf`

Here's an example of `stats-init` in `init.conf`:

```
Init fn="stats-init" update-interval="5" virtual-servers="2000"
profiling="yes"
```

The following figure shows a sample `<instance_name>-obj.conf` file which has `stats-xml` enabled.



xterm

```
NetsiteRoot /export/home/software/ias70_gold
ServerID sizing
ServerName iasperf
PidLog /export/home/software/ias70_gold/domains/domain1/sizing/logs/pid
User vm95884
DNS off
Security off
RqThrottle 128
StackSize 131072
TempDir /tmp/sizing-8f612f65

Init fn=flex-init access="$accesslog" format.access="%Ses->client.ip% - %Req->va
rs.auth-user% [%SYSDATE%] \"%Req->reqpb.clf-request%\" %Req->srvhdrs.clf-status%
 %Req->srvhdrs.content-length%"
Init fn=stats-init
Init fn="load-modules" shlib="/export/home/software/ias70_gold/lib/libj2eeplugin
.so" funcs="init-j2ee,ntrans-j2ee,service-j2ee,error-j2ee" shlib_flags="(global|
now)"
Init fn="init-j2ee" LateInit=yes
#Line Added for enabling stats-xml
Init fn="stats-init" update-interval="5" virtual-servers="2000" profiling="yes"

~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
"init.conf" 18 lines, 774 characters
```

Figure 4-2 Enabling Statistics with `stats-xml`

The above example shows you can also designate the following:

- **update-interval**. The period in seconds between statistics updates. A higher setting (less frequent) will be better for performance. The minimum value is 1; the default value is 5.
- **virtual-servers**. The maximum number of virtual servers for which you track statistics. This number should be set equal to or higher than the number of virtual servers configured. Smaller numbers result in lower memory usage. The minimum value is 1; the default is 1000.

- **profiling**. Enable NSAPI performance profiling. The default is "no" which results in slightly better server performance.

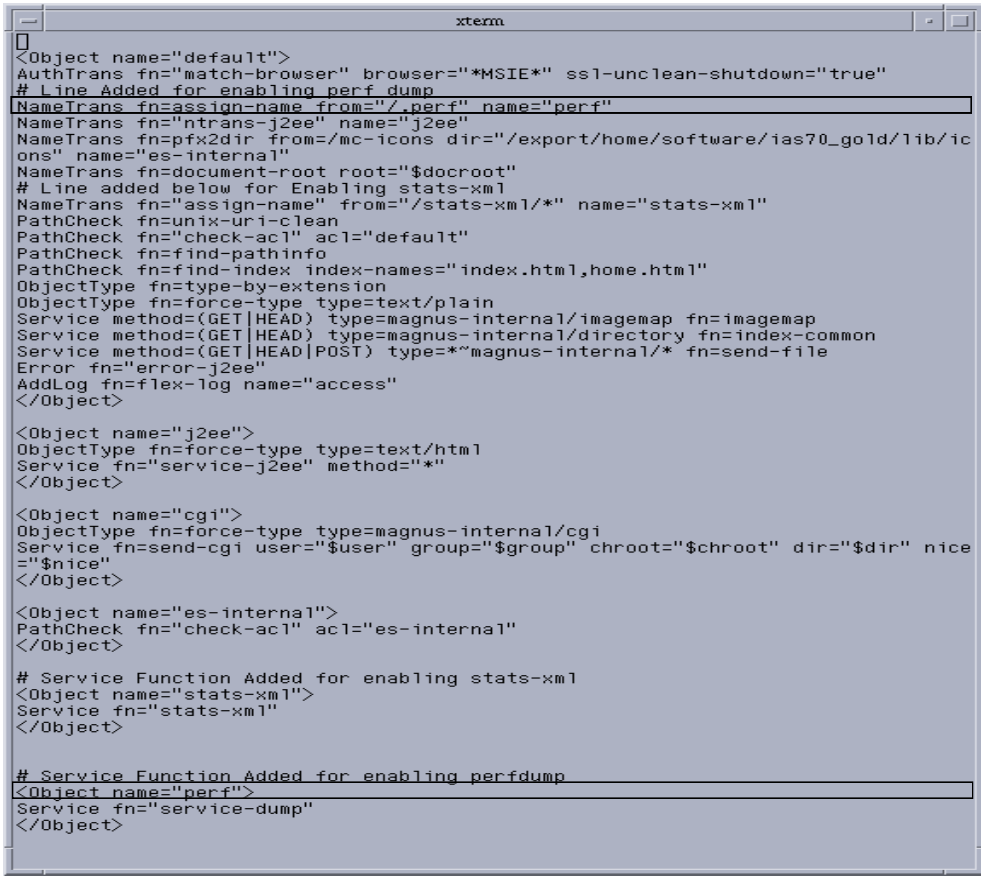
For more information on editing the configuration files, see the *Sun ONE Application Server NSAPI Programmer's Guide*.

Monitoring Current Activity Using the perfdump Utility

The `perfdump` utility is an SAF built into Sun ONE Application Server. It collects various pieces of performance data from the Application Server internal statistics and displays them in ASCII text. The `perfdump` utility allows you to monitor a greater variety of statistics.

Installing the perfdump Utility

The following figure provides a sample of the <instancename>-obj.conf file with the perfdump utility configured.



```
<Object name="default">
AuthTrans fn="match-browser" browser="*MSIE*" ssl-unclean-shutdown="true"
# Line Added for enabling perf dump
NameTrans fn=assign-name from="/.perf" name="perf"
NameTrans fn="ntrans-j2ee" name="j2ee"
NameTrans fn=pfx2dir from=/mc-icons dir="/export/home/software/ias70_gold/lib/ic
ons" name="es-internal"
NameTrans fn=document-root root="$docroot"
# Line added below for Enabling stats-xml
NameTrans fn="assign-name" from="/stats-xml/*" name="stats-xml"
PathCheck fn=unix-uri-clean
PathCheck fn="check-acl" acl="default"
PathCheck fn=find-pathinfo
PathCheck fn=find-index index-names="index.html,home.html"
ObjectType fn=type-by-extension
ObjectType fn=force-type type=text/plain
Service method=(GET|HEAD) type=magnus-internal/imagemap fn=imagemap
Service method=(GET|HEAD) type=magnus-internal/directory fn=index-common
Service method=(GET|HEAD|POST) type=*~magnus-internal/* fn=send-file
Error fn="error-j2ee"
AddLog fn=flex-log name="access"
</Object>

<Object name="j2ee">
ObjectType fn=force-type type=text/html
Service fn="service-j2ee" method="*"
</Object>

<Object name="cgi">
ObjectType fn=force-type type=magnus-internal/cgi
Service fn=send-cgi user="$user" group="$group" chroot="$chroot" dir="$dir" nice
="$nice"
</Object>

<Object name="es-internal">
PathCheck fn="check-acl" acl="es-internal"
</Object>

# Service Function Added for enabling stats-xml
<Object name="stats-xml">
Service fn="stats-xml"
</Object>


# Service Function Added for enabling perfdump
<Object name="perf">
Service fn="service-dump"
</Object>
```

Figure 4-3 Sample `<instance-name>-obj.conf` file with `perfdump` Configured

To install `perfdump`, you need to make the following modifications in `<instancename>-obj.conf` file:

1. Add the following object to your `<instancename>-obj.conf` file after the default object:

```
<Object name="perf">
Service fn="service-dump"
</Object>
```

2. Add the following to the default object:

```
NameTrans fn=assign-name from="/.perf" name="perf"
```

3. If not already enabled, enable `stats-xml`.

   If you need to enable `stats-xml`, see "Enabling Statistics with stats-xml".

4. Restart your server software.

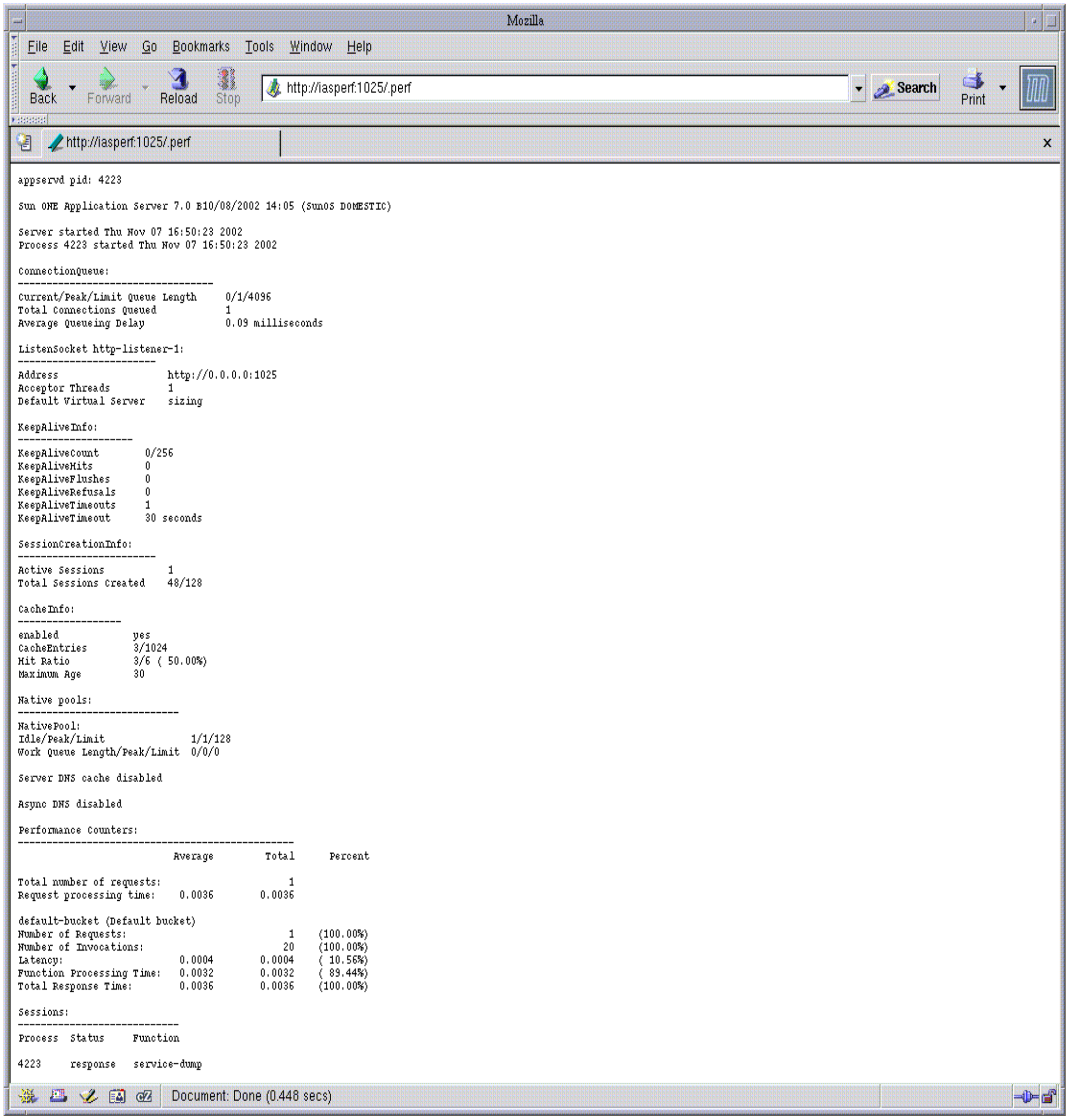
5. Access `perfdump` by entering this URL:

   ```
   http://yourhost/.perf
   ```

6. You can request the `perfdump` statistics and specify how frequently (in seconds) the browser should automatically refresh. This example sets the refresh to every 5 seconds:

   ```
   http://yourhost/.perf?refresh=5
   ```

The following figure shows a sample `perfdump` output.


Mozilla
File Edit View Go Bookmarks Tools Window Help
Back Forward Reload Stop
http://iasperf:1025/.perf
Search
Print
http://iasperf:1025/.perf
Document: Done (0.448 secs)

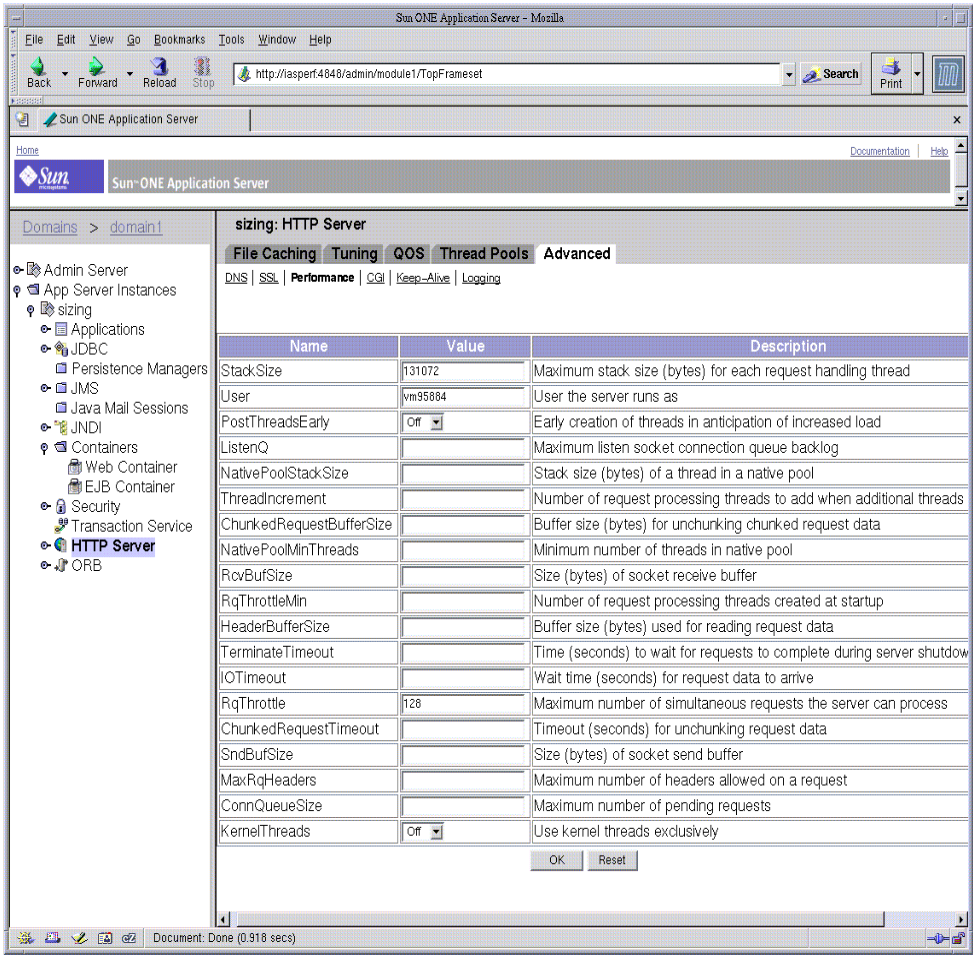
```
appservd pid: 4223

Sun ONE Application Server 7.0 B10/08/2002 14:05 (SunOS DOMESTIC)

Server started Thu Nov 07 16:50:23 2002
Process 4223 started Thu Nov 07 16:50:23 2002

ConnectionQueue:
----------------------------------
Current/Peak/Limit Queue Length     0/1/4096
Total Connections Queued            1
Average Queueing Delay              0.09 milliseconds

ListenSocket http-listener-1:
------------------------
Address                   http://0.0.0.0:1025
Acceptor Threads          1
Default Virtual Server    sizing

KeepAliveInfo:
--------------------
KeepAliveCount        0/256
KeepAliveHits         0
KeepAliveFlushes      0
KeepAliveRefusals     0
KeepAliveTimeouts     1
KeepAliveTimeout      30 seconds

SessionCreationInfo:
------------------------
Active Sessions           1
Total Sessions Created    48/128

CacheInfo:
------------------
enabled             yes
CacheEntries        3/1024
Hit Ratio           3/6 ( 50.00%)
Maximum Age         30

Native pools:
----------------------------
NativePool:
Idle/Peak/Limit                 1/1/128
Work Queue Length/Peak/Limit    0/0/0

Server DNS cache disabled

Async DNS disabled

Performance Counters:
------------------------------------------------
                           Average        Total      Percent

Total number of requests:                     1
Request processing time:    0.0036       0.0036

default-bucket (Default bucket)
Number of Requests:                           1    (100.00%)
Number of Invocations:                       20    (100.00%)
Latency:                    0.0004       0.0004    ( 10.56%)
Function Processing Time:   0.0032       0.0032    ( 89.44%)
Total Response Time:        0.0036       0.0036    (100.00%)

Sessions:
----------------------------
Process  Status     Function

4223     response   service-dump
```

Figure 4-4 Sample `perfdump` Output

For more information on editing the configuration files, see the *Sun ONE Application Server Developer's Guide to NSAPI.*

Using Statistics to Tune Your Server

This section describes the information available through the `perfdump` utility and discusses how to tune some parameters to improve your server's performance. The default tuning parameters are appropriate for all sites except those with very high volume. The only parameters that large sites may regularly need to change are `RqThrottle`, `MaxKeepAliveConnections`, and `KeepAliveTimeout`, which can be tuned by using the web-based Administration interface or by directly editing the `<instancename>-obj.conf` file. The following figure shows the Administration interface for tuning the HTTP Server.


Sun ONE Application Server - Mozilla
File Edit View Go Bookmarks Tools Window Help
Back Forward Reload Stop
http://iasperf:4848/admin/module1/TopFrameset
Search Print
Sun ONE Application Server
Home Documentation Help
Sun
Sun ONE Application Server
Domains > domain1
Admin Server
App Server Instances
sizing
Applications
JDBC
Persistence Managers
JMS
Java Mail Sessions
JNDI
Containers
Web Container
EJB Container
Security
Transaction Service
HTTP Server
ORB
sizing: HTTP Server
File Caching Tuning QOS Thread Pools Advanced
DNS | SSL | Performance | CGI | Keep-Alive | Logging
OK Reset
Document: Done (0.918 secs)

Name	Value	Description
StackSize	131072	Maximum stack size (bytes) for each request handling thread
User	vm95884	User the server runs as
PostThreadsEarly	Off	Early creation of threads in anticipation of increased load
ListenQ		Maximum listen socket connection queue backlog
NativePoolStackSize		Stack size (bytes) of a thread in a native pool
ThreadIncrement		Number of request processing threads to add when additional threads
ChunkedRequestBufferSize		Buffer size (bytes) for unchunking chunked request data
NativePoolMinThreads		Minimum number of threads in native pool
RcvBufSize		Size (bytes) of socket receive buffer
RqThrottleMin		Number of request processing threads created at startup
HeaderBufferSize		Buffer size (bytes) used for reading request data
TerminateTimeout		Time (seconds) to wait for requests to complete during server shutdow
IOTimeout		Wait time (seconds) for request data to arrive
RqThrottle	128	Maximum number of simultaneous requests the server can process
ChunkedRequestTimeout		Timeout (seconds) for unchunking request data
SndBufSize		Size (bytes) of socket send buffer
MaxRqHeaders		Maximum number of headers allowed on a request
ConnQueueSize		Maximum number of pending requests
KernelThreads	Off	Use kernel threads exclusively

Figure 4-5 Performance Tuning the Server using the Administration Interface

The `perfdump` utility monitors statistics in the following categories:

- Connection Queue Information
- HTTP Listener Information
- Keep-Alive / Persistent Connection Information
- Session Creation Information
- Cache Information
- Thread Pools
- DNS Cache Information

Connection Queue Information

Connection queue information shows the number of sessions in the queue, and the average delay before the connection is accepted.

Following is an example of how these statistics are displayed in `perfdump`:

```
ConnectionQueue:

---------------------------------

Current/peak/limit queue length 0/48/5000

Total connections queued 3753

Average queueing delay 0.0013 seconds
```

Current /peak /limit

Current / peak / limit queue length shows, in order:

- The number of connections currently in the queue.
- The largest number of connections that have been in the queue simultaneously.
- The maximum size of the connection queue.

Tuning

If the peak queue length is close to the limit, you may wish to increase the maximum connection queue size to avoid dropping connections under heavy load.

You can increase the connection queue size by:

- Setting or changing the value of `ConnQueueSize` from the web-based Administration interface. Follow the path `http-server-Advanced-performance`.

- Editing the `ConnQueueSize` directive in `init.conf`.

CAUTION Setting the connection queue too high can degrade server performance. It was designed to prevent the server from becoming overloaded with connections it cannot handle. If your server is overloaded and you increase the connection queue size, the latency of request handling will increase further, and the connection queue will fill up again.

Total Connections Queued

Total connections queued is the total number of times a connection has been queued. This includes newly accepted connections and connections from the keep-alive system.

This is a gathered statistic and is not tunable.

Average Queuing Delay

Average queueing delay is the average amount of time a connection spends in the connection queue. This represents the delay between when a request connection is accepted by the server, and a request processing thread (also known as a session) begins servicing the request.

This is a gathered statistic and is not tunable.

HTTP Listener Information

The HTTP listener information includes the IP address, port number, number of acceptor threads, and the default virtual server for the HTTP listener. For tuning purposes, the most important field in the HTTP listener information is the number of acceptor threads.

You can have many listeners enabled for virtual servers, but you will at least have one (usually `http://0.0.0.0:80`) enabled for your default server instance.

```
Http listeners1:

------------------------

Address http://0.0.0.0:1890

Acceptor threads 1

Default virtual server test
```

Tuning

You can create and configure HTTP listeners through the web-based Administration interface. For more information, see *Sun ONE Application Server Administration Guide*.

If you have created multiple HTTP Listeners, `perfdump` displays them all.

Set the TCP/IP listen queue size for all HTTP Listeners by:

- Editing the `ListenQ` parameter in `init.conf`.
- Entering the value in the `Listen Queue Size` field of the Performance Tuning page of the web-based Administration interface.

Address

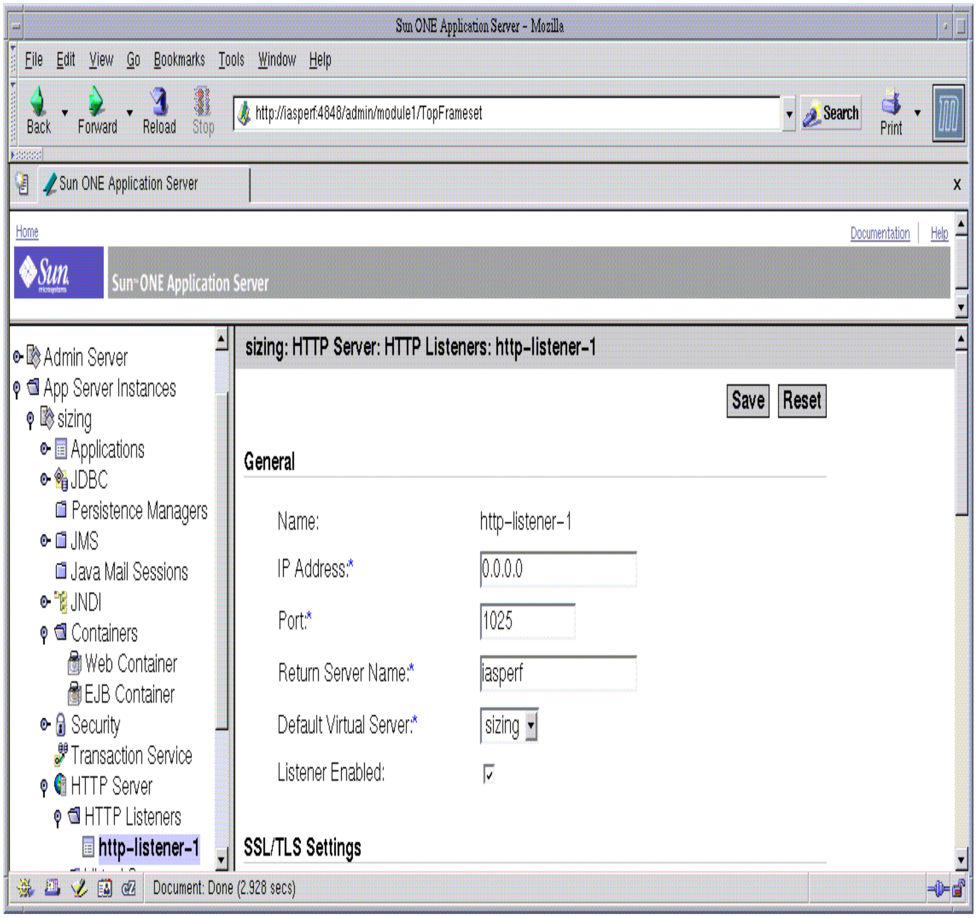
This field contains the base address that this listener is listening on. It contains the IP address and the port number.

If your HTTP listener listens on all IP addresses for the machine, the IP part of the address is 0.0.0.0.

Tuning

This setting is tunable when you edit a listen socket. If you specify an IP address other than 0.0.0.0, the server will make one less system call per connection. Specify an IP address other than 0.0.0.0 for the best possible performance.

The following figure shows the Administration interface for the HTTP Listener.



http://iasperf:4848/admin/module1/TopFrameset

sizing: HTTP Server: HTTP Listeners: http-listener-1

General

Name:	http-listener-1
IP Address:*	0.0.0.0
Port:*	1025
Return Server Name:*	iasperf
Default Virtual Server:*	sizing
Listener Enabled:	✓

SSL/TLS Settings

Figure 4-6 Tuning the HTTP Listener using the Administration Interface

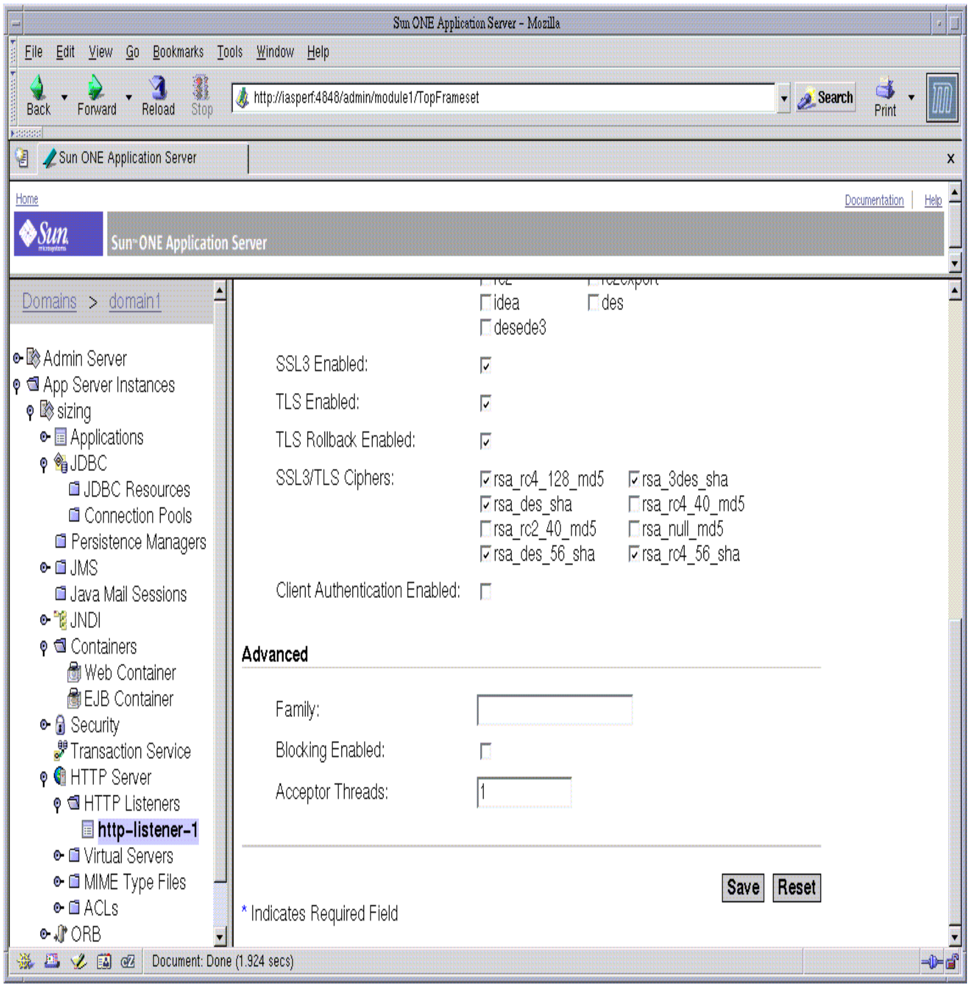
Acceptor Threads

Acceptor threads are threads that wait for connections. The threads accept connections and put them in a queue where they are then picked up by worker threads. Ideally, you want to have enough acceptor threads so that there is always one available when a user needs one, but few enough so that they do not put too much of a burden on the system. A good rule is to have one acceptor thread per CPU on your system. You can increase this value to about double the number of CPUs if you find indications of TCP/IP listen queue overruns.

Tuning

You can tune the number of acceptor threads by selecting the HTTP listener node and changing the number of acceptor threads on the right hand side of the Advanced category.

The following figure shows the Administration interface for the acceptor threads.



http://iasperf:4848/admin/module1/TopFrameset

- [ ] idea
- [ ] des
- [ ] desede3

SSL3 Enabled:	✓
TLS Enabled:	✓
TLS Rollback Enabled:	✓
SSL3/TLS Ciphers:	✓ rsa_rc4_128_md5, ✓ rsa_3des_sha, ✓ rsa_des_sha, ☐ rsa_rc4_40_md5, ☐ rsa_rc2_40_md5, ☐ rsa_null_md5, ✓ rsa_des_56_sha, ✓ rsa_rc4_56_sha
Client Authentication Enabled:	☐

Advanced

Family:	
Blocking Enabled:	☐
Acceptor Threads:	1

* Indicates Required Field

Document: Done (1.924 secs)

Figure 4-7 Tuning the Acceptor Threads using the Administration Interface

Default Virtual Server

Software virtual servers work using the HTTP 1.1 Host header. If the end user's browser does not send the host header, or if the server cannot find the virtual server specified by the Host header, Sun ONE Application Server handles the request using a default virtual server. Also, for hardware virtual servers, if the application server cannot find the virtual server corresponding to the IP address, it displays the default virtual server. You can configure the default virtual server to send an error message or serve pages from a special document root.

Tuning

You can specify a default virtual server for an individual listen socket and the server instance. If a given HTTP listener does not have a default virtual server, the server instance's default virtual server is used.

You can specify a default virtual server for a listen socket using the web-based Administration interface. You can set or change the default virtual server information using the Edit HTTP Listener page on the Preferences Tab of the web-based Administration interface for the HTTP server. The settings for the default virtual server are on the Connection Group Settings page that appears when you click Groups.

Keep-Alive/Persistent Connection Information

This section provides statistics about the server's HTTP-level keep-alive system.

The following example shows the keep-alive statistics displayed by `perfdump`:

```
KeepAliveInfo:

--------------------

KeepAliveCount 1/256

KeepAliveHits 4

KeepAliveFlushes 1

KeepAliveTimeout 30 seconds
```

NOTE The name "keep-alive" should not be confused with TCP "keep-alives." Also, note that the name "keep-alive" was changed to "Persistent Connections" in HTTP/1.1, but the `.perf` continues to refer to them as "KeepAlive" connections.

Both HTTP 1.0 and HTTP 1.1 support the ability to send multiple requests across a single HTTP session. A web server can receive hundreds of new HTTP requests per second. If every request was allowed to keep the connection open indefinitely, the server could become overloaded with connections. On Unix/Linux systems, this could easily lead to a file table overflow.

To deal with this problem, the server maintains a "Maximum number of 'waiting' keep-alive connections" counter. A 'waiting' keep-alive connection has fully completed processing the previous request, and is waiting for a new request to arrive on the same connection. If the server has more than the maximum waiting connections open when a new connection waits for a keep-alive request, the server closes the oldest connection. This algorithm keeps an upper bound on the number of open waiting keep-alive connections that the server can maintain.

Sun ONE Application Server does not always honor a keep-alive request from a client. The following conditions cause the server to close a connection even if the client has requested a keep-alive connection:

- `KeepAliveTimeout` is set to 0.
- `MaxKeepAliveConnections` count is exceeded.
- Dynamic content, such as a CGI, does not have an HTTP `content-length` header set. This applies only to HTTP 1.0 requests. If the request is HTTP 1.1, the server honors keep-alive requests even if the `content-length` is not set. The server can use chuncked encoding for these requests if the client can handle them (indicated by the request header `transfer-encoding:chunked`). For more information regarding chuncked encoding, see the *Sun ONE Application Server Developer's Guide to NSAPI*.
- Request is not HTTP GET or HEAD.
- The request was determined to be bad. For example, if the client sends only headers with no content.

KeepAliveThreads

You can configure the number of threads used in the keep-alive system by:

- Editing the KeepAliveThreads parameter in `init.conf`.
- Setting or changing the KeepAliveThreads value in the web-based Administration interface. Follow the path: HTTP Server, Advanced Tab, Keep-Alive sub-menu.

KeepAliveCount

This setting has two numbers:

- Number of connections in keep-alive mode
- Maximum number of connections allowed in keep-alive mode simultaneously

Tuning

You can tune the maximum number of sessions the server allows to wait at one time before closing the oldest connection by:

- Editing the `MaxKeepAliveConnections` parameter in the `init.conf` file.
- Setting or changing the `MaxKeepAliveConnections` value in the web-based Administration interface.

NOTE The number of connections specified by `MaxKeepAliveConnections` is divided equally among the keep-alive threads. If `MaxKeeepAliveConnections` is not equally divisible by `KeepAliveThreads`, the server may allow slightly more than `MaxKeepAliveConnections` simultaneous keep-alive connections.

KeepAliveHits

The number of times a request was successfully received from a connection that had been kept alive.

This setting is not tunable.

KeepAliveFlushes

The number of times the server had to close a connection because the `KeepAliveCount` exceeded the `MaxKeepAliveConnections`.

This setting is not tunable.

KeepAliveTimeout

Specifies the number of seconds the server allows a client connection to remain open with no activity. A web client may keep a connection to the server open so that multiple requests to one server can be serviced by a single network connection. Since a given server can handle a finite number of open connections, a high number of open connections will prevent new clients from connecting.

Tuning

You can change `KeepAliveTimeout` by:

- Editing the `KeepAliveTimeout` parameter in `init.conf`

- Setting or changing the `KeepAliveTimeout` value in the web-based Administration interface
- Entering the value in the HTTP Persistent Connection Timeout field of the Performance Tuning page in the web-based Administration interface.

KeepAliveQueryMeanTime

This parameter determines the intervals between the polling of Connections being handled by the `KeepAlive` Subsytem. If this parameter is set to a value N milliseconds, the Response time seen by a client which has requested persistent connections will have an overhead ranging from 0 to N milliseconds. This value is set by default to 1 millisecond (if unspecified in `init.conf`). This value works well if you expect a concurrent load of no more than about 300 `KeepAlive` connections. The default value can severely affect the scalability with higher concurrent loads. It is suggested that this be appropriately increased for higher connection load.

Tuning

You can change `KeepAliveQueryMeanTime` by editing the `KeepAliveQueryMeanTime` parameter in `init.conf`.

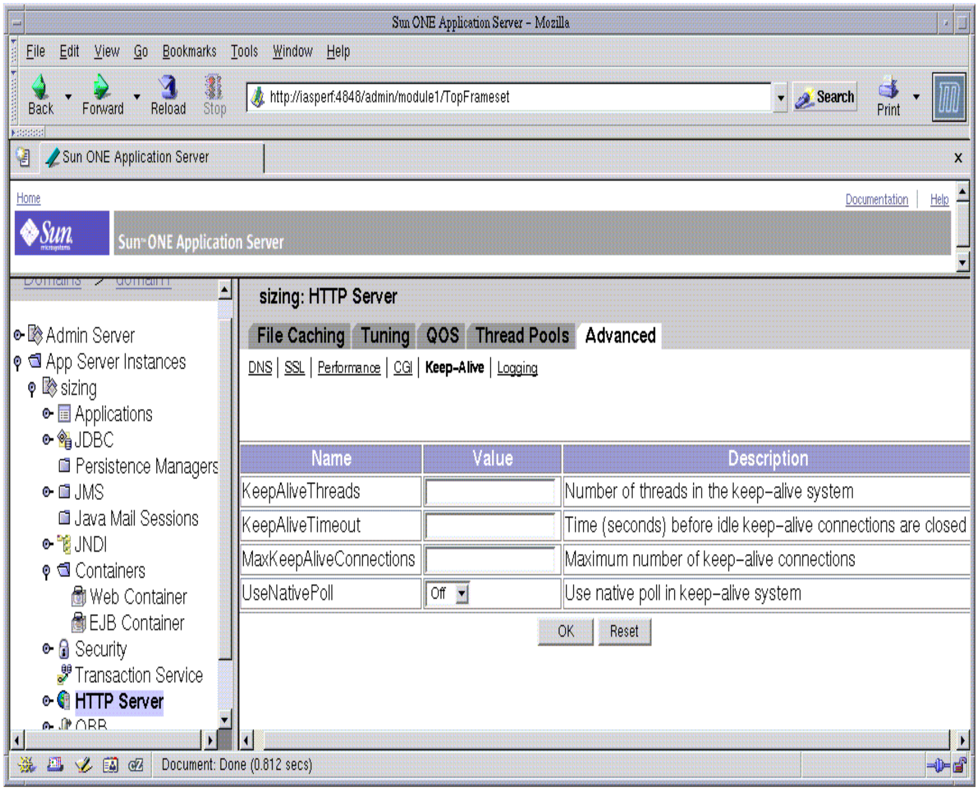
UseNativePoll

For Unix /Linux users, this parameter should be enabled for maximum performance.

To enable native poll for your keep-alive system from the web-based Administration interface, follow these steps:

1. Select the HTTPServer node for the server instance that needs to have this option turned on.
2. Select the Advanced Tab on the right hand side of the pane.
3. Select the Keep alive page tab.
4. Use the drop-down list to set `UseNativePoll` to ON.
5. Click OK.
6. Select the server instance tab from the tree view.
7. Select Apply Changes.
8. Restart the instance to cause your changes to take effect.

The following figure shows how to configure the keep-alive subsystem.


Sun ONE Application Server - Mozilla
File Edit View Go Bookmarks Tools Window Help
Back Forward Reload Stop
http://iasperf:4848/admin/module1/TopFrameset
Search Print
Sun ONE Application Server
Home
Documentation Help
Sun ONE Application Server
Domains > domain1
Admin Server
App Server Instances
sizing
Applications
JDBC
Persistence Managers
JMS
Java Mail Sessions
JNDI
Containers
Web Container
EJB Container
Security
Transaction Service
HTTP Server
ORB
File Caching Tuning QOS Thread Pools Advanced
DNS | SSL | Performance | CGI | Keep-Alive | Logging
OK Reset
Document: Done (0.812 secs)

sizing: HTTP Server

Name	Value	Description
KeepAliveThreads		Number of threads in the keep-alive system
KeepAliveTimeout		Time (seconds) before idle keep-alive connections are closed
MaxKeepAliveConnections		Maximum number of keep-alive connections
UseNativePoll	Off	Use native poll in keep-alive system

Figure 4-8 Tuning the Keep-Alive / Persistent Connections using the Administration Interface

Session Creation Information

Session creation statistics are only displayed in `perfdump`. Following is an example of `SessionCreationInfo` displayed in `perfdump`:

```
SessionCreationInfo:

------------------------

Active Sessions 1

Total Sessions Created 48/512
```

Active Sessions shows the number of sessions (request processing threads) currently servicing requests.

Total Sessions Created shows both the number of sessions that have been created and the maximum number of sessions allowed.

Reaching the maximum number of configured threads is not necessarily undesirable. It is not necessary to automatically increase the number of threads in the server. Reaching this limit means that the server needed this many threads at peak load. As long as it was able to serve requests in a timely manner, the server is adequately tuned. However, at this point connections will queue up in the connection queue, potentially overflowing it. If you check your `perfdump` output on a regular basis and notice that total sessions created is often near the `RqThrottle` maximum, you should consider increasing your thread limits.

Tuning

You can increase your thread limits by:

- Editing the `RqThrottle` parameter in `init.conf`.
- Setting or changing the `RqThrottle` value via the web-based Administration interface.
- Entering the value in the Maximum Simultaneous Requests field of the Performance Tuning page in the web-based Administration interface.

Cache Information

The Cache information section provides statistics on how your file cache is being used. The file cache caches static content so that the server handles requests for static content quickly.

Following is an example of how the cache statistics are displayed in `perfdump`:

```
CacheInfo:

------------------

enabled yes

CacheEntries 5/1024

Hit Ratio 93/190 ( 48.95%)

Maximum age 30
```

enabled

If the cache is disabled, the rest of this section is not displayed.

Tuning

The cache is enabled by default. You can disable it by:

- Unselecting it from the File Cache Configuration page under File Caching Tab in the web-based Administration interface for the HTTP Server instance.
- Editing the `FileCacheEnable` parameter in the `nsfc.conf` file. For more information, see the *Sun ONE Application Server Developer's Guide to NSAPI*.

CacheEntries

The number of current cache entries and the maximum number of cache entries are both displayed. A single cache entry represents a single URI.

Tuning

You can set the maximum number of cached entries by:

- Entering a value in the Maximum Number of Files field on the File Cache Configuration page under Preferences in the Server Manger.
- Creating or editing the `MaxFiles` parameter in the `nsfc.conf` file. For more information, see the *Sun ONE Application Server Developer's Guide to NSAPI*.

Hit Ratio (CacheHits / CacheLookups)

The hit ratio gives you the number of file cache hits versus cache lookups. Numbers approaching 100% indicate the file cache is operating effectively, while numbers approaching 0% could indicate that the file cache is not serving many requests.

This setting is not tunable.

Maximum Age

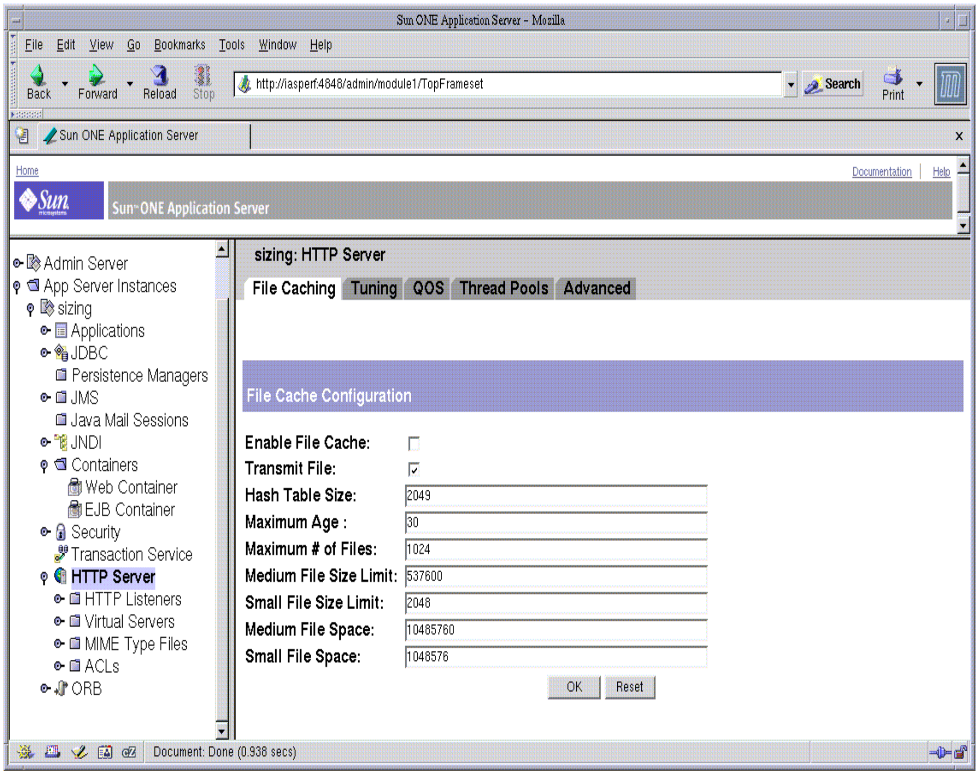
The maximum age displays the maximum age of a valid cache entry. This parameter controls how long cached information is used after a file has been cached. An entry older than the maximum age is replaced by a new entry for the same file.

Tuning

If your web site's content changes infrequently, you may want to increase this value for improved performance. You can set the maximum age by:

- Entering or changing the value in the Maximum Age field of the File Cache Configuration page in the web-based Admin Console for the HTTP server node and selecting the File Caching Tab.
- Editing the `MaxAge` parameter in the `nsfc.conf` file. For more information, see the *Sun ONE Application Server Developer's Guide to NSAPI*.

The following figure shows the Administration interface for configuring the file cache system.



Enable File Cache:	☐
Transmit File:	☑
Hash Table Size:	2049
Maximum Age :	30
Maximum # of Files:	1024
Medium File Size Limit:	537600
Small File Size Limit:	2048
Medium File Space:	10485760
Small File Space:	1048576

Figure 4-9 Tuning the File Cache Information using the Administration Interface

Thread Pools

The following figure shows Administration interface for configuring the thread pools.

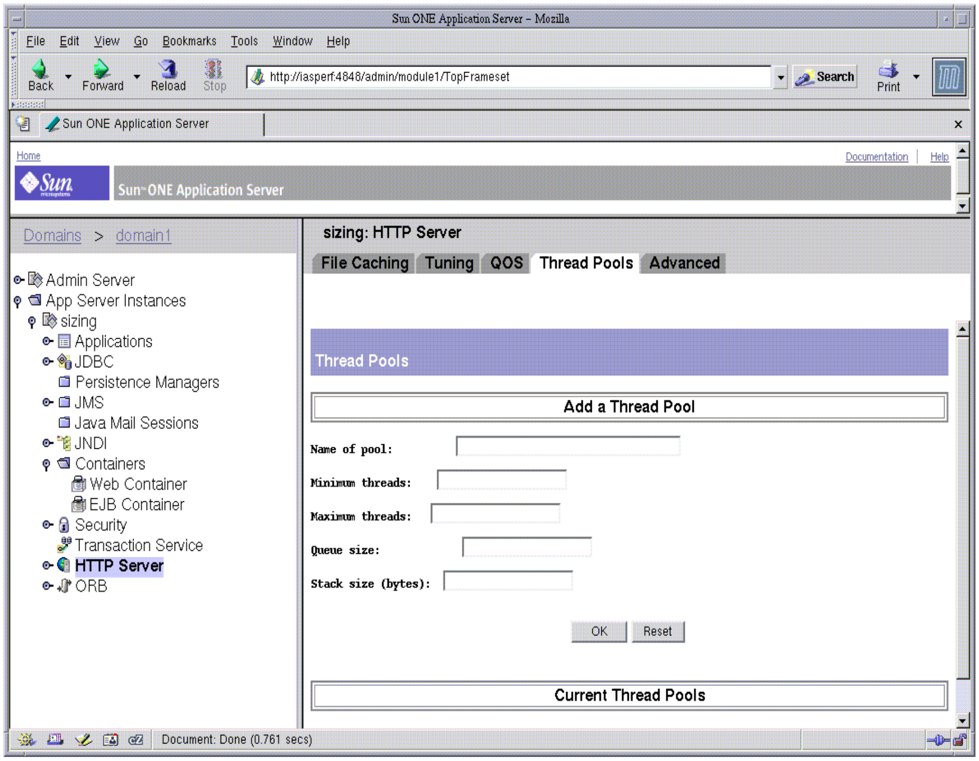


Figure 4-10 Tuning the Thread Pools using the Administration Interface

Three types of thread pools can be configured through the web-based Administration interface:

- Thread Pools (Unix /Linux)
- Native Thread Pools (NT)
- Generic Thread Pools (NT)

Thread Pools (Unix /Linux only)

Since threads on Unix/Linux are always operating system (OS)-scheduled, as opposed to user-scheduled, Unix/Linux users do not need to use native thread pools. Therefore, this option is not offered in a Unix/Linux user interface. However, you can edit the OS-scheduled thread pools and add new thread pools, if needed, using the web-based Administration interface.

Native Thread Pools (NT only)

On NT, the native thread pool (`NativePool`) is used internally by the server to execute NSAPI functions that require a native thread for execution.

```
Native pools:

----------------------------

NativePool:

Idle/Peak/Limit 1/1/128

Work queue length/Peak/Limit 0/0/0
```

Windows NT users can edit their native thread pool settings using the web-based Administration interface.

Sun ONE Application Server uses NSPR, which is an underlying portability layer providing access to the host OS services. This layer provides abstractions for threads that are not always the same as those for the OS-provided threads. These non-native threads have lower scheduling overhead, so their use improves performance. However, these threads are sensitive to blocking calls to the OS, such as I/O calls. To make it easier to write NSAPI extensions that can make use of blocking calls, the server keeps a pool of threads that safely support blocking calls. This usually means it is a native OS thread. During request processing, any NSAPI function that is not marked as being safe for execution on a non-native thread is scheduled for execution on one of the threads in the native thread pool.

If you have written your own NSAPI plug-ins such as `NameTrans`, `Service`, or `PathCheck` functions, these execute by default on a thread from the native thread pool. If your plug-in makes use of the NSAPI functions for I/O exclusively or does not use the NSAPI I/O functions at all, then it can execute on a non-native thread. For this to happen, the function must be loaded with a `NativeThread="no"` option, indicating that it does not require a native thread.

To do this, add the following to the `"load-modules"` `Init` line in the `init.conf` file:

```
Init funcs="pcheck_uri_clean_fixed_init"
shlib="C:/Netscape/p186244/P186244.dll" fn="load-modules"
NativeThread="no"
```

The `NativeThread` flag affects all functions in the `funcslist`, so if you have more than one function in a library, but only some of them use native threads, use separate `Init` lines.

Generic Thread Pools (NT only)

On NT, you can set up additional thread pools using the web-based Admin Console. Use thread pools to put a limit on the maximum number of requests answered by a service function at any moment. Additional thread pools are a way to run thread-unsafe plug-ins. By defining a pool with a maximum number of threads set to 1, only one request is allowed into the specified service function.

Idle/Peak/Limit

Idle indicates the number of threads that are currently idle. Peak indicates the peak number in the pool. Limit indicates the maximum number of native threads allowed in the thread pool, and is determined by the setting of `NativePoolMaxThreads`.

Tuning

You can modify the `NativePoolMaxThreads` by:

- Editing the `NativePoolMaxThreads` parameter in `init.conf`
- Entering or changing the value in the Maximum Threads field of the Native Thread Pool page in the Performance tab for the Http server node via the administration interface

Work Queue Length /Peak /Limit

These numbers refer to a queue of server requests that are waiting for the use of a native thread from the pool. The Work Queue Length is the current number of requests waiting for a native thread.

Peak is the highest number of requests that were ever queued up simultaneously for the use of a native thread since the server was started. This value can be viewed as the maximum concurrency for requests requiring a native thread.

Limit is the maximum number of requests that can be queued at one time to wait for a native thread, and is determined by the setting of `NativePoolQueueSize`.

Tuning

You can modify the `NativePoolQueueSize` by:

- Editing the `NativePoolQueueSize` parameter in `init.conf`
- Entering or changing the value in the Queue Size field of the Native Thread Pool page in the Performance tab for the HTTP server node via the web-based Administration interface.

NativePoolStackSize (NT only)

The `NativePoolStackSize` determines the stack size in bytes of each thread in the native (kernel) thread pool.

Tuning

You can modify the `NativePoolStackSize` by:

- Editing the `NativePoolStackSize` parameter in `init.conf`
- Setting or changing the `NativePoolStackSize` value in the Performance tab for the HTTP server node via the web-based Administration interface.

NativePoolQueueSize (NT only)

The `NativePoolQueueSize` determines the number of threads that can wait in the queue for the thread pool. If all threads in the pool are busy, the next request-handling thread that needs to use a thread in the native pool must wait in the queue. If the queue is full, the next request-handling thread that tries to get in the queue is rejected, and a busy response is returned to the client. It is then free to handle another incoming request instead of being tied up waiting in the queue.

Setting The `NativePoolQueueSize` lower than the `RqThrottle` value causes the server to execute a busy function instead of the intended NSAPI function whenever the number of requests waiting for service by pool threads exceeds this value. The default returns a "503 Service Unavailable" response and logs a message if `LogVerbose` is enabled. Setting The `NativePoolQueueSize` higher than `RqThrottle` causes the server to reject connections before a busy function can execute.

This value represents the maximum number of concurrent requests for service which require a native thread. If your system is unable to fulfill requests due to load, letting more requests queue up increases the latency for requests and could result in all available request threads waiting for a native thread. In general, set this value to be high enough to avoid rejecting requests by anticipating the maximum number of concurrent users who would execute requests requiring a native thread.

The difference between this value and `RqThrottle` is the number of requests reserved for non-native thread requests, such as static HTML and image files. Keeping a reserve and rejecting requests ensures that your server continues to fill requests for static files, which prevents it from becoming unresponsive during periods of very heavy dynamic content load. If your server consistently rejects connections, this value is either set too low, or your server hardware is overloaded.

Tuning

You can modify the `NativePoolQueueSize` by:

- Editing the `NativePoolQueueSize` parameter in `init.conf`

NativePoolMaxThreads (NT only)

`NativePoolMaxThreads` determine the maximum number of threads in the native (kernel) thread pool.

A higher value allows more requests to execute concurrently, but has more overhead due to context switching, so "bigger is not always better." Typically, you will not need to increase this number, but if you are not saturating your CPU and you are seeing requests queue up, you should increase this number.

Tuning

You can modify the `NativePoolMaxThreads` by editing the `NativePoolMaxThreads` parameter in `init.conf`.

NativePoolMinThreads (NT only)

Determines the minimum number of threads in the native (kernel) thread pool.

Tuning

You can modify the `NativePoolMinThreads` by:

- Editing the `NativePoolMinThreads` parameter in `init.conf`
- Setting or changing the `NativePoolMinThreads` value in the Performance tab for the HTTP server node via the web-based Administration interface.

DNS Cache Information

The DNS cache caches IP addresses and DNS names. Your server's DNS cache is disabled by default. In the DNS Statistics for Process ID All page under Monitor in the web-based Administration interface the following statistics are displayed:

enabled

If the DNS cache is disabled, the rest of this section is not displayed.

Tuning

By default, the DNS cache is off. You can enable DNS caching by:

- Adding the following line to `init.conf`:

  ```
  Init fn=dns-cache-init
  ```
- Setting the DNS value to “Perform DNS lookups on clients accessing the server” via the web-based Administration interface.

CacheEntries (CurrentCacheEntries / MaxCacheEntries)

The number of current cache entries and the maximum number of cache entries. A single cache entry represents a single IP address or DNS name lookup. The cache should be as large as the maximum number of clients that will access your web site concurrently. Note that setting the cache size too high will waste memory and degrade performance.

Tuning

You can set the maximum size of the DNS cache by:

- Adding the following line to the `init.conf` file:

  ```
  Init fn=dns-cache-init cache-size=1024
  ```

  The default cache size is 1024

- Entering or changing the value in the Size of DNS Cache field of the Performance Tuning page in the web-based Administration interface.

HitRatio (CacheHits / CacheLookups)

The hit ratio displays the number of cache hits versus the number of cache lookups.

This setting is not tunable.

NOTE If you turn off DNS lookups on your server, host name restrictions will not work and hostnames will not appear in your log files. Instead, you'll see IP addresses.

Caching DNS Entries

You can also specify whether to cache the DNS entries. If you enable the DNS cache, the server can store hostname information after receiving it. If the server needs information about the client in the future, the information is cached and available without further querying. You can specify the size of the DNS cache and an expiration time for DNS cache entries. The DNS cache can contain 32 to 32768 entries; the default value is 1024. Values for the time it takes for a cache entry to expire can range from 1 second to 1 year specified in seconds; the default value is 1200 seconds (20 minutes).

Limit DNS Lookups to Asynchronous

It is recommended that you do not use DNS lookups in server processes because they are so resource-intensive. If you must include DNS lookups, be sure to make them asynchronous.

enabled

If asynchronous DNS is disabled, the rest of this section will not be displayed.

Tuning

You can enable asynchronous DNS by:

- Adding `AsyncDNS` ON in the `init.conf` file.
- Setting the `AsyncDNS` value to ON in the web-based Administration interface.
- Selecting Async DNS Enabled from the Performance Tuning page under Preferences in the Server Manger.

NameLookups

The number of name lookups (DNS name to IP address) that have been done since the server was started.

This setting is not tunable.

AddrLookups

The number of address loops (IP address to DNS name) that have been done since the server was started.

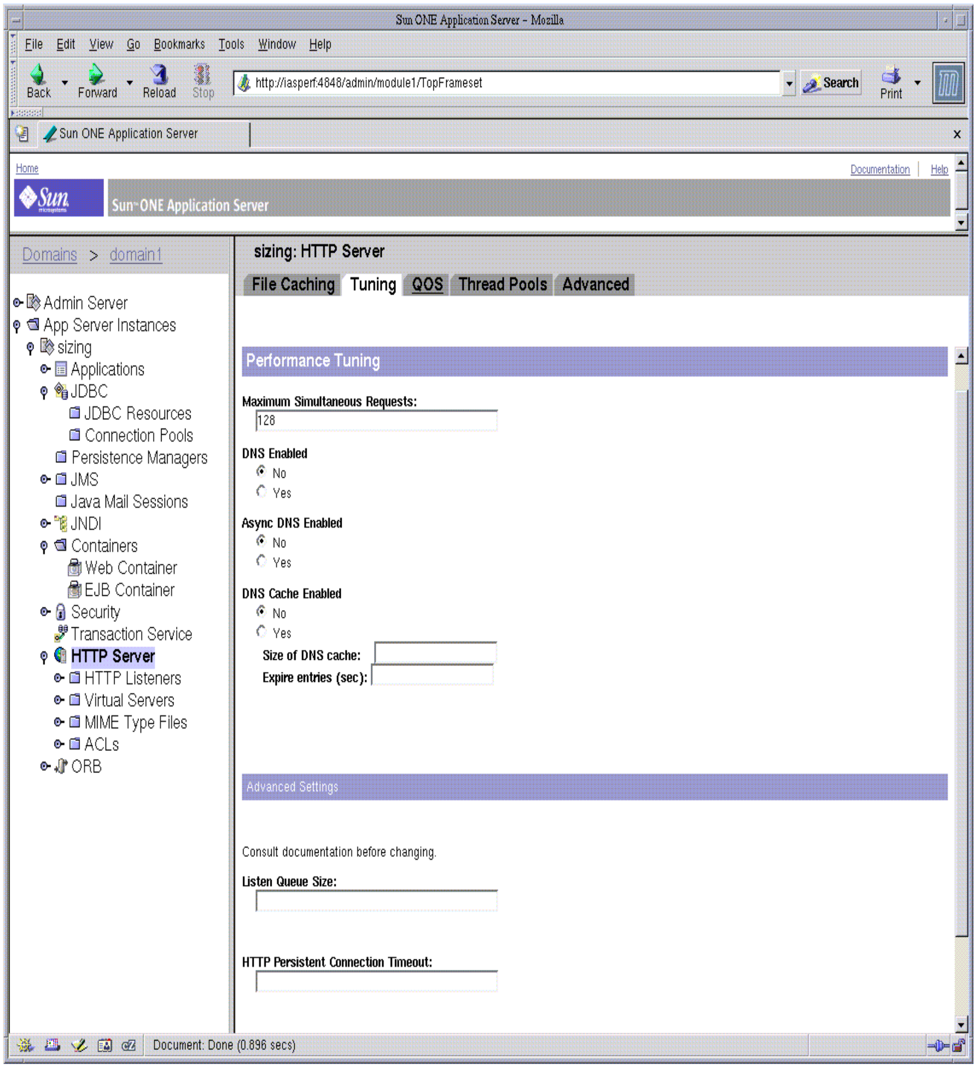
This setting is not tunable.

LookupsInProgress

The current number of lookups in progress.

This setting is not tunable.

The following figure shows the Administration interface for configuring the DNS cache information.



Maximum Simultaneous Requests: 128

DNS Enabled: [✓ No] Yes

Async DNS Enabled: [✓ No] Yes

DNS Cache Enabled: [✓ No] Yes

Size of DNS cache:

Expire entries (sec):

Consult documentation before changing.

Listen Queue Size:

HTTP Persistent Connection Timeout:

Figure 4-11 Tuning the DNS Cache Information using the Administration Interface

Busy Functions

The default busy function returns a "503 Service Unavailable" response and logs a message if `LogVerbose` is enabled. You may wish to modify this behavior for your application. To better troubleshoot performance problems, it is useful to specify your own busy functions for any NSAPI function in the `<instancename>-obj.conf` file by including a service function in the configuration file in this format:

```
busy="<my-busy-function>"
```

For example, you could use this sample service function:

```
Service fn="send-cgi" busy="service-toobusy"
```

This allows different responses if the server becomes too busy in the course of processing a request that includes a number of types (such as `Service`, `AddLog`, and `PathCheck`). Note that your busy function will apply to all functions that require a native thread to execute when the default thread type is non-native.

To use your own busy function instead of the default busy function for the entire server, you can write an NSAPI `init` function that includes a `func_insert` call as shown below:

```
extern "C" NSAPI_PUBLIC int my_custom_busy_function(pblock *pb,
Session *sn, Request *rq);

my_init(pblock *pb, Session *, Request *)

{

func_insert("service-toobusy", my_custom_busy_function);

}
```

Busy functions are never executed on a pool thread, so you must be careful to avoid using function calls that could cause the thread to block.

Using Performance Buckets

Performance buckets allow you to define buckets, and link them to various server functions. Every time one of these functions is invoked, the server collects statistical data and adds it to the bucket. For example, `send-cgi` and `NSServletService` are functions used to serve the CGI and Java servlet requests respectively. You can either define two buckets to maintain separate counters for

CGI and servlet requests, or create one bucket that counts requests for both types of dynamic content. The cost of collecting this information is little and impact on the server performance is usually negligible. The following information is stored in a bucket:

- **Name of the bucket**. This name is used for associating the bucket with a function.
- **Description**. A description of the functions associated with the bucket.
- **Number of requests for this function**. The total number of requests that caused this function to be called.
- **Number of times the function was invoked**. This number may not coincide with the number of requests for the function because some functions may be executed more than once for a single request.
- **Function latency or the dispatch time**. The time taken by the server to invoke the function.
- **Function time**. The time spent in the function itself.

The `default-bucket` is pre-defined by the server. It records statistics for the functions not associated with any user defined bucket.

Configuration

You must specify all the configuration information for performance buckets in the `init.conf` and `<instancename>-obj.conf` files. Only the default bucket is automatically enabled.

The following examples show how to define new buckets in `init.conf`:

```
Init fn="define-perf-bucket" name="acl-bucket" description="ACL
bucket"
```

```
Init fn="define-perf-bucket" name="file-bucket"
description="Non-cached responses"
```

```
Init fn="define-perf-bucket" name="cgi-bucket" description="CGI
Stats"
```

The prior example creates three buckets: `acl-bucket`, `file-bucket`, and `cgi-bucket`. To associate these buckets with functions, add `bucket=`*bucket-name* to the `obj.conf` function for which you wish to measure performance. For example:

```
PathCheck fn="check-acl" acl="default" bucket="acl-bucket"
...
Service method="(GET|HEAD|POST)" type="*~magnus-internal/*"
fn="send-file" bucket="file-bucket"
```

```
...
<Object name="cgi">
ObjectType fn="force-type" type="magnus-internal/cgi"
Service fn="send-cgi" bucket="cgi-bucket"
</Object>
```

Performance Report

The performance buckets information is located in the last section of the report that `perfdump` returns.

For more information, see "Enabling Statistics with stats-xml" and "Using Performance Buckets".

The report contains the following information:

- Average, Total, and Percent columns give data for each requested statistic.
- Request Processing Time is the total time required by the server to process all the requests it has received so far.
- Number of Requests is the total number of requests for the function.
- Number of Invocations is the total number of times that the function was invoked. This differs from the number of requests in that a function can be called multiple times while processing one request. The percentage column for this row is calculated in reference to the total number of invocations for all the buckets.
- Latency is the time, in seconds, that the Sun ONE Application Server takes to prepare for calling the function.
- Function Processing Time is the time, in seconds, that the Sun ONE Application Server spent inside the function. The percentage of Function Processing Time and Total Response Time is calculated with reference to the total Request processing time.
- Total Response Time is the sum, in seconds, of Function Processing Time and Latency.

The following is an example of the performance bucket information available through `perfdump`:

```
Performance Counters:

------------------------------------------------

Average Total Percent
```

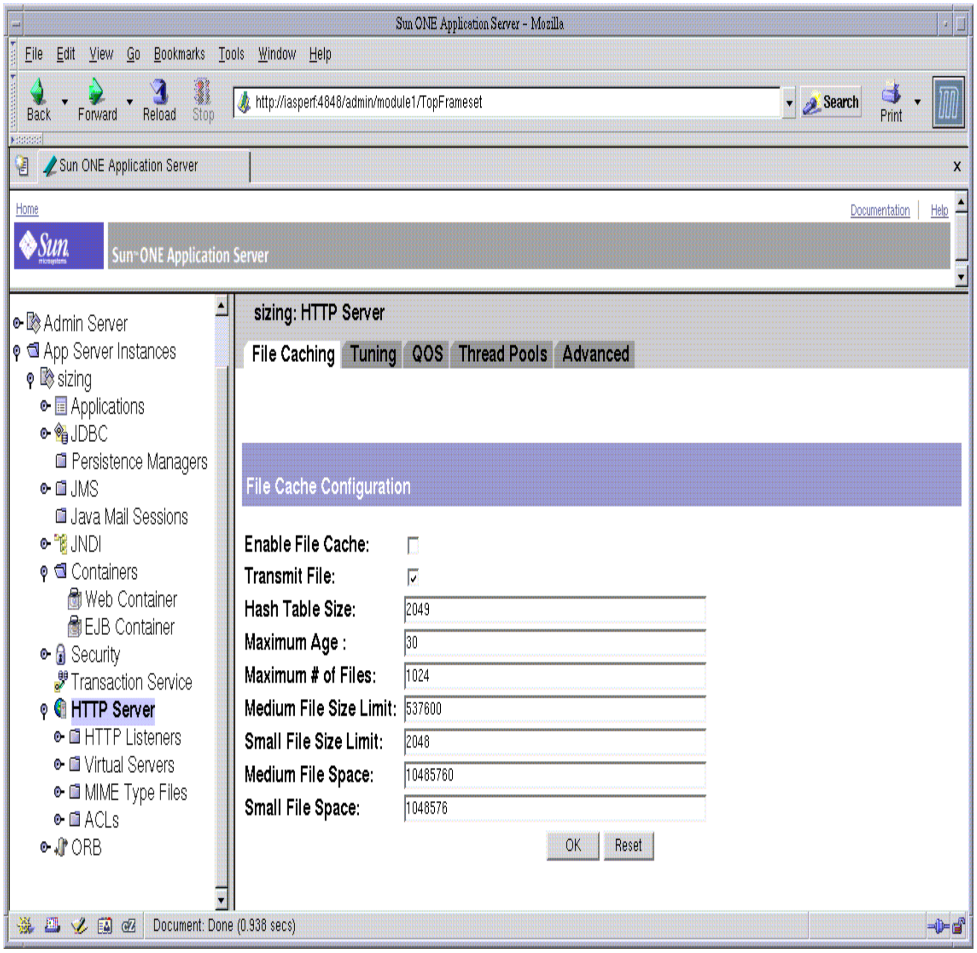
```
Total number of requests: 474851
Request processing time: 0.0010 485.3198

Default Bucket (default-bucket)
Number of Requests: 597 ( 0.13%)
Number of Invocations: 9554 ( 1.97%)
Latency: 0.0000 0.1526 ( 0.03%)
Function Processing Time: 0.0256 245.0459 ( 50.49%)
Total Response Time: 0.0257 245.1985 ( 50.52%)
```

Configuring the File Cache

The Sun ONE Application Server uses a file cache to serve static information faster. The file cache contains information about files and static file content. The file cache also caches information that is used to speed up processing of server-parsed HTML.

The file cache is turned on by default. The file cache settings are contained in a file called `nsfc.conf`. You can use the web-based Administration interface to change the file cache settings.

The following figure shows the Administration interface for configuring the file cache settings.



Enable File Cache:	☐
Transmit File:	☑
Hash Table Size:	2049
Maximum Age :	30
Maximum # of Files:	1024
Medium File Size Limit:	537600
Small File Size Limit:	2048
Medium File Space:	10485760
Small File Space:	1048576

Figure 4-12 Tuning the File Caching using the Administration Interface

To configure the file cache:

1. Select the File Caching tab of the HTTP server.
2. Check Enable File Cache, if not already selected.

3. Choose whether or not to transmit files.

   When you enable Transmit File, the server caches open file descriptors for files in the file cache, rather than the file contents. `PR_TransmitFile` is used to send the file contents to a client. When Transmit File is enabled, the distinction normally made by the file cache between small, medium, and large files no longer applies since only the open file descriptor is being cached. By default, Transmit File is enabled on NT, and not enabled on Unix. On Unix, enable Transmit File for platforms that have native OS support for `PR_TransmitFile`, which currently includes HP-UX and AIX. It is not recommended for other Unix/Linux platforms.

4. Enter a size for the hash table.

   The default size is twice the maximum number of files plus 1. For example, if your maximum number of files is set to 1024, the default hash table size is 2049.

5. Enter a maximum age in seconds for a valid cache entry.

   By default, this is set to 30.

   This setting controls how long cached information will continue to be used once a file has been cached. An entry older than `MaxAge` is replaced by a new entry for the same file, if the same file is referenced through the cache.

   Set the maximum age based on whether the content is updated (existing files are modified) on a regular schedule or not. For example, if content is updated four times a day at regular intervals, you could set the maximum age to 21600 seconds (6 hours). Otherwise, consider setting the maximum age to the longest time you are willing to serve the previous version of a content file after the file has been modified.

6. Enter the Maximum Number of Files to be cached.

   By default, this is set to 1024.

7. (Unix /Linux only) Enter medium and small file size limits in bytes.

   By default, the Medium File Size Limit is set to 525000 (525 KB).

   By default, Small File Size Limit is set to 2048.

   The cache treats small, medium, and large files differently. The contents of medium files are cached by mapping the file into virtual memory (Unix/Linux platforms). The contents of "small" files are cached by allocating heap space and reading the file into it. The contents of "large" files (larger than "medium") are not cached, although information about large files is cached.

   The advantage of distinguishing between small files and medium files is to avoid wasting part of many pages of virtual memory when there are lots of small files. So the Small File Size Limit is typically a slightly lower value than the VM page size.

8. (Unix /Linux only) Set the medium and small file space.

   The medium file space is the size in bytes of the virtual memory used to map all medium sized files. By default, this is set to 10000000 (10MB).

   The small file space is the size of heap space in bytes used for the cache, including heap space used to cache small files. By default, this is set to 1MB for Unix/Linux.

9. Click OK.
10. Click Apply.
11. Select Apply Changes to restart your server.

Using the nocache Parameter

You can use the parameter nocache for the Service function send-file to specify that files in a certain directory not be cached. For example, if you have a set of files that changes too rapidly for caching to be useful, you can put them in a directory and instruct the server not to cache files in that directory by editing the `<instancename>-obj.conf` file.

For example:

```
<Object name=default>

...

NameTrans fn="pfx2dir" from="/myurl" dir="/export/mydir"
name="myname"

...
```

```
Service method=(GET|HEAD|POST) type=*~magnus-internal/*
fn=send-file

...

</Object>

<Object name="myname">

Service method=(GET|HEAD) type=*~magnus-internal/* fn=send-file
nocache=""

</Object>
```

In the above example, the server does not cache static files from `/export/mydir/` when requested by the URL prefix `/myurl`.

File Cache Dynamic Control and Monitoring

You can add an object to `<instancename>-obj.conf` to dynamically monitor and control the `nsfc.conf` file cache while the server is running. To do this:

Add a `NameTrans` directive to the default object:

```
NameTrans fn="assign-name" from="/nsfc" name="nsfc"
```

Add an `nsfc` object definition:

```
<Object name="nsfc">
Service fn=service-nsfc-dump
</Object>
```

This enables the file cache control and monitoring function (`nsfc-dump`) to be accessed via the URI, "`/nsfc`." By changing the "`from`" parameter in the `NameTrans` directive, a different URI can be used.

The following is an example of the information you receive when you access the URI:

```
Sun ONE Application Server File Cache Status (pid 7960)

The file cache is enabled.

Cache resource utilization


Number of cached file entries = 1039 (112 bytes each, 116368
total bytes)

Heap space used for cache = 237641/1204228 bytes

Mapped memory used for medium file contents = 5742797/10485760
bytes
```

```
Number of cache lookup hits = 435877/720427 ( 60.50 %)
Number of hits/misses on cached file info = 212125/128556
Number of hits/misses on cached file content = 19426/502284
Number of outdated cache entries deleted = 0
Number of cache entry replacements = 127405
Total number of cache entries deleted = 127407
Number of busy deleted cache entries = 17

Parameter settings

HitOrder: false
CacheFileInfo: true
CacheFileContent: true
TransmitFile: false
MaxAge: 30 seconds
MaxFiles: 1024 files
SmallFileSizeLimit: 2048 bytes
MediumFileSizeLimit: 537600 bytes
CopyFiles: false
Directory for temporary files:
/tmp/netscape/https-axilla.mcom.com
Hash table size: 2049 buckets
```

You can include a query string when you access the "`/nsfc`" URI. The following values are recognized:

- `?list` - Lists the files in the cache.
- `?refresh=n` - Causes the client to reload the page every n seconds.
- `?restart` - Causes the cache to be shut down and then restarted.
- `?start` - Starts the cache.
- `?stop` - Shuts down the cache.

If you choose the `?list` option, the file listing includes the file name, a set of flags, the current number of references to the cache entry, the size of the file, and an internal file ID value. The flags are as follows:

- `C` - File contents are cached.
- `D` - Cache entry is marked for delete.
- `E` - `PR_GetFileInfo()` returned an error for this file.
- `I` - File information (size, modify date, etc.) is cached.
- `M` - File contents are mapped into virtual memory.
- `O` - File descriptor is cached (when `TransmitFile` is set to true).
- `P` - File has associated private data (should appear on `shtml` files).
- `T` - Cache entry has a temporary file.
- `W` - Cache entry is locked for write access.

For sites with scheduled updates to content, consider shutting down the cache while the content is being updated, and starting it again after the update is complete. Although performance will slow down, the server operates normally when the cache is off.

Tuning the ACL User Cache

The ACL user cache is ON by default. Because of the default size of the cache (200 entries), the ACL user cache can be a bottleneck, or can simply not serve its purpose on a site with heavy traffic. On a busy site, more than 200 users can hit ACL-protected resources in less time than the lifetime of the cache entries. When this situation occurs, the Sun ONE Application Server has to query the LDAP server more often to validate users, which impacts performance.

This bottleneck can be avoided by increasing the size of the ACL cache with the `ACLUserCacheSize` directive in `init.conf`. Note that increasing the cache size will use more resources; the larger you make the cache the more RAM you'll need to hold it.

There can also be a potential (but much harder to hit) bottleneck with the number of groups stored in a cache entry (by default four). If a user belongs to five groups and hits five ACLs that check for these different groups within the ACL cache lifetime, an additional cache entry is created to hold the additional group entry. When there are two cache entries, the entry with the original group information is ignored.

While it would be extremely unusual to hit this possible performance problem, the number of groups cached in a single ACL cache entry can be tuned with the `ACLGroupCacheSize` directive.

ACL User Cache Directives

To adjust the ACL user cache values you will need to manually add the following directives to your `init.conf` file:

- `ACLCacheLifetime`
- `ACLUserCacheSize`
- `ACLGroupCacheSize`

ACLCacheLifetime

Set this directive to a number that determines the number of seconds before the cache entries expire. Each time an entry in the cache is referenced, its age is calculated and checked against `ACLCacheLifetime`. The entry is not used if its age is greater than or equal to the `ACLCacheLifetime`. The default value is 120 seconds. If this value is set to 0, the cache is turned off. If you use a large number for this value, you may need to restart the Sun ONE Application Server when you make changes to the LDAP entries. For example, if this value is set to 120 seconds, the Sun ONE Application Server might be out of sync with the LDAP server for as long as two minutes. If your LDAP is not likely to change often, use a large number.

ACLUserCacheSize

Set this directive to a number that determines the size of the User Cache (default is 200).

ACLGroupCacheSize

Set this directive to a number that determines how many group IDs can be cached for a single UID/cache entry (default is 4).

Verifying ACL User Cache Settings

With `LogVerbose` you can verify that the ACL user cache settings are being used. When `LogVerbose` is running, you should expect to see these messages in your error log when the server starts:

```
User authentication cache entries expire in ### seconds.

User authentication cache holds ### users.

Up to ### groups are cached for each cached user.
```

Tuning

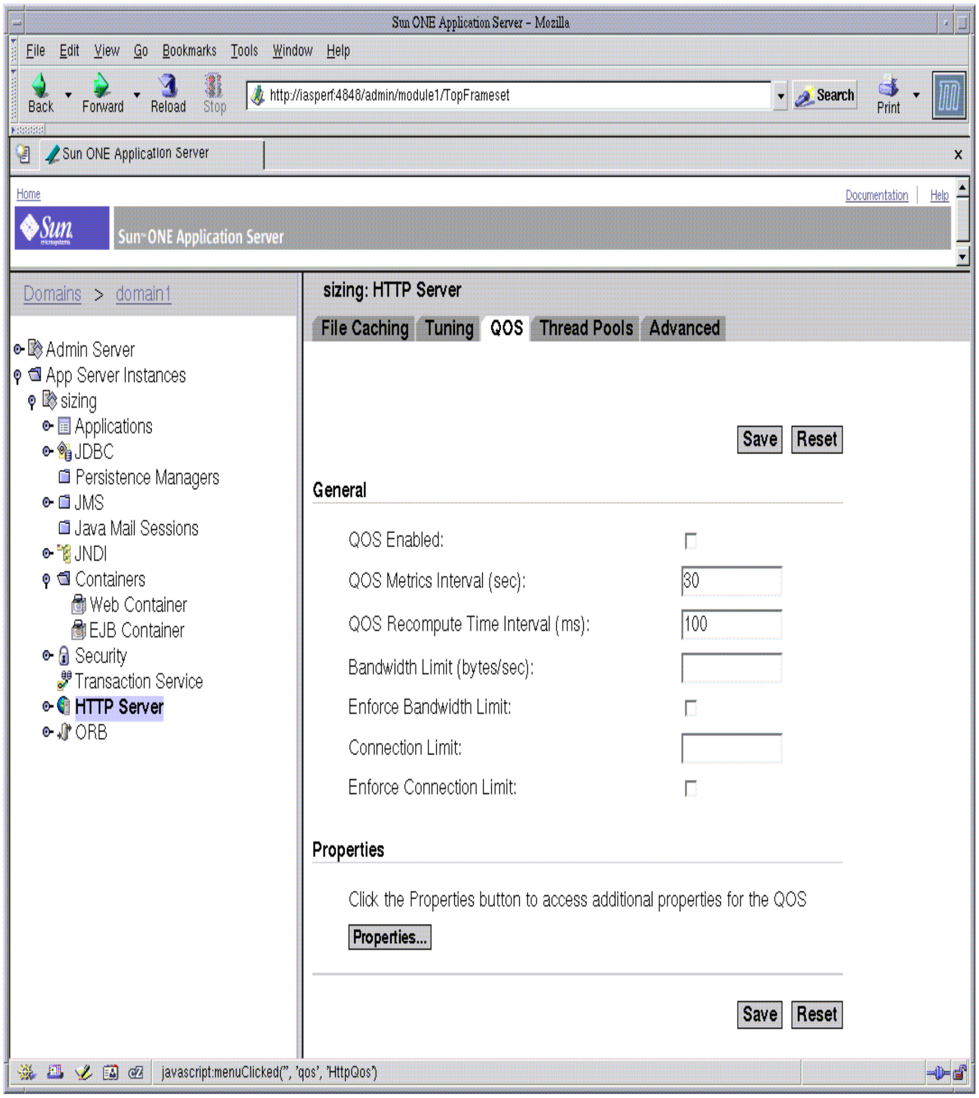
You can turn `LogVerbose` ONby editing the `LogVerbose` parameter in `init.conf`.

CAUTION Do not turn on `LogVerbose` on a production server. Doing so degrades performance and increases the size of your error logs.

Using Quality of Service

The quality of service features let you limit the amount of bandwidth and number of connections for a server instance, class of virtual servers, or individual virtual server. You can set these performance limits, track them, and optionally enforce them.

The following figure shows the Administration interface for configuring the Quality of Service.



sizing: HTTP Server

General

QOS Enabled:	☐
QOS Metrics Interval (sec):	30
QOS Recompute Time Interval (ms):	100
Bandwidth Limit (bytes/sec):	
Enforce Bandwidth Limit:	☐
Connection Limit:	
Enforce Connection Limit:	☐

Properties

Click the Properties button to access additional properties for the QOS

Figure 4-13 Tuning the Quality of Service using the Administration Interface

For more information, see “Using Quality of Service” in the *Sun ONE Application Server Administrator's Guide.*

Threads, Processes, and Connections

In the Sun ONE Application Server, acceptor threads on an HTTP Listener accept connections and put them onto a connection queue. Session threads then pick up connections from the queue and service the requests. More session threads are posted if required at the end of the request. The policy for adding new threads is based on the connection queue state:

- Each time a new connection is returned, the number of connections waiting in the queue (the backlog of connections) is compared to the number of session threads already created. If it is greater than the number of threads, more threads are scheduled to be added the next time a request completes.
- The previous backlog is tracked, so that another `ThreadIncrement` number of threads are scheduled to be added of the following are true:
    - The number of threads are seen to be increasing over time.
    - The increase is greater than the `ThreadIncrement` value.
    - The number of session threads minus the backlog is less than the `ThreadIncrement` value.
- The process of adding new session threads is strictly limited by the `RqThrottle` value.
- To avoid creating too many threads when the backlog increases suddenly (such as the startup of benchmark loads), the decision whether more threads are needed is made only once every 16 or 32 times a connection is made based on how many session threads already exist.

The following directives affect the number and timeout of threads, processes, and connections can be tuned in the web-based Admin Console or `init.conf`:

- `ConnQueueSize`
- `HeaderBufferSize`
- `AcceptTimeOut`
- `KeepAliveThreads`
- `KeepAliveTimeout`
- `KernelThreads`
- `ListenQ`
- `MaxKeepAliveConnections`

- `MaxProcs (Unix Only)`
- `PostThreadsEarly`
- `RcvBufSize`
- `RqThrottle`
- `RqThrottleMin`
- `SndBufSize`
- `StackSize`
- `TerminateTimeout`
- `ThreadIncrement`
- `UseNativePoll (Unix only)`

For more information about these directives, see the *Sun ONE Application Server Developer's Guide to NSAPI*.

HTTP listener Acceptor Threads

You can specify how many threads you want in accept mode on a listen socket at any time. It is a good practice to set this to less than or equal to the number of CPUs in your system.

Tuning

You can set the number of HTTP listener acceptor threads by:

- Editing the `server.xml` file
- Selecting the http-listener node of the web-based Administration interface.

Maximum Simultaneous Requests

The `RqThrottle` parameter in the `init.conf` file specifies the maximum number of simultaneous transactions the web server can handle. The default value is 128. Changes to this value can be used to throttle the server, minimizing latencies for the transactions that are performed. The `RqThrottle` value acts across multiple virtual servers, but does not attempt to load-balance.

To compute the number of simultaneous requests, the server counts the number of active requests, adding one to the number when a new request arrives, subtracting one when it finishes the request. When a new request arrives, the server checks to see if it is already processing the maximum number of requests. If it has reached the limit, it defers processing new requests until the number of active requests drops below the maximum amount.

In theory, you could set the maximum simultaneous requests to 1 and still have a functional server. Setting this value to 1 would mean that the server could only handle one request at a time, but since HTTP requests for static files and generally have a very short duration (response time can be as low as 5 milliseconds), processing one request at a time would still allow you to process up to 200 requests per second.

However, in actuality, Internet clients frequently connect to the server and then do not complete their requests. In these cases, the server waits 30 seconds or more for the data before timing out. You can define this timeout period using the `AcceptTimeOut` directive in `init.conf`. The default value is 30 seconds. Also, some sites do heavyweight transactions that take minutes to complete. Both of these factors add to the maximum simultaneous requests that are required. If your site is processing many requests that take many seconds, you may need to increase the number of maximum simultaneous requests. For more information on `AcceptTimeOut`, see AcceptTimeOut Information.

Suitable `RqThrottle` values range from 100-500, depending on the load.

`RqThrottleMin` is the minimum number of threads the server initiates upon start-up. The default value is 48. `RqThrottle` represents a hard limit for the maximum number of active threads that can run simultaneously, which can become a bottleneck for performance. The default value is 128.

NOTE If you are using older NSAPI plug-ins that are not re-entrant, they will not work with the multi-threading model described. To continue using them, revise them so they are re-entrant. If this is not possible, configure your server to work with them by setting `RqThrottle` to 1, and use a high value for `MaxProcs`, such as 48 or greater. This will adversely impact your server's performance.

Tuning

You can tune the number of simultaneous requests by:

- Editing `RqThrottleMin` and `RqThrottle` in the `init.conf` file.

- Entering the desired value in the Maximum Simultaneous Requests field from the Performance Tuning page under Preferences in the web-based Administration interface.

Improving Java Performance

There are a number of ways you can improve Java performance on Sun ONE Application Server. These include:

- Using Alternate Thread Library
- Using Pre-compiled JSPs
- Configuring Class Reloading

Using an Alternate Thread Library

On Solaris 8 and above, using an alternate thread library such as `libthread` or `/usr/lib/lwp`, gives optimal performance. This `libthread` is enabled by default.

Using Pre-compiled JSPs

Compiling JSPs is a resource intensive and time-consuming process. You will improve performance if you pre-compile your JSPs before installing them into your server.

Configuring Class Reloading

The configuration for flag for dynamic reloading should be disabled for better performance. This can be accomplished by editing the `server.xml` and setting `dynamic-reload-enabled="false"`

Miscellaneous init.conf Directives

The following sections discuss `init.conf` directives you can use to configure your server to function more effectively:

- AcceptTimeOut Information
- CGIStub Processes (Unix/Linux)
- Buffer Size

AcceptTimeOut Information

Use `AcceptTimeOut` to specify the number of seconds the server waits between accepting a connection to a client and receiving information from it. The default setting is 30 seconds. Under most circumstances you should not have to change this setting. By setting it to less than the default 30 seconds, you can free up threads sooner. However, you may also disconnect users with slower connections.

Tuning

You can set the `AcceptTimeOut` by:

- Editing the `AcceptTimeOut` parameter in `init.conf`.
- Modifying the value in the performance sub-menu of the Advanced tab in the web-based Administration interface.

CGIStub Processes (Unix/Linux)

You can adjust the `CGIStub` parameters on Unix/Linux systems. In Sun ONE Application Server, the CGI engine creates `CGIStub` processes as needed. On systems that serve a large load and rely heavily on CGI-generated content, it is possible for the `CGIStub` processes to consume all system resources. If this is happening on your server, the `CGIStub` processes can be tuned to restrict how many new `CGIStub` processes can be spawned, their timeout value, and the minimum number of `CGIStub` processes that will be running at any given moment.

NOTE If you have an `init-cgi` function in the `init.conf` file and you are running in multi-process mode, you must add `LateInit = yes` to the `init-cgi` line.

The four directives and their defaults that can be tuned to control CGI stubs are:

- `MinCGIStubs`
- `MaxCGIStubs`
- `CGIStubIdleTimeout`
- `CGIExpirationTimeout`

`MinCGIStubs` controls the number of processes that are started by default. The first `CGIStub` process is not started until a CGI program has been accessed. The default value is 2. If you have an init-cgi directive in the `init.conf` file, the minimum number of `CGIStub` processes are spawned at startup.

MaxCGIStubs controls the maximum number of CGIStub processes the server can spawn. This specifies the maximum concurrent CGIStub processes in execution, not the maximum number of pending requests. The default value shown should be adequate for most systems. Setting this too high may actually reduce throughput. The default value is 10.

CGIStubIdleTimeout causes the server to kill any CGIStub processes that have been idle for the number of seconds set by this directive. Once the number of processes is at MinCGIStubs it does not kill any more processes. The default is 45.

CGIExpirationTimeout limits the maximum time in seconds that CGI processes can run.

Tuning

You can configure all of the directives for CGI Stub processes by:

- Editing the init.conf file
- Modifying the value in the CGI sub-menu of the Advanced tab in the web-based Administration interface.

Buffer Size

You can specify the size of the send buffer (SndBufSize) and the receiving buffer (RcvBufSize) at the server's sockets. For more information regarding these buffers, see your Unix/Linux documentation.

Tuning

You can set the buffer size by:

- Editing the SndBufSize and RcvBufSize parameters in init.conf.
- Setting or changing the SndBufSize and RcvBufSize values in the Performance sub-menu of the Advanced tab in the web-based Administration interface.

Miscellaneous obj.conf Parameters

You can use some obj.conf function parameters to improve your server's performance. In addition to the ones listed below, see "Using the nocache Parameter" for additional information.

For more information on using obj.conf, see the *Sun ONE Application Server Developer's Guide to NSAPI.*

find-pathinfo-forward

The parameter `find-pathinfo-forward` for the `PathCheck` function `find-pathinfo` and the `NameTrans` functions `pfx2dir` and `assign-name` can help you improve your performance. This parameter instructs the server to search forward for `PATH_INFO` in the path after `ntrans-base`, instead of backward from the end of path in the server function `find-pathinfo`.

NOTE The server ignores the `find-pathinfo-forward` parameter if the `ntrans-base` parameter is not set in `rq->vars` when the server function `find-pathinfo` is called. By default, `ntrans-base` is set.

For example:

```
NameTrans fn="pfx2dir" find-pathinfo-forward="" from="/cgi-bin"
dir="/export/home/cgi-bin" name="cgi"

NameTrans fn="assign-name" from="/perf" find-pathinfo-forward=""
name="perf"
```

This feature can improve performance for certain URLs by doing fewer stats in the server function `find-pathinfo`. On Windows NT, you can also use this feature to prevent the server from changing "\" to "/" when using the `PathCheck` server function `find-pathinfo`.

nostat

You can specify the parameter `nostat` in the `NameTrans` function `assign-name` to prevent the server from doing a stat on a specified URL whenever possible. Use the following syntax:

```
nostat=virtual-path
```

For example:

```
<Object name=default>

NameTrans fn="assign-name" from="/nsfc" nostat="/nsfc"
name="nsfc"

</Object>

<Object name=nsfc>

Service fn=service-nsfc-dump

</Object>
```

In the above example, the server does not stat for path `/`*ntrans-base*`/nsfc` and `/`*ntrans-base*`/nsfc/*` if *ntrans-base* is set. If *ntrans-base* is not set, the server does not stat for URLs `/nsfc` and `/nsfc/*`. By default *ntrans-base* is set. The example assumes the default `PathCheck` server functions are used.

When you use `nostat=` *virtual-path* in the `assign-nameNameTrans`, the server assumes that stat on the specified *virtual-path* will fail. Therefore, use `nostat` only when the path of the *virtual-path* does not exist on the system, for example, in NSAPI plug-in URLs. Using `nostat` on those URLs improves performance by avoiding unnecessary stats on those URLs.

Scaling Your Server

This section examines subsystems of your server and makes some recommendations for optimal performance:

- Processors
- Memory
- Disk Space
- Networking

Processors

On Solaris and Windows NT, Sun ONE Application Server transparently takes advantage of multiple CPUs. In general, the effectiveness of multiple CPUs varies with the operating system and the workload. Dynamic content performance improves as more processors are added to the system. Because static content involves mostly IO, and more primary memory means more caching of the content (assuming the server is tuned to take advantage of the memory) more time is spent in IO rather than any busy CPU activity. Our study of dynamic content performance on a four-CPU machine indicate a 40-60% increase for NSAPI and about 50-80% increase for servlets., by doubling the number of CPUs.

Memory

Sun ONE Application Server requires a minimum of 256 MB RAM on Solaris and Windows. These values apply to the application server running on a system that is not running Sun ONE Studio. Please refer to the *Sun ONE Application Server Installation Guide* on the Sun Microsystems documentation web site.

Disk Space

You need to have enough disk space for your OS, document tree, and log files. In most cases 2GB total is sufficient.

Put the OS, swap/paging file, Sun ONE Application Server logs, and document tree each on separate hard drives. Thus, if your log files fill up the log drive, your OS will not suffer. Also, you'll be able to tell whether, for example, the OS paging file is causing drive activity.

Your OS vendor may have specific recommendations for how much swap or paging space you should allocate. Based on our testing, Sun ONE Application Server performs best with swap space equal to RAM, plus enough to map the document tree.

Networking

For an Internet site, decide how many peak concurrent users you need the server to handle, and multiply that number of users by the average request size on your site. Your average request may include multiple documents. If you're not sure, try using your home page and all its associated sub-frames and graphics.

Next decide how long the average user will be willing to wait for a document, at peak utilization. Divide by that number of seconds. That's the WAN bandwidth your server needs.

For example, to support a peak of 50 users with an average document size of 24kB, and transferring each document in an average of 5 seconds, we need 240 KBs (1920 kbit/s). So our site needs two T1 lines (each 1544 kbit/s). This also allows some overhead for growth.

Your server's network interface card should support more than the WAN it's connected to. For example, if you have up to three T1 lines, you can get by with a 10BaseT interface. Up to a T3 line (45 Mbit/s), you can use 100BaseT. But if you have more than 50 Mbit/s of WAN bandwidth, consider configuring multiple 100BaseT interfaces, or look at Gigabit Ethernet technology.

For an intranet site, your network is unlikely to be a bottleneck. However, you can use the same calculations as above to decide.

Connection Pool Tuning

This section advises how users can tune their JDBC Connection Pools.

For database intensive applications, the JDBC Connection Pools managed by the Sun ONE Application Server can be tuned for optimum performance. These connection pools maintain numerous live physical database connections that can be reused in order reduce the overhead of opening and closing database connections.

JDBC Resources are defined as `<jdbc-resource>` elements in the Sun ONE Application Server configuration file `server.xml` and are configured to point to a `<jdbc-connection-pool>`. J2EE applications use JDBC Resources to obtain connections that are maintained by the JDBC Connection Pool. More than one JDBC Resource is allowed to point to the same JDBC Connection Pool. In such a case, the physical connection pool is shared by all the resources.

JDBC Connection Pools can be defined and configured by using the web-based Admin Console or by editing the `jdbc-connection-pool` element in the `server.xml` file. Though each defined pool is instantiated at server start-up, the pool is only populated with physical connections when accessed for the first time.

The following are the attributes that can be specified for a JDBC connection pool:

Table 4-1 JDBC Connection Pool Attributes

Name	**Description**
`name`	Unique name of the pool definition.
`datasource-classname`	Name of the vendor supplied JDBC datasource resource manager. An XA or global transactions capable datasource class will implement `javax.sql.XADatasource` interface. Non XA or Local transactions only datasources will implement `javax.sql.Datasource` interface.
`res-type`	Datasource implementation class could implement one or both of `javax.sql.DataSource`, `javax.sql.XADataSource` interfaces. This optional attribute must be specified to disambiguate when a Datasource class implements both interfaces. An error is produced when this attribute has a legal value and the indicated interface is not implemented by the datasource class. This attribute has no default value.
`steady-pool-size`	Minimum and initial number of connections created.
`max-pool-size`	Maximum number of connections that can be created.
`max-wait-time-in-millis`	Amount of time the caller will wait before getting a connection timeout. The default is 60 seconds. A value of 0 will force caller to wait indefinitely.

Table 4-1 JDBC Connection Pool Attributes

`pool-resize-quantity`	Number of connections to be removed when `idle-timeout-in-seconds timer` expires. Connections that have idled for longer than the timeout are candidates for removal. When the pool size reaches `steady-pool-size`, the connection removal stops.
`idle-timeout-in-seconds`	Maximum time in seconds that a connection can remain idle in the pool. After this time, the pool implementation can close this connection. Note that this does not control connection timeouts enforced at the database server side. Administrators are advised to keep this timeout shorter than the database server side timeout (if such timeouts are configured on the specific vendor's database), to prevent accumulation of unusable connection in Application Server.
`transaction-isolation-level`	Specifies the Transaction Isolation Level on the pooled database connections. This setting is optional and has no default. If left unspecified the pool operates with default isolation level provided by the JDBC Driver. A desired isolation level can be set using one of the standard transaction isolation levels: `read-uncommitted`, `read-committed`, `repeatable-read`, `serializable`.
`is-isolation-level-guaranteed`	Applicable only when a particular isolation level is specified for `transaction-isolation-level`. The default value is true. This assures that every time a connection is obtained from the pool, it is guaranteed to have the isolation set to the desired value. This setting can have some performance impact on some JDBC drivers. It can be set to false by that administrator when they are certain that the application does not change the isolation level before returning the connection.
`is-connection-validation-required`	If true, connections are validated (checked to find out if they are usable) before being given out to the application. Also, the `connection-validation-type` specifies the type of validation to be performed. The default is false. Types of validation supported: 1) using connection.`autoCommit()`, 2) using connection.`getMetaData()` 3) performing a query on a user specified table (see `validation-table-name`). The possible values are one of: `auto-commit`, or `meta-data`. The table `validation-table-name` attribute specifies the table name to be used to perform a query to validate a connection. This parameter is mandatory, if `connection-validation-type` is set to table. Verification by accessing a user specified table may become necessary for connection validation, particularly if database driver caches calls to `setAutoCommit()` and `getMetaData()`.
`fail-all-connections`:	Indicates if all connections in the pool must be closed should a single validation check fail. The default is false. One attempt will be made to re-establish failed connections.

JDBC Connection Pool Tuning

The following performance tuning practices are recommended for JDBC Connection Pools:

- Use the default isolation level provided by the driver rather than calling the `setTransactionIsolationLevel()`; unless you are certain that your application behaves correctly and performs better at a different isolation level.
- Set the idle time out to 0 seconds. This directive ensures that the connections which are idle will not be removed at all. This ensures that there is normally no penalty in creating new connections and disables the idle monitor thread. However, there is a risk that the connection unused for too long is reset by the database server.
- When sizing connection pools, keep the following pros and cons in mind:

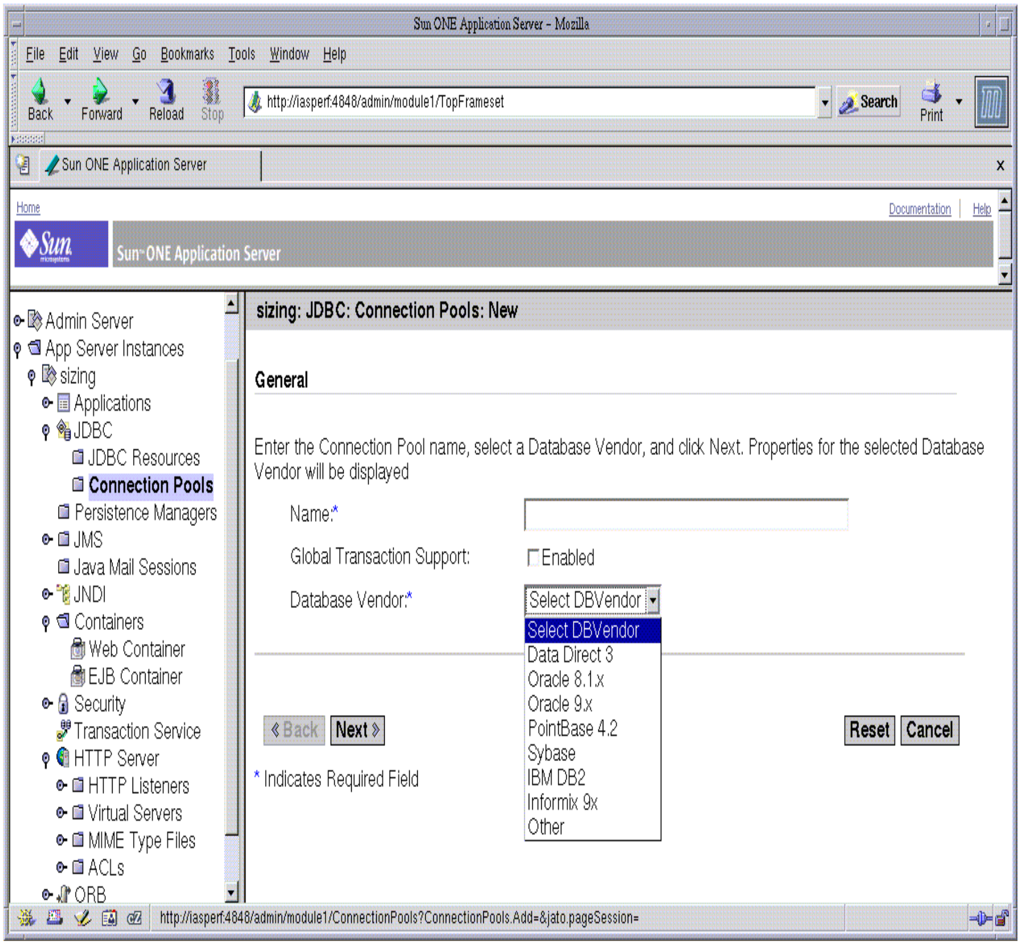
Table 4-2 Connection Pool Sizing Pros and Cons

Connection pool	Pros	Cons
Small Connection pool	• faster access on the connection table.	• not enough connections to satisfy requests. • most requests will spend more time in the queue.
Large Connection pool	• more connections to fulfill requests. • less (or no) time in the queue	• slower access on the connection table.

- Set the `max-wait-time-in-millis` to 0. This essentially blocks the client thread until a connection becomes available. Also, this allows the server to alleviate the task of tracking the elapsed wait time for each request and increases performance.
- As previously noted, avoid modifying the `transaction-isolation-level`. If that is not possible, consider setting the `is-isolation-level-guaranteed` flag to false and make sure applications do not programmatically alter the connections' isolation level.

- Setting the`is-connection-validation-required` parameter to `true` forces the server to apply the connection validation algorithm every time a connection is returned from the pool. This adds overhead to the latency of `getConnection()`. If the database connectivity is reliable, validation can be skipped.

The following figure shows the Administration interface for configuring the connection pools.



sizing: JDBC: Connection Pools: New

General

Enter the Connection Pool name, select a Database Vendor, and click Next. Properties for the selected Database Vendor will be displayed

Name:*

Global Transaction Support: Enabled

Database Vendor:* Select DBVendor

Select DBVendor
Data Direct 3
Oracle 8.1.x
Oracle 9.x
PointBase 4.2
Sybase
IBM DB2
Informix 9x
Other

* Indicates Required Field

Figure 4-14 Tuning the JDBC Connection Pools using the Administration Interface

JSP and Servlet Tuning

This section advises how users can tune JSP and Servlet applications by following several coding practices and checking several relevant Sun ONE Application Server configuration settings.

Suggested Coding Practices for JSP's and Servlets

The following coding practices are recommended for JSP and Servlet applications:

1. Do not store large objects as `HttpSession` variables
2. Use `javax.servlet.http.HttpSession.invalidate()` to release HTTP Sessions when they are no longer needed.
3. Use the JSP directive `<%page session="false"%>` to prevent HTTP Sessions from being automatically created when they are not necessary.
4. Minimize Java synchronization in Servlets.
5. Don't use the single thread model for Servlets.
6. Use the servlet's `init()` method to perform expensive one time initialization.
7. Avoid the use of `System.out.println()` calls.

Configuration Settings that Affect JSP/Servlet Performance

The following configuration settings will improve performance. It is important to remember that they are intended for production environments as some of the settings make developing JSP and Servlets impractical.

1. In the server `CLASSPATH` setting, avoid excessive directories to improve class loading time. Package application related classes into JAR files.
2. HTTP settings - connections, keep-alive subsystem settings: the response times are dependent on how the keep-alive subsystem and the HTTP server is tuned in general. Please refer to the section on HTTP Server Tuning for more information.
3. Set the recompile reload interval to -1 to prevent JSP recompilation.

4. Use `mtmalloc` for SSL. Functions in this library provide a collection of `malloc` routines that provide concurrent access to heap space. Obtain the patch from http://www.sunsolve for `libmtmalloc`. Edit the `startserv` script, located in `/bin/startserv`, for the server instance in question and prepend the location of the `so` file to `LD_LIBRARY_PATH`.

5. JSP Servlet caching configuration. For more information, see the *Sun ONE Application Server 7 Developer's Guide to Web Applications* specifically, the chapter titled *Using Servlets* subsection on *Caching Features*.

6. Deploy applications that do not contain EJB's as a WAR file rather than an EAR file.

7. The security manager is expensive. This is because all the calls to the required resources will have to go through a `doPrivileged()` method call. This also involves checking the resource in question with the `server.policy` file. If there is an option where having `server.policy` doesn't make sense for the application, and under the assumption that no malicious code will be run on the server, then the user can disable the `server.policy` by commenting out the line in `server.xml`.

   For example, you can comment out the `server.policy` as follows:

   ```
   <!-- jvm-options>
   -Djava.security.policy=/export/home/software/ias70_gold3/domains
   /domain1/server1/config/server.policy
   ```

   ```
   </jvm-options -->
   ```

Performance Tuning for EJBs

The Sun ONE Application Server's high performance EJB Container provides various tunables, with default values, that can be modified in the `server.xml` configuration file, and in each bean's descriptors. The values in `server.xml` apply to all EJBs unless they are also specified in the bean's deployment descriptors. Properties set in a bean's descriptors always override any settings in the `server.xml`. For a detailed description of `<ejb-container>` element in the `server.xml` file, see the *Sun ONE Application Server Configuration File Reference*.

Some properties that are in the EJB 2.0 deployment descriptor are also a good source of tuning. The default settings for the `<ejb-container>` element in the `server.xml` file are set for a single processor computer system. A user may want to change the default settings in order to derive the desired behavior from the container. The desired effects after tuning are for:

- Speed: Response times can be decreased effectively by caching as many beans in the EJB caches as possible. This saves several CPU-intensive operations (as explained below). However, one can have only finite memory as a resource, as the caches become large, house-keeping for these caches (including garbage collection) takes longer.
- Memory consumption: Beans in the pools or caches consume memory from the Java Virtual Machine heap. Exceedingly large pools and caches are detrimental to performance due to longer and frequent garbage collection cycles.
- Functional properties: (such as user timeout, commit options, security and transaction options, etc.) - Most of these properties are related to the functionality and configuration of the application in the J2EE server. It is not recommended to compromise functionality for performance, though some suggestions will be made to help make choices in case such a situation arises.

Performance Tuning the EJB Container

The EJB specification formally defines the life cycle of various types of beans. This document assumes that you are familiar with bean lifecycle events. Active beans in the container process requests and are cached or pooled for better performance. Tuning the cache and pool properties is a significant part of tuning for performance

Depending on the type of a bean, some of the suggested tuning tips may not apply to a particular container.

Guide to Using Tunables

The following table illustrates the cache and bean tunables for each type of EJB.

Table 4-3 Cache and Bean Tunables for EJBs

	Cache Tunables						**Pool Tunables**			
Type of Bean	**cache-resize-quantity**	**max- cache-size**	**cache-idle-timeout-in-seconds**	**removal-timeout-in-seconds**	**victim-selection-policy**	**refresh-period-in-seconds**	**steady-pool-size**	**pool-resize-quantity**	**max-pool-size**	**pool-idle-timeout-in-seconds**
Stateful Session	X	X	X	X	X					
Stateless Session							X	X	X	X
Entity (BMP/CMP)	X	X	X	X	X		X	X	X	X
Entity (BMP) ReadOnly	X	X	X	X	X	X	X	X	X	X
Message Driven Bean								X	X	X

EJB Descriptor Properties

The following properties are available to tune for each bean in EJB Container:

- **`steady-pool-size`**: `steady-pool-size` specifies the initial and minimum number of beans that must be maintained in the pool. Valid values are from 0 to `MAX_INTEGER`. This value is specified at the server instance level. The bean specific counterpart to this is also the same. Note that for all the variables below, if there is a setting specified at the bean level (in the `sun-ejb-jar.xml`), the values specified at the bean level are used.

- **`pool-resize-quantity`**: `pool-resize-quantity` specifies the number of beans to be created or deleted when the pool is being serviced by the server. Valid values are from 0 to `MAX_INTEGER` and subject to maximum size limit). Default is 16. The corresponding attribute in the `sun-ejb-jar.xml` is `resize-quantity`.
- **`max-pool-size`**: `max-pool-size` specifies the maximum pool size. Valid values are from 0 to `MAX_INTEGER`. Default is 64. A value of 0 means that the size of the pool is unbounded. The potential implication is that the JVM heap will be filled with objects in the pool. The corresponding attribute in the `sun-ejb-jar.xml` is `max-pool-size` in the <`bean-pool`> element.
- **`max-wait-time-in-millis`** (deprecated)
- **`pool-idle-timeout-in-seconds`**: `pool-idle-timeout-in-seconds` specifies the maximum time that a stateless session bean, entity bean, or message-driven bean is allowed to be idle in the pool. After this time, the bean is destroyed if the bean in case is a stateless session bean or a message driver bean. This is a hint to server. Default value for `pool-idle-timeout-in-seconds` is 600 seconds. The corresponding attribute in the `sun-ejb-jar.xml` is `pool-idle-timeout-in-seconds` in the <`bean-pool`> element.
- **`cache-resize-quantity`**: `cache-resize-quantity` specifies the number of beans to be created or deleted when the cache is being serviced by the server. Valid values are from 0 to `MAX_INTEGER` and subject to maximum size limit. Default is 16. The corresponding attribute in the `sun-ejb-jar.xml` is `resize-quantity` in the <bean-cache> element.
- **`max-cache-size`**: `max-cache-size` defines the maximum number of beans in the cache. Should be greater than 1. Default is 512. Avalue of 0 indicates the cache is unbounded. The size of the cache, in this case, is governed by cache-idle-timeout-in-seconds and cache-resize-quantity. The corresponding attribute in the `sun-ejb-jar.xml` is `max-cache-size` in the <`bean-cache`> element.
- **`cache-idle-timeout-in-seconds`**: `cache-idle-timeout-in-seconds` specifies the maximum time that a stateful session bean or entity bean is allowed to be idle in the cache. After this time, the bean is passivated to backup store. Default value for cache-idle-timeout-in-seconds is 600 seconds. The corresponding attribute in the `sun-ejb-jar.xml` is `cache-idle-timeout-in-seconds` in the <`bean-cache`> element.
- **`is-cache-overflow-allowed`** (deprecated)

- **`removal-timeout-in-seconds`**: The amount of time that a stateful session bean remains passivated (i.e. idle in the backup store) is controlled by `removal-timeout-in-seconds` parameter. Note that if a bean was not accessed beyond `removal-timeout-in-seconds`, then it will be removed from the backup store and hence will not be accessible to the client. The Default value for `removal-timeout-in-seconds` is 60min. The corresponding attribute in the `sun-ejb-jar.xml` is `removal-timeout-in-seconds` in the <`bean-cache`> element.

- **`victim-selection-policy`**: `victim-selection-policy` specifies the algorithm to use to pick victims to be removed from the stateful session bean cache. Possible values are `FIFO | LRU | NRU`. Default is `NRU`, which is actually pseudo-random selection policy. The corresponding attribute in the `sun-ejb-jar.xml` is `victim-selection-policy` in the <`bean-cache`> element.

- **`commit-option`**: values are either "`B`", or "`C`". Default is "`B`". These reflect `commit-options` for transactions as per the EJB specification.

- **`refresh-period-in-seconds`**: (for BMP / Read Only Beans only) `refresh-period-in-seconds` specifies the rate at which the read-only-bean must be refreshed from the data source. 0 (never refreshed) and positive (refreshed at specified intervals). Default is 600 seconds.

Tuning the EJB Pool

A bean in the pool represents the pooled state in the EJB lifecycle. This means that the bean does not have an identity. The advantage of having beans in the pool is that the time to create a bean may be saved for a request. The container has mechanisms that create pool objects in the background, to save the time of bean creation on the request path.

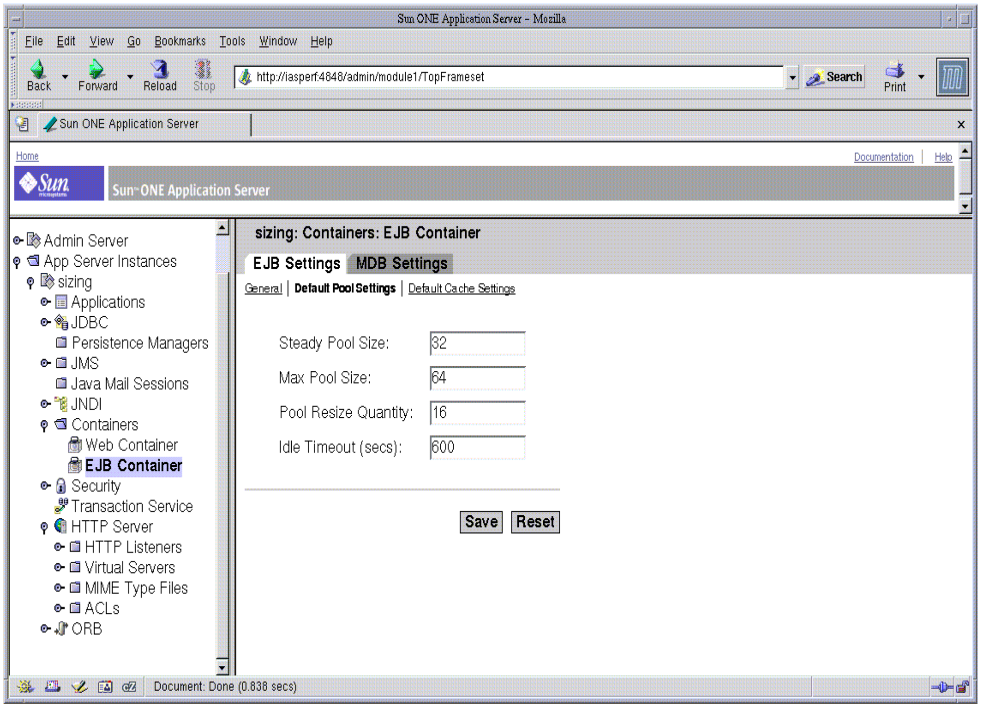
Set the `steady-pool-size` to a number that is indicative of a moderately loaded system. It is recommended that `steady-pool-size` be greater than 0, as it ensures that there is always a pooled instance to process an incoming request.

Set the `max-pool-size` to be representative of the anticipated high load of the system. An excessively large pool wastes memory and can slow down the system. A very small pool is also inefficient due to contention.

A good rule to remember when changing the `<max-pool-size>` is to also re-calibrate the `<pool-resize-quantity>`. This quantity is the number of beans that will be reclaimed by the periodic cleaner. An increase in the max size should mean an appropriate increase in the resize quantity to maintain a good equilibrium.

Another important tunable is the `<pool-idle-timeout-in-seconds>` value. In case there are more beans in the pool than the `<steady-pool-size>`, the pool will be drained back to `<steady-pool-size>` in steps of `<pool-resize-quantity>`, every `<pool-idle-timeout-in-seconds>` seconds. If the resize quantity is too small and the idle timeout large, the user would not see the pool draining back to steady size quick enough; this should be expected or corrected.

The following figure shows the Administration interface for tuning the EJB pool for the server instance.



sizing: Containers: EJB Container

Steady Pool Size:	32
Max Pool Size:	64
Pool Resize Quantity:	16
Idle Timeout (secs):	600

Figure 4-15 Tuning the EJB Pool using the Administration Interface

Tuning the EJB Cache

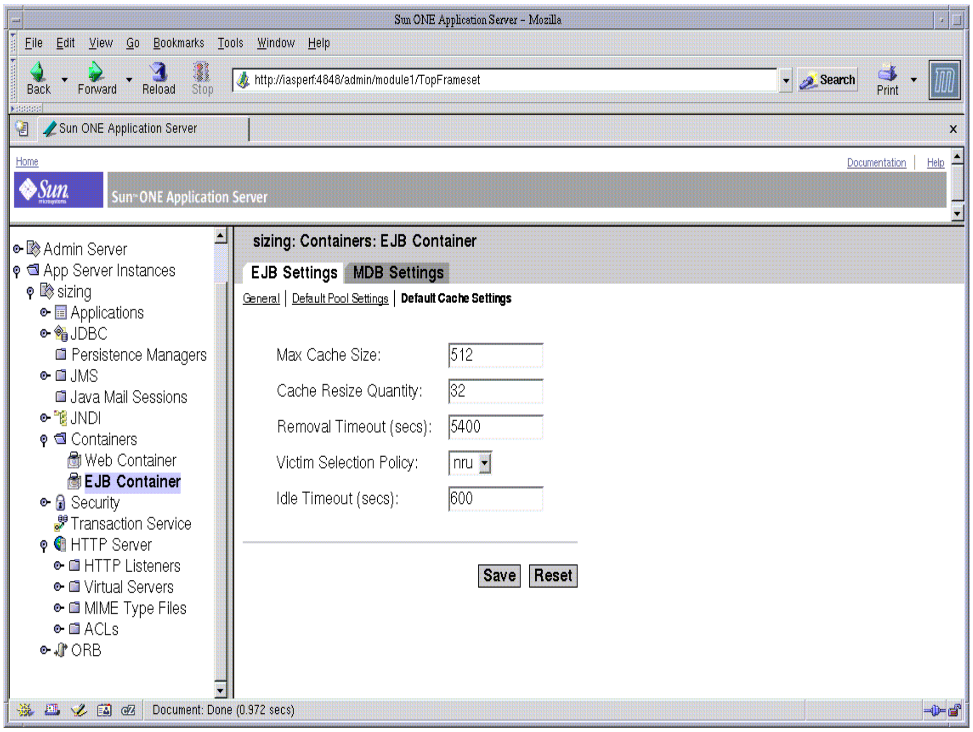
A bean in the cache represents the ready state in the EJB lifecycle. This means that the bean has an identity (e.g. primary key or session ID) associated with it. Beans moving out of the cache have to be passivated or destroyed according to the EJB lifecycle. Once passivated, a bean has to be activated to come back into the cache. Entity beans are generally stored in databases and use some form of query language semantics to load and store data. Session beans have to be serialized when storing them upon passivation onto the disk or a database; and similarly have to be deserialized upon activation.

Any incoming request using these 'ready' beans from the cache avoids the overheads of creation, setting identity, and potentially, activation. So, theoretically, it is good to cache as many beans as possible. However, there are downsides to caching extensively:

- memory consumed by all the beans affect the heap available in the Virtual Machine,
- increasing objects and memory taken by cache means longer, and perhaps more frequent, full Garbage Collection,
- application server might run out of memory (unless the heap is carefully tuned for peak loads).

The periodic cleaner will remove all beans in the cache that have reached the `<cache-idle-timeout-in-seconds>`.

The following figure shows the Administration interface for tuning the EJB cache for the container as a whole.

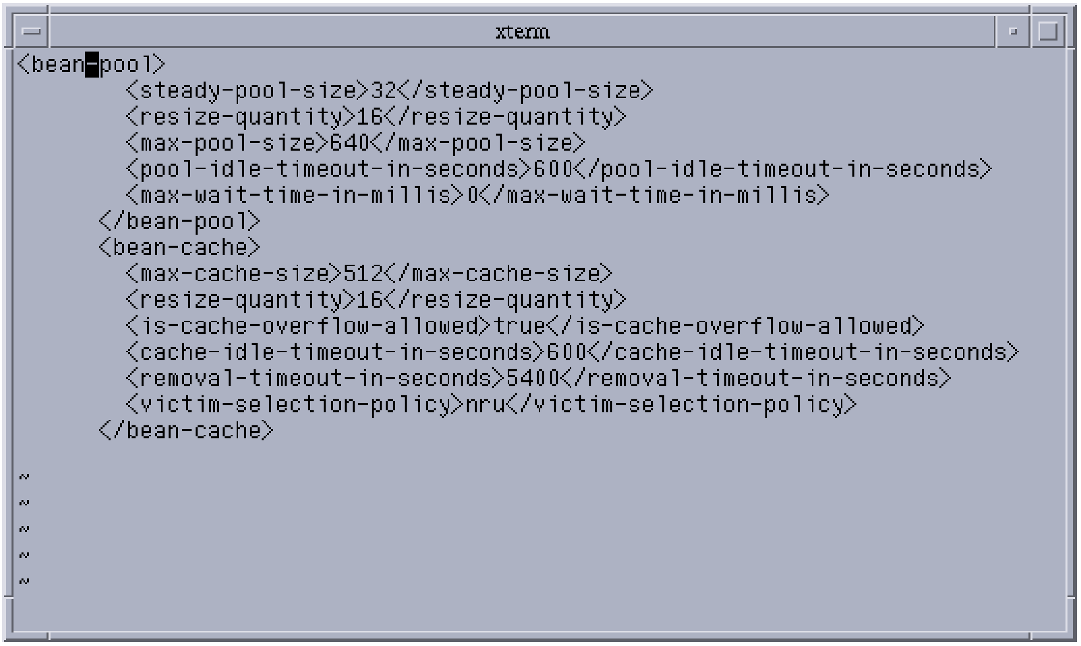

Sun ONE Application Server - Mozilla
File Edit View Go Bookmarks Tools Window Help
Back Forward Reload Stop
http://iasperf:4848/admin/module1/TopFrameset
Search Print
Sun ONE Application Server
Home Documentation Help
Sun ONE Application Server
Admin Server
App Server Instances
sizing
Applications
JDBC
Persistence Managers
JMS
Java Mail Sessions
JNDI
Containers
Web Container
EJB Container
Security
Transaction Service
HTTP Server
HTTP Listeners
Virtual Servers
MIME Type Files
ACLs
ORB
sizing: Containers: EJB Container
EJB Settings MDB Settings
General | Default Pool Settings | Default Cache Settings
Save Reset
Document: Done (0.972 secs)

Max Cache Size:	512
Cache Resize Quantity:	32
Removal Timeout (secs):	5400
Victim Selection Policy:	nru
Idle Timeout (secs):	600

Figure 4-16 Tuning the EJB Cache using the Administration Interface

Performance Considerations for Various Types of EJBs

The following figure shows an example of possible bean descriptors for an individual bean pool and cache.



```
<bean-pool>
        <steady-pool-size>32</steady-pool-size>
        <resize-quantity>16</resize-quantity>
        <max-pool-size>640</max-pool-size>
        <pool-idle-timeout-in-seconds>600</pool-idle-timeout-in-seconds>
        <max-wait-time-in-millis>0</max-wait-time-in-millis>
      </bean-pool>
      <bean-cache>
        <max-cache-size>512</max-cache-size>
        <resize-quantity>16</resize-quantity>
        <is-cache-overflow-allowed>true</is-cache-overflow-allowed>
        <cache-idle-timeout-in-seconds>600</cache-idle-timeout-in-seconds>
        <removal-timeout-in-seconds>5400</removal-timeout-in-seconds>
        <victim-selection-policy>nru</victim-selection-policy>
      </bean-cache>

~
~
~
~
~
```

Figure 4-17 Bean Descriptors for Individual

The following are performance related discussions of various bean types:

- **Entity beans**: Depending on the usage of a particular entity bean, one should tune max-cache-size so that beans that are used less (e.g. an order that is created and never used after the transaction is over) are cached less, and beans that are used frequently (e.g. an item in the inventory that gets referenced very often), are cached more in numbers. Please see the section titled *Commit Options* for other ways of tuning the entity container.
- **Stateful session beans**: In case a stateful bean represents a user, a healthy `max-cache-size` of beans could be the expected number of concurrent users on the application server process. If this value is too low (in relation to the steady load of users), beans would be frequently passivated and activated, causing a negative impact on the response times, due to CPU intensive serialization and deserialization as well as disk I/O. Another important variable for tuning is `cache-idle-timeout-in-seconds` where at periodic intervals of `cache-idle-timeout-in-seconds`, all the beans in the cache that have not been accessed for more than `cache-idle-timeout-in-seconds` time,

are passivated. Similar to an HttpSession inactivity/ idle timeout, the bean is removed after it has not been accessed for `removal-timeout-in-seconds`. Passivated beans are stored on disk in serialized form. A large number of passivated beans could not only mean many files on the disk system, but also slower response time as the session state has to be deserialized before the invocation.

- **Stateless session beans**: There is no state associated with stateless session beans and they are more readily pooled than entity or the stateful session beans. Appropriate values for `steady-pool-size`, `pool-resize-quantity` and `max-pool-size` are the best tunables for these type of beans. Set the `steady-pool-size` to greater than zero if you want to pre-populate the pool. This way, when the container comes up, it creates a pool with `steady-pool-size` number of beans. By pre-populating the pool you can avoid the object creation time during method invocations. Setting the `steady-pool size` to a very large value may cause unwanted memory growth and may result in large GC times. `pool-resize-quantity` determines the rate of growth as well as the rate of decay of the pool. Setting it to a small value will be better as the decay will behave like an exponential decay. Setting a small `max-pool-size` may cause excessive object destruction (and as a result excessive object creation) as instances will be destroyed from the pool if the current pool size exceeds `max-pool-size`.

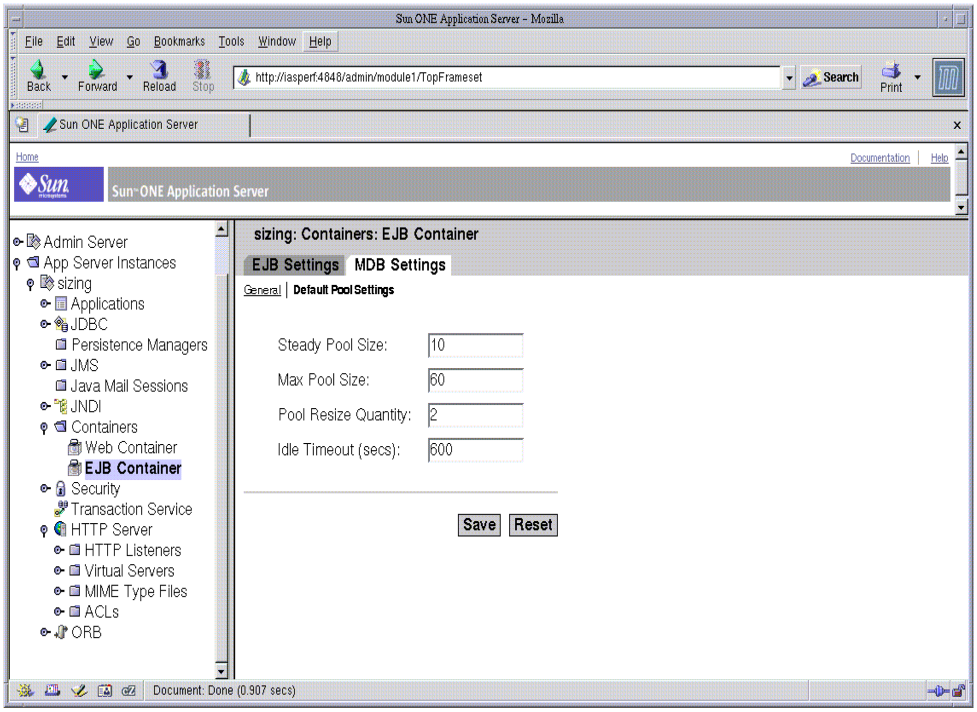
- **Read only entity beans**: If you have a regular BMP bean that never updates the database, try using a read-only bean in its place. By default, a read-only bean will work correctly only if the database row(s) represented by this bean are not being changed in the background. In the Sun ONE application server, read-only beans are supported only for bean managed persistence (BMP). A read-only bean never updates the database (i.e., `ejbStore` is never called). Consequently, there is a significant performance gain between a BMP bean and a read-only bean. If a read-only bean's method is accessed with a transaction (because the method descriptor in `ejb-jar.xml` is `TX_REQUIRED` or `TX_REQUIRES_NEW`), the `ejbLoad()` is always called. You may want to access a read-only bean method with a transaction if you want the cached data to always be in sync with the database. Its the non-transactional accesses where read-only beans perform at their best by avoiding the overhead of `ejbLoad()`. An important tunable to consider in this case is `refresh-period-in-seconds`. The current implementation of the container for these beans is a pull-cache, i.e. if for any beans instance, more than `refresh-period-in-seconds` time has passed, a user access to this bean instance will first invoke a `ejbLoad()` on the bean before executing any business methods. Tune this time to an appropriate value, typically in minutes, where you anticipate the data to change. A good example is when hosting a stock quote with 5 minute periods, i.e. 300 seconds set as the `refresh-period-in-seconds`.

NOTE If you have a regular BMP bean that updates the data cached by a read-only bean, then consider using the programatic refresh feature described in the *Sun ONE Application Server Developer's Guide to EJB Technology*.

NOTE If the beans are developed and deployed onto the application server using Sun ONE Studio, then the user needs to edit the individual bean descriptor settings for bean pool and bean cache. These settings may not be suitable for production level deployment.

- **Message driven beans**: The container of these beans is a bit different than the ones for the entity and session beans. In the MDB container of the current version of the application server, session and threads are attached with the beans in the MDB pool. This is a good pattern to pool the threads for executing message driven requests in the container. Thus the bean pool should be given an appropriate value, considering all the parameters of the server (taking other applications into perspective). e.g. values greater than 500 will be inappropriate.

The following figure shows the Administration interface for tuning the pool for message driven beans.



sizing: Containers: EJB Container

Steady Pool Size:	10
Max Pool Size:	60
Pool Resize Quantity:	2
Idle Timeout (secs):	600

Figure 4-18 Configuring Message Driven Bean Container using the Administration Interface

Related Considerations

Here are related considerations to keep in mind when using EJB's.

- Remote vs Local interfaces

  An EJB can have remote and local interfaces. Remote clients which are not co-located in the same application server instance use the remote interface to access the bean. Calls to the remote interface are more expensive as it involves argument marshalling, transportation of the marshalled data over the network and unmarshaling and dispatch at the receiving end. Local clients which are co-located in the same application server instance can use the local interface of a bean if provided. Using the local interface is more efficient as it does not involve any argument marshalling, transportation and unmarshalling. The arguments are passed by reference and this means that the passed objects are shareable by the caller and callee (hence they need to be implemented appropriately so that they are shareable). If a bean is written to be used only by co-located clients then it makes sense to just provide the local interface for the bean and have the clients use the local interface. If on the other hand the bean is to be written in a location independent manner then both the remote and local interface can be provided so that remote clients use the remote interface and local clients can use the local interface for efficiency.

- Pass-by-value vs Pass-by-reference semantics

  Using the remote and local interface appropriately it should be possible to write beans that can be accessed by clients efficiently. But there may be some instances where it may not be possible to use the local interface:

- The application predates EJB 2.0 specification and was written without any local interfaces.

- There are bean to bean calls and the client beans are written without making any co-location assumptions about the called beans.

  For these cases Sun ONE Application Server 7.0 provides a pass-by-reference option which can be used to indicate that when making calls to the remote interface of the bean a co-located client can pass arguments by reference. By default Sun ONE Application Server uses pass-by-value semantics for calling the remote interface of a bean even if it is co-located. This can be quite expensive as pass-by-value semantics involves making copies of the argument before passing them. The pass-by-reference option can be specified at the entire application level or on a per bean basis. If if is specified at the application level then pass-by-reference semantics is used when passing arguments to the remote interface of all beans in the application. If this option is specified at a bean level then calls to the remote interface of the specified bean use the pass-by-reference semantics. Please refer to Sun ONE Application Server EJB Developers guide and Sun ONE Application Server Developers guide for more details about the pass-by-reference flag.

- Transaction isolation levels:

  With a clear idea on the application semantics with respect to transactions, one can choose the correct isolation level for optimum performance. The following are the transaction isolation levels listed in the order of performance from best for performance to worst:

  a. `READ_UNCOMMITTED`

  b. `READ_COMMITTED`

  c. `REPEATABLE_READ`

d. `SERIALIZABLE`

These values can be specified as a attribute of the database connection pool (`jdbc-connection-pool`).

- From the EJB container point of view, the following transaction attributes can be specified again from the following list. Options are listed in the order that is best for performance to worst.

  a. `NEVER`

  b. `TX_NOTSUPPORTED`

  c. `TX_MANDATORY`

  d. `TX_SUPPORTS`

  e. `TX_REQUIRED`

  f. `TX_REQUIRESNEW`

Commit Options

Commit option controls the action taken by the container on a bean when the transaction that the bean participated completes. Commit option has no effect on the bean code (the bean developer need not worry about the commit options). Commit option, however, has a significant impact on performance.

Sun ONE Application Server supports commit option B and commit option C.

Before we explain when to use the various commit options, let us describe what the container does when these commit options are used.

In Commit option B, when a transaction completes, the bean is kept in the cache and retains its identity. This means that the next invocation for the same primary key can use the instance that is in the cache. Of course, the bean's `ejbLoad` will be called before the method invocation to sync up with the database.

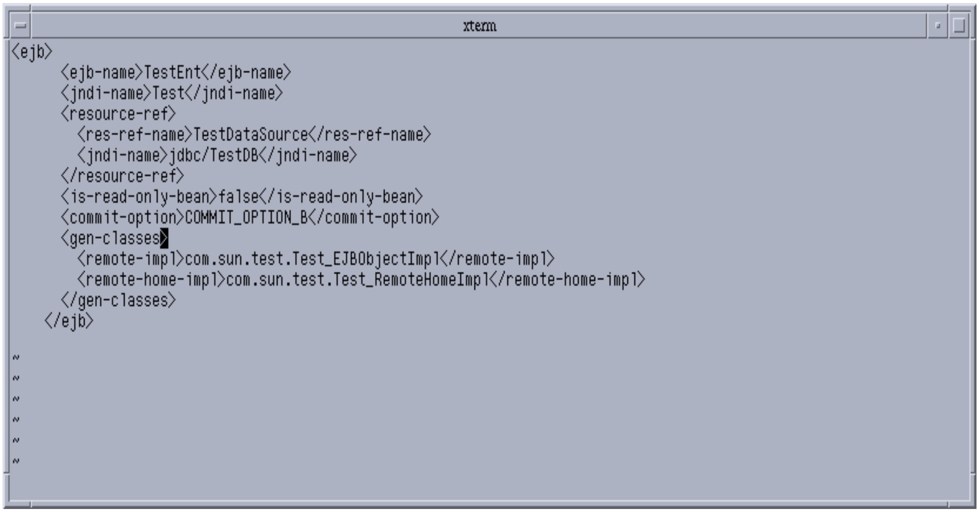
In case of Commit option C, when a transaction completes, the bean's `ejbPassivate()` method is called, then the bean is disassociated from its primary key and then it is returned to the free pool.This means that the next invocation for the same primary key will have to grab a free bean from the pool, set the `PrimaryKey` on this instance, and then call `ejbActivate` on the instance. Again, the bean's `ejbLoad` will be called before the method invocation to sync up with the database.

It is clear that Commit Option B avoids `ejbAcivate` and `ejbPassivate` calls. So, in most cases commit option-B should perform better than commit option-C since it avoids `ejbActivate`, `ejbPassivate` and some overhead in acquiring and releasing objects back to pool. However, there are some cases where commit option-C can do better. If the beans in the cache are very rarely reused and if beans are constantly added to the cache, then it makes no sense to cache beans.

Commit option C does exactly that. When commit option C is used, the container puts beans back into the pool (instead of caching the instance) after method invocation or on transaction completion. This way instances are reused better and the number of live objects in the VM is reduced resulting in smaller GC cycle.

How would you decide whether to use Commit option B or commit option C? First take a look at the cache-hits value using the monitoring command for the bean. If the cache-hits are very high compared to cache-misses, then commit-B option is an appropriate choice. You may still have to change the `max-cache-size` and `cache-resize-quantity` to get the best result. If the cache hits are too low and cache misses are very high, then the application is not reusing the bean instances and hence increasing the cache size (using `max-cache-size`) will not help (assuming that the access pattern remains the same). In this case you may want to use commit option-C. If there is no great difference between cache-hits and cache-misses then you may have to tune `max-cache-size`, and probably `cache-idle-timeout-in-seconds`.

The following figure shows the commit option settings.



```
<ejb>
     <ejb-name>TestEnt</ejb-name>
     <jndi-name>Test</jndi-name>
     <resource-ref>
       <res-ref-name>TestDataSource</res-ref-name>
       <jndi-name>jdbc/TestDB</jndi-name>
     </resource-ref>
     <is-read-only-bean>false</is-read-only-bean>
     <commit-option>COMMIT_OPTION_B</commit-option>
     <gen-classes>
       <remote-impl>com.sun.test.Test_EJBObjectImpl</remote-impl>
       <remote-home-impl>com.sun.test.Test_RemoteHomeImpl</remote-home-impl>
     </gen-classes>
   </ejb>
~
~
~
~
~
~
```

Figure 4-19 Commit Option Settings

At any given instance of time, if monitoring is enabled for ejb-container, the statistics for the individual beans can be examined and analyzed based on the bean pool and cache settings can be tuned. The pool settings are valid for stateless session and entity beans while the cache settings are valid for stateful session and entity beans. The configuration for the container can be done at the server instance level, via setting the properties in the `server.xml` file. These values can be overwritten by specifying the values for the individual beans in the sun-ejb-jar.xml. For a description of the tunables below, please refer to the EJB Descriptor Properties section.

The settings that can be specified at the server instance level are:

- steady-pool-size
- pool-resize-quantity
- max-pool-size
- cache-resize-quantity
- max-cache-size
- pool-idle-timeout-in-seconds
- cache-idle-timeout-in-seconds
- removal-timeout-in-seconds
- victim-selection-policy
- commit-option
- log-level
- monitoring-enabled

The settings for the pool that can be specified at the bean level are:

- steady-pool-size
- resize-quantity
- max-pool-size
- pool-idle-timeout-in-seconds

The settings for cache that can be specified at the bean level are:

- max-cache-size
- resize-quantity

- is-cache-overflow-allowed
- cache-idle-timeout-in-seconds
- removal-timeout-in-seconds
- victim-selection-policy

The monitoring command below gives the Bean Cache statistics for a stateful session bean. The following is a sample of the monitoring output:

```
$./asadmin get --user admin --password netscape --host e4800-241-a
--port 4848 -m
specjcmp.application.SPECjAppServer.ejb-module.supplier_jar.statefu
l-session-bean.BuyerSes.bean-cache.*

resize-quantity = -1

cache-misses = 0

idle-timeout-in-seconds = 0

num-passivations = 0

cache-hits = 59

num-passivation-errors = 0

total-beans-in-cache = 59

num-expired-sessions-removed = 0

max-beans-in-cache = 4096

num-passivation-success = 0
```

The monitoring command below gives the bean pool statistics for a Entity bean:

```
$./asadmin get --user admin --password netscape --host e4800-241-a
--port 4848 -m
specjcmp.application.SPECjAppServer.ejb-module.supplier_jar.statefu
l-entity-bean.ItemEnt.bean-pool.*

idle-timeout-in-seconds = 0

steady-pool-size = 0

total-beans-destroyed = 0

num-threads-waiting = 0

num-beans-in-pool = 54

max-pool-size = 2147483647

pool-resize-quantity = 0
```

```
total-beans-created = 255
```

The monitoring command below gives the bean pool statistics for a stateless bean.

```
$./asadmin get --user admin --password netscape --host e4800-241-a
--port 4848 -m
test.application.testEjbMon.ejb-module.slsb.stateless-session-bean.
slsb.bean-pool.*

idle-timeout-in-seconds = 200

steady-pool-size = 32

total-beans-destroyed = 12

num-threads-waiting = 0

num-beans-in-pool = 4

max-pool-size = 1024

pool-resize-quantity = 12

total-beans-created = 42
```

Tuning the bean involves charting out the behavior of the cache and pool for the bean in question over a period of time. Some of the observations that can be made are:

- If too many passivations are happening and the VM heap remains fairly small, then the `max-cache-size` can be increased or the `cache-idle-timeout-in-seconds` can be increased.

If too many GCs are happening and the pool size is growing, but the cache hit rate is small, then the `pool-idle-timeout-in-seconds` can be reduced to destroy the instances.

NOTE Specifying the `max-pool-size` as 0 means that the pool is unbounded. The pooled beans remain in memory unless they are removed by specifying a small interval for the `pool-idle-timeout-in-seconds`. For production systems, specifying the pool as unbounded is NOT recommended.

ORB Tuning

The Sun ONE Application Server includes a high performance and scalable CORBA ORB (Object Request Broker). The ORB is the foundation of the EJB Container on the server. Most of the functionality of the ORB is utilized when exercising Enterprise Java Beans via:

1. RMI/ IIOP path from an application client (or rich client) using Application client container.
2. RMI/ IIOP path from another Sun ONE Application Server instance ORB
3. RMI/ IIOP path from another vendor's ORB
4. In-process path from the web/ MDB (message driven beans) container

When a connection is made from a server instance to another server instance ORB, the first instance starts and acts as a client-side ORB. SSL over IIOP uses an optimized transport that is one of the fastest, and utilizes native implementations of cryptography algorithms to deliver high performance.

How a Client Connects to the ORB

A rich client Java program performs a new `initialContext()` call which creates a client side ORB instance. This in turn creates a socket connection to the Sun ONE Application Server IIOP port. The reader thread is started on the server ORB to service IIOP requests from this client. Using the `initialContext`, the client code does a lookup of an EJB deployed on the server. An IOR which is a remote reference to the deployed EJB on the server is returned to the client. Using this object reference, the client code invokes remote methods on the EJB.

`InitialContext` lookup for the bean and the method invocations translate the marshalling application request data in Java into IIOP message(s) that are sent on the socket connection that was created earlier on to the server ORB. The server then creates a response and sends it back on the same connection. This data in the response is then unmarshalled by the client ORB and given back to the client code for processing. The Client ORB shuts down and closes the connection when the rich client application exits.

Performance Tuning the ORB

A user may want to change the default setting, as well as add some non-standard options in order to derive certain behavior from the configuration such as high performance and scalability. The main components of the ORB that can be tuned are:

- Inter-ORB Communication Infrastructure
- Server ORB thread pool

Response time can be decreased by leveraging load-balancing, multiple shared connections, finely tuned server thread pool and message fragment size. Scalability can be achieved by using multiple ORB servers and load balancing between them from the client, and tuning the number of connection between the client and the server(s).

ORB Tunables

The following sets of tunables are available on the ORB:

1. **Inter-ORB Communication Infrastructure**: The infrastructure allows for tuning the message size, load balancing (in cases of heavy load), better throughput, and high performance.
2. **Server ORB Thread Pool**: The ORB thread pool facilitates quick and simultaneous job execution through configuration-controlled multi-threading. Pooling threads mean that one can avoid overheads such as thread creation, thread stack allocation, associated GC, etc. In some cases, excessive thread creation and removal can lead to `OutOfMemoryError,` which the thread pool prevents, by providing thresholds.

The ORB thread pool contains a task queue and a pool of threads. Tasks or jobs are inserted into the task queue and free threads pick tasks from this queue for execution. It is not advisable to always size a thread pool size such that the task queue is always empty. It is normal for an intense application to have 1:10 ratio of 'current task queue size': `max-thread-pool-size` at any time. The thread pool has capability to shrink to the steady size if current size is larger and when `max-thread-pool-size` > `steady-thread-pool-size` is the configured setting. The `steady-thread-pool-size` should be set to the average number of threads needed at a steady (RMI/ IIOP) load.

In the current Application Server version, the ORB thread pool is used in two main activities:

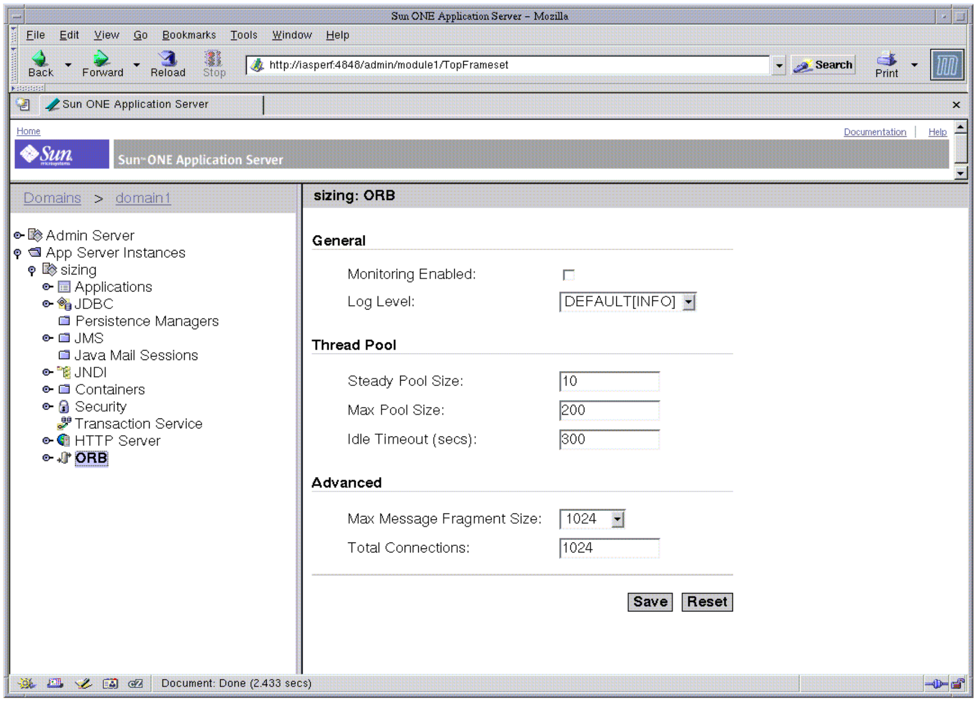
1. execution of every ORB request, and

2. trimming of EJB pools and caches.

Thus even when one is not using ORB for remote-calls (i.e. via RMI/ IIOP), the thread pool should be sized so that cleaning-up activity of the EJB pools and caches can be facilitated.

ORB Properties

The properties for tuning the ORBcan be managed using the Administration interface.



sizing: ORB

General

Monitoring Enabled:	☐
Log Level:	DEFAULT[INFO]

Thread Pool

Steady Pool Size:	10
Max Pool Size:	200
Idle Timeout (secs):	300

Advanced

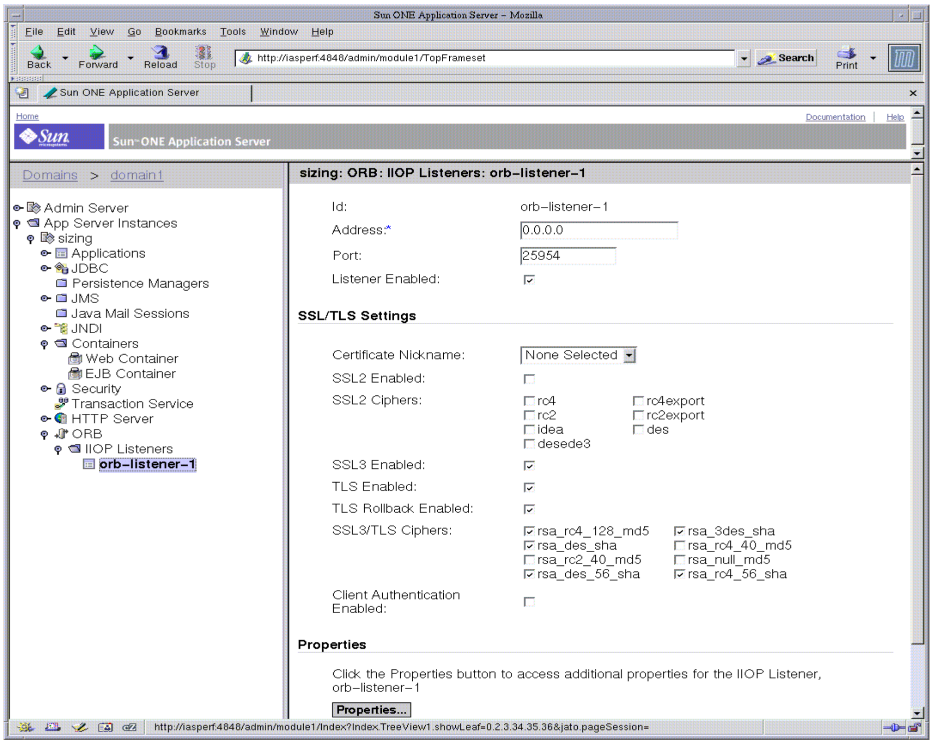
Max Message Fragment Size:	1024
Total Connections:	1024

Figure 4-20 Tuning the ORB Properties using the Administration Interface

The following standard properties are available to tune on the ORB:

- **`message-fragment-size`**: CORBA GIOPv1.2 messages (15.4.9) larger than this size in bytes will be fragmented. All sizes should be multiples of 8. In GIOP v1.2, a Request, Reply, LocateRequest and LocateReply message can be broken into multiple fragments. The first message is a regular Request or Reply message with more fragments bit in the flags field set to true. When inter-ORB messages are mostly larger than the default size (1024 bytes), one can increase this size to decrease latencies on the network due to fragmentation.
- **`steady-thread-pool-size`**: The minimum number of threads in the ORB thread pool, should be close to the active number of thread needed to work on requests (and EJB cleanup) at server's steady state (i.e. in steady load conditions).
- **`max-thread-pool-size`**: The maximum number of threads in the ORB thread pool.
- **`idle-thread-timeout-in-seconds`**: Timeout when an idle thread is removed from pool. Allows shrinking of the thread pool.
- **`max-connections`**: Maximum number of incoming connections at any time, on all listeners. Protects the server state by allowing finite number of connections. This value equals also the the maximum number of threads that will be actively reading from the connection.
- **`iiop-listener`**: Property to add a listener (SSL/ HTTP) to the ORB, specifying the listener host and port. An enabled ORB listener translates to a thread actively listening on the server socket for incoming connection connect requests.

The following figure shows the Administration interface for the IIOP listener.



sizing: ORB: IIOP Listeners: orb-listener-1

Id:	orb-listener-1
Address:*	0.0.0.0
Port:	25954
Listener Enabled:	✓

SSL/TLS Settings

Certificate Nickname:	None Selected
SSL2 Enabled:	☐
SSL2 Ciphers:	☐ rc4 ☐ rc4export ☐ rc2 ☐ rc2export ☐ idea ☐ des ☐ desede3
SSL3 Enabled:	✓
TLS Enabled:	✓
TLS Rollback Enabled:	✓
SSL3/TLS Ciphers:	✓ rsa_rc4_128_md5 ✓ rsa_3des_sha ✓ rsa_des_sha ☐ rsa_rc4_40_md5 ☐ rsa_rc2_40_md5 ☐ rsa_null_md5 ✓ rsa_des_56_sha ✓ rsa_rc4_56_sha
Client Authentication Enabled:	☐

Properties

Click the Properties button to access additional properties for the IIOP Listener, orb-listener-1

Properties...

Figure 4-21 Tuning the ORB Listener using the Administration Interface

Non-standard ORB Properties and Functionality

The following values are specified as -D arguments when launching the client program:

Controlling connections between client and server ORB

When using the default JDK ORB on the client, a connection is established from the client ORB to the application server ORB every time an initial context is created. One may wish to pool or share these connections when they are opened from the same process by adding to the configuration on the client ORB -

```
-Djava.naming.factory.initial=com.sun.appserv.naming.S1ASCtxFactory
```

Using multiple connections for better throughput

When using the Sun One context factory, (`com.sun.appserv.naming.S1ASCtxFactory`) an important tunable is to specify the number of connections to open to the server from the client ORB (default is 1). This feature is seen to produce better throughput to and from the server for network intense application traffic. The configuration changes are specified on the client ORB(s) by adding the following jvm-options:

```
-Djava.naming.factory.initial=com.sun.appserv.naming.S1ASCtxFactory

-Dcom.sun.appserv.iiop.orbconnections=[number]
```

Load balancing on server-side using configured DNS

One or multiple client ORBs can balance the load by utilizing a specially configured DNS. This DNS is configured such that it internally contains a list for a given host-name, so that every time an `nslookup` call is made, it iterates on the list of IP-addresses, giving intrinsic load balancing feature. The user can also use the connection pool specified in section 2.3.2 to specify the number of connections to use. The configuration changes are specified on the client ORBs by adding the following jvm-options:

```
-Djava.naming.factory.initial=com.sun.appserv.naming.S1ASCtxFactory

-Djava.naming.provider.url.pkgs=com.sun.enterprise.naming

-Djava.naming.provider.url=iiop://${SERVER_HOST}:${ORB_PORT}
```

Load-balancing on server-side using client configured server instances

One or multiple client ORBs can balance the load by a simple round-robin scheme on multiple ORB listeners (or multiple distinct ORB processes). This configuration is recommended in B2B scenarios, where there are controlled number of clients generating load on the server(s) via the RMI/ IIOP path. The user can also use the connection pool specified in section 2.3.2 to specify the number of connections to use. The configuration changes are specified on the client ORBs by adding the following jvm-options:

```
-Djava.naming.factory.initial=
com.sun.appserv.naming.S1ASCtxFactory

-Djava.naming.provider.url.pkgs=com.sun.enterprise.naming 5.

-Dcom.sun.appserv.iiop.loadbalancingpolicy=roundrobin,host1:port1,h
ost2:port2,... ,host[n]:port[n]
```

High performance CORBA Util Delegate class

When using JDK-bundled ORB or Sun ONE Application Server ORB, users can benefit from a high performance CORBA Util Delegate implementation, that can be used by adding to the configuration (`server.xml`)

```
<jvm-options>-Djavax.rmi.CORBA.UtilClass=com.iplanet.ias.util.orbut
il.IasUtilDelegate</jvm-options>
```

An important consideration when tuning the client ORB for load-balancing and connections, is to consider the number of connections opened on the server ORB. It is always advisable to start from a lower number of connections and grow upwards to observe any performance benefits. A connection to the server translated to an ORB thread reading actively from the connection (these threads are not pooled, but exist currently for the lifetime of the connection).

Guide to using Tunables

The following table helps you identify the ORB modules and Server tunables involved in tuning your application.

Table 4-4 Using Tunables

Path	**ORB modules involved**	**Tunables involved on server**
RMI/ IIOP from application client to application server	communication infrastructure, thread pool	steady-thread-pool-size, max-thread-pool-size, idle-thread-timeout-in-seconds
RMI/ IIOP from Sun ONE (server) ORB to Sun ONE Application Server	communication infrastructure, thread pool	steady-thread-pool-size, max-thread-pool-size, idle-thread-timeout-in-seconds
RMI/ IIOP from a vendor ORB	parts of communication infrastructure, thread pool	steady-thread-pool-size, max-thread-pool-size, idle-thread-timeout-in-seconds
In-process	thread pool	steady-thread-pool-size, max-thread-pool-size, idle-thread-timeout-in-seconds

Thread Pool Sizing

After examining the number of inbound and outbound connections as explained above, users can tune the size of the thread pool appropriately. This can affect performance and response times to a large degree.

The size computation should take into account the number of client requests to be processed concurrently, the resource (number of cpus/memory) available on the machine and the response times required for processing the client requests. Setting the size to a very small value can affect the ability of the server to process requests concurrently thus affecting the response times of requests as they will be sitting longer in the task queue waiting for a worker thread to process it. On the other hand having a large number of worker threads to service requests can also be detrimental because more system resources are used up because of the large number of threads, which- increases concurrency. This can mean that threads take longer to acquire shared structures in the EJB container, thus affecting response times The Worker thread pool is also used for the EJB containers house keeping activity such as trimming the pools and caches. This activity needs to be accounted for also when determining the size.

Having too many ORB worker threads is detrimental for performance since the server has to maintain all these threads. The idle threads are destroyed after the `idle-thread-time-out-in-seconds`. Below is a snipet from the `server.xml`. This includes the section for `iiop-service`.

```
<iiop-service>

   <orb message-fragment-size=1024

   steady-thread-pool-size=10

   max-thread-pool-size=200

   idle-thread-timeout-in-seconds=300

   max-connections=1024

   monitoring-enabled=false />

   <iiop-listener id=orb-listener-1 address=0.0.0.0 port=3700
   enabled=true>

</ioop-listener>
```

Related Considerations

Please refer to the Performance Tuning the EJB Container section for Pass-by-value vs Pass-by-reference semantics considerations.

Examining IIOP Messages

It is sometimes useful to examine the contents of the IIOP messages being passed by the Sun ONE Application Server. The option `-Dcom.sun.CORBA.ORBDebug=giop` can be passed as jvm-options in `server.xml` to get dumps of the messages. The dumps are produced in server.log. The same option can also be used on the client ORB.

A sample output is as follows:

```
[29/Aug/2002:22:41:43] INFO (27179): CORE3282: stdout:
++++++++++++++++++++++++++++++

[29/Aug/2002:22:41:43] INFO (27179): CORE3282: stdout:
Message(Thread[ORB Client-side Reader, conn to
192.18.80.118:1050,5,main]):

createFromStream: type is 4 <

[29/Aug/2002:22:41:43] INFO (27179): CORE3282: stdout:
MessageBase(Thread[ORB Client-side Reader, conn to
192.18.80.118:1050,5,main]): Message GIOP version: 1.2

[29/Aug/2002:22:41:43] INFO (27179): CORE3282: stdout:
MessageBase(Thread[ORB Client-side Reader, conn to
192.18.80.118:1050,5,main]): ORB Max GIOP Version: 1.2

[29/Aug/2002:22:41:43] INFO (27179): CORE3282: stdout:
Message(Thread[ORB Client-side Reader, conn to
192.18.80.118:1050,5,main]): createFromStream: message construction
complete.

[29/Aug/2002:22:41:43] INFO (27179): CORE3282: stdout:
com.sun.corba.ee.internal.iiop.MessageMediator(Thread[ORB
Client-side Reader, conn to 192.18.80.118:1050,5,main]): Received
message:

[29/Aug/2002:22:41:43] INFO (27179): CORE3282: stdout: ----- Input
Buffer -----

[29/Aug/2002:22:41:43] INFO (27179): CORE3282: stdout: Current
index: 0

[29/Aug/2002:22:41:43] INFO (27179): CORE3282: stdout: Total length
: 340
```

```
[29/Aug/2002:22:41:43] INFO (27179): CORE3282: stdout: 47 49 4f 50
01 02 00 04 0 0 00 01 48 00 00 00 05 GIOP.......H....
```

NOTE The flag `-Dcom.sun.CORBA.ORBdebug=giop` generates many debug messages in the logs. This should be used only when the user suspects message fragmentation.

Fragmented Messages

In this sample output above, the "createFromStream" type is shown as 4. This implies that the message is a fragment of a bigger message. One could change the fragment size to avoid fragmented messages. This would mean that messages would be sent as one unit and not as fragments thus saving the overhead of sending multiple messages and corresponding processing at the receiving end to piece the messages together. It might be more efficient to increase the fragment size if most messages being sent in the application turn out to be fragmented because of a low fragment size specification. On the other hand if only a few messages are fragmented, it might be more efficient to have a lower fragment size as this would mean smaller buffers would be allocated for writing messages and only the occasional message would end up getting fragmented.

Local Interfaces for EJB's

It is important to remember that the ORB is not used when using Local Interfaces for EJB's. In this situation, all arguments are passed by reference and no object copying is involved.

Tuning the Transaction Manager

A distributed transactional system writes transactional activity into transaction logs so that they can be recovered later. But writing `transactional logs` will have some performance penalty. This property can be used to disable the transaction logging, where the performance is of utmost importance more than the recovery. This property, by default, won't exist in the `server.xml`.

The `automatic-recovery` and `key-point-interval` attributes have an impact on performance when using the transaction manager. When `automatic-recovery` is set to true, `disable-distributed-transaction-logging` will not be considered and transaction logging will always happen. If `automatic-recovery` is set to false, `disable-distributed-transaction-logging` will be considered to determine whether to write transaction logs or not.

automatic-recovery

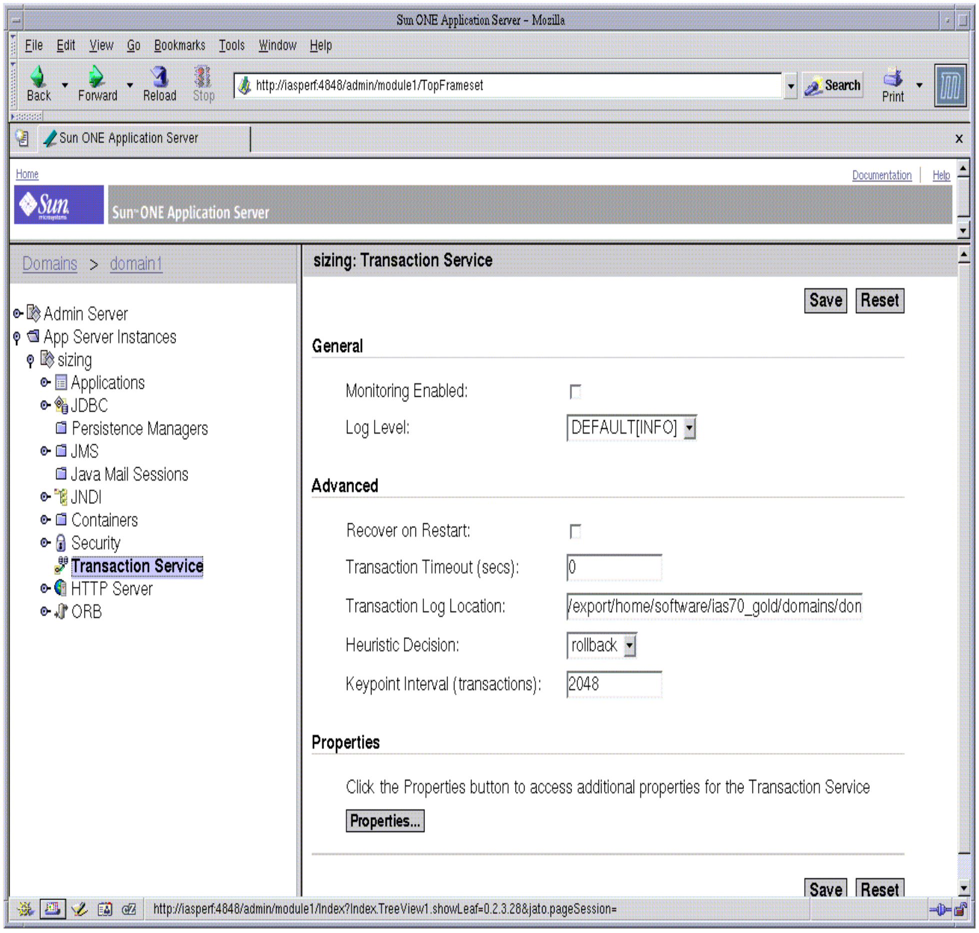
This value, together with `disable-distributed-transaction-logging` attribute, has some impact on performance. Here is how it works.

1. If `automatic-recovery` is true, transaction logs will always be written.
2. If automatic recovery is false and `disable-distributed-transaction-logging` is off (default case), then the logs will be written.
3. If automatic recovery is false and `disable-distributed-transaction-logging` is on, then the transaction logs will not be written. This will give approximately 20% improvement in performance but at the cost of not recovering as there won't be any transaction logs. In other words, transaction logging in case 1and 2 results in approximately 20% impact. All these results apply only to global transactions intensive tests. Gains in real applications may be less.

keypoint-interval

The default value of this attribute is 2048. Key pointing prevents the physical log for a process from growing indefinitely by defining the frequency at which the log file may be cleaned up by removing entries for completed transactions. Frequent checkpointing is deritmental for performance. In most of the cases, the default value is good enough.

The following figure shows the Administration interface for configuring the transaction manager.



Sun ONE Application Server - Mozilla

http://iasperf:4848/admin/module1/TopFrameset

Sun ONE Application Server

Domains > domain1

- Admin Server
- App Server Instances
  - sizing
    - Applications
    - JDBC
    - Persistence Managers
    - JMS
    - Java Mail Sessions
    - JNDI
    - Containers
    - Security
    - Transaction Service
    - HTTP Server
    - ORB

sizing: Transaction Service

General

Monitoring Enabled:	☐
Log Level:	DEFAULT[INFO]

Advanced

Recover on Restart:	☐
Transaction Timeout (secs):	0
Transaction Log Location:	/export/home/software/ias70_gold/domains/don
Heuristic Decision:	rollback
Keypoint Interval (transactions):	2048

Properties

Click the Properties button to access additional properties for the Transaction Service

http://iasperf:4848/admin/module1/Index?Index.TreeView1.showLeaf=0.2.3.28&jato.pageSession=

Figure 4-22 Tuning the Transaction Service using the Administration Interface

Transaction Manager Monitoring

Users can monitor the Transaction Manager to obtain performance statistics. To generate these statistics, use the following command using the asadmin utility:

```
asadmin>export AS_ADMIN_USER=admin AS_ADMIN_PASSWORD=password
AS_ADMIN_HOST=localhost
asadmin>get -m server1.transaction-service.*
```

The following is the sample output of the above command:

```
********** Stats for JTS ************

total-tx-completed = 244283

total-tx-rolled-back = 2640

total-tx-inflight = 702

isFrozen = False

inflight-tx =
Transaction Id , Status, ElapsedTime(msec)

000000000003C95A_00, Active, 999
```

References

- For details on profiling, see the *Sun ONE Application Server Developer's Guide*, chapter on *Developing J2EE Applications*; specifically the section titled *Profiling Tools.*
- For more details on SNMP monitoring see the *Sun ONE Application Server Administrator's Guide*, the chapter on *Monitoring and Managing Sun ONE Applications.*
- for more details on the `server.xml` file see the *Sun ONE Application Server Configuration File Reference*

Chapter 5

Tuning the Java Runtime System

The Solaris operating environment, by default, supports a two level thread model (up to Solaris 8). Application level Java threads are mapped to user level Solaris threads, which are multiplexed on a limited pool of light weight processes (LWPS). Often, we need only as many LWPS as there are processors on the system, leading to conserved kernel resources and greater system efficiency. This helps when there are hundreds of user level threads. Fortunately (or unfortunately), you can choose from multiple threading models and different methods of synchronization within the model, but this varies from VM to VM. Adding to the confusion, the threads library will be transitioning from Solaris 8 to 9, eliminating many of the choices. Although we have a 2 level model, in the 1.4 VM, we have an effectively 1-to-1 thread/lwp model since the VM used LWP based sync by default.

The following topics are discussed in this chapter:

Using Alternate Threads

You can try to load the alternate `libthread.so` in `/usr/lib/lwp/` on Solaris 8 by changing your `LD_LIBRARY_PATH` to include `/usr/lib/lwp` before `/usr/lib`. Both give better throughput and system utilization for certain applications; especially those using fewer threads.

By default, the Sun ONE Application Server uses `/usr/lib/lwp`. You can change the default settings to not use the LWP by removing `/usr/lib/lwp` from the `LD_LIBRARY_PATH` in the `startserv` script, but should be avoided unless required.

For applications using many threads, `/usr/lib/libthread.so` is the best library to use. Of course, see using `-Xconcurrentio` for applications with many threads as this will not only turn on LWP based sync, the default in 1.4, but also turn off TLABS, or thread local allocation buffers, which can chew up the heap and cause premature gcs.

To further examine the threading issues on Solaris with Java, see http://java.sun.com/docs/hotspot/threads/threads.html

Managing Memory and Allocation

The efficient running of any application depends on how well memory and garbage collection are managed. The following sections provide information on optimizing memory and allocation functions:

- Tuning the Garbage Collector
- Specifying Other Garbage Collector Settings
- Tracing Garbage Collection
- Tuning the Java Heap
- HotSpot Virtual Machine Tuning Options

Tuning the Garbage Collector

Garbage collection reclaims the heap space previously allocated to objects no longer needed.The process of locating and removing the dead objects can stall any application while consuming as much as 25 percent throughput.

Almost all Java Runtime Environments come with a generational object memory system and sophisticated garbage collection algorithms. A generational memory system divides the heap into a few carefully sized partitions called generations. As these objects accumulate a low memory condition occurs forcing garbage collection to take place. The efficiency of a generational memory system is based on the observation that most of the objects are short lived.The heap space is divided into the old and the new generation.

The new generation includes the new object space (Eden), and two survivor spaces. New objects allocate in eden. Longer lived objects are moved from the new generation and tenured to the old generation.

The young generation uses a fast copying garbage collector which employs two semi-spaces (survivor spaces) in the eden, copying surviving objects from one survivor space to the second. Objects that survive multiple young space collections are tenured -- copied to a tenured generation. The tenured generation is larger and fills up less quickly. So, it is garbage collected less frequently; and each collection takes longer than a young space only collection. Collecting the tenured space is also referred to as doing a full Generation Collection (GC).

The frequent young space collections are quick (few milliseconds), and the occasional full GC takes a relatively longer time (tens of milliseconds to even a few seconds, depending upon the heap size).

Other garbage collection algorithms, such as the Train algorithm, are incremental. They chop down the full GC into several incremental pieces. This provides a high probability of small garbage collection pauses even when full GC takes affect. This comes with an overhead and is not required for enterprise web applications.

When the new generation fills up, it triggers a minor collection in which the surviving objects are moved to the old generation. When the old generation fills up, it triggers a major collection which involves the entire object heap.

Both HotSpot and Solaris JDK use thread local object allocation pools for lock-free, fast, and scalable object allocation. User application level object pooling may have been more beneficial running on earlier generation Java Virtual Machines. Consider pooling only if the object construction cost is very high and shows up being significant in the execution profiles.

For detail information on Tuning Garbage Collection, see
http://java.sun.com/docs/hotspot/gc/index.html

Tracing Garbage Collection

Two primary measures of garbage collection performance are Throughput and Pauses. Throughput is the percentage of the total time spent on other activities apart from garbage collection.

Pauses are times when an application appears unresponsive due to garbage collection. Users can have different requirements of garbage collection. A server centric application may consider throughput to be a metric, but a short pause may upset a graphical program. There are two other considerations - Footprint and promptness.

Footprint

Footprint is the working set of a process, measured in pages and cache lines. Promptness is the time between when an object becomes dead, and when the memory becomes available. This is an important consideration for distributed systems.

A particular generation sizing chooses a trade-off between these considerations. A very large young generation may maximize the throughput, but does so at the expense of footprint and promptness. Pauses can be minimized by using a small young generation and incremental collection.

Pauses due to Generation Collection are inspected by diagnostic output of the Java Virtual Machine. The command line argument "`-verbose:gc`" prints information at every collection. Below is a sample output of the information generated when this flag is passed to the Java Virtual Machine.

```
[GC 50650K->21808K(76868K), 0.0478645 secs]
[GC 51197K->22305K(76868K), 0.0478645 secs]
[GC 52293K->23867K(76868K), 0.0478645 secs]
[Full GC 52970K->1690K(76868K), 0.54789968 secs]
```

The numbers before and after the arrows indicate the combined size of live objects before and after the collection. The number in the parenthesis is the total available space, which is the total heap minus one of the survivor spaces. In this sample, there are three minor collections and one major collection. In the first GC, 50650 KB of objects existed before collection and 21808 KB of objects after collection. This means that 28842 KB of objects were dead and collected. The total heap size is 76868 KB. The collection process required 0.0478645 seconds.

Specifying Other Garbage Collector Settings

For applications which dynamically generate and load classes, permanent generation is not relevant to the GC performance. For applications which dynamically generate and load classes (JSP's), the permanent generation is relevant to the GC performance, as filling the permanent generation can trigger a Full GC. The maximum permanent generation can be tuned with `-XX:MaxPermSize` option.

Applications can interact with the garbage collection by invoking collections explicitly through the `System.gc()` call. But, relying on the application to manage the resources is a bad idea since these force major collections, and inhibit scalability on large systems. This can be disabled by using the flag `-XX:+DisableExplicitGC`.

The Sun ONE Application Server uses RMI in the Administration module for monitoring. Garbage cannot be collected in RMI based distributed applications without occasional local collections, so RMI forces a periodic full collection. The frequency of these collections can be controlled with the property `-sun.rmi.dgc.client.gcInterval`. For example, `- java -Dsun.rmi.dgc.client.gcInterval=3600000` specifies explicit collection once per hour instead of the default rate of once per minute.

To specify the attributes for the Java virtual machine:

- Edit the `server.xml` by hand and manually add `<jvm-config>vm tunable</jvm-config>` where `vm tunable` is the tuning that the user wants to apply.
- Using the administration interface and JVM settings | JVM options.

Tuning the Java Heap

This section discusses topics related to tuning the Java Heap for performance.

- Guidelines for Java Heap Sizing
- Sample Heap Configuration on Solaris
- Sample Heap Configuration on Windows

Guidelines for Java Heap Sizing

You can control the heap size using various parameters.

The `-Xms` and `-Xmx` parameters defines the minimum and maximum heap sizes. Since collections occur when the generations fill up, throughput is inversely proportional to the amount of the memory available. By default, the JVM grows or shrinks the heap at each collection to try to keep the proportion of free space to the living objects at each collection within a specific range. This range is set as a percentage by the parameters `-XX:MinHeapFreeRatio=<minimum>` and `-XX:MaxHeapFreeRatio=<maximum>`; and the total size bounded by `-Xms` and `-Xmx`.

Server side applications set the values of `-Xms` and `-Xmx` equal to each other for a fixed heap size. When the heap grows or shrinks, the JVM must recalculate the old and new generation sizes to maintain a predefined `NewRatio`.

The `NewSize` and `MaxNewSize` parameters control the new generation's minimum and maximum size. You can regulate the new generation size by setting these parameters equal. The bigger the younger generation, the less often minor collections occur. By default, the young generation is controlled by `NewRatio`. For example, setting `-XX:NewRatio=3` means that the ratio between the old and young generation is 1:3, the combined size of eden and the survivor spaces will be fourth of the heap. In order to be safe, set the `NewSize`/`MaxNewSize` to the same value.

By default, the Sun ONE Application Server is invoked with the Java HotSpot Server JVM. The default `NewRatio` for the Server JVM is 2, the old generation occupies 2/3 of the heap while the new generation occupies 1/3. The larger new generation can accommodate many more short lived objects, decreasing the need for slow major collections. The old generation is still sufficiently large enough to hold many long-lived objects.

The following are important guidelines for sizing Java heap.

- Decide the total amount of memory you can afford to the JVM. Accordingly, graph your own performance metric against young generation sizes to find the best setting.
- Make plenty of memory available to the young generation, the default for 1.4 is calculated from `NewRatio` and the `-Xmx` setting.
- Larger Eden or younger generation spaces increase the spacing between full garbage collections. But young space collections could take a proportionally longer time. In general, you could keep the eden size between 1/4th and 1/3rd the maximum heap size.

  Old generation must be typically larger than the new generation.

Survivor Ratio Sizing

The `SurvivorRatio` parameter controls the size of the two survivor spaces. For example, `-XX:SurvivorRatio=6` sets the ratio between each survivor space and eden to be 1:6, each survivor space will be one eighth of the young generation. With JDK 1.4, the Solaris default is 32. If survivor spaces are too small, copying collection overflows directly into the old generation. If survivor spaces are too large, they will be empty. At each garbage collection, the JVM chooses a threshold number of times an object can be copied before it is tenured.

This threshold is chosen to keep the survivors half full.

The option `-XX:+PrintTenuringDistribution` can be used to show the threshold and ages of the objects in the new generation. It is useful for observing the lifetime distribution of an application.

For up-to-date defaults, refer to
http://java.sun.com/docs/hotspot/VMOptions.html

Sample Heap Configuration on Solaris

This is a sample heap configuration used by Sun ONE Application server for heavy server-centric applications, on Solaris, as set in the `server.xml` file.

```
<jvm-options> -Xms3584m </jvm-options>

<jvm-options> -Xmx3584m </jvm-options>

<jvm-options> -verbose:gc </jvm-options>

<jvm-options> -Dsun.rmi.dgc.client.gcInterval=3600000
</jvm-options>
```

Sample Heap Configuration on Windows

This is a sample heap configuration used by Sun ONE Application server for heavy server-centric applications, on Windows, as set in the `server.xml` file.

```
<jvm-options> -Xms1400m </jvm-options>

<jvm-options> -Xmx1400m </jvm-options>
```

HotSpot Virtual Machine Tuning Options

HotSpot is a just-in-time byte-code compiler to improve the performance of Java applications. It can be highly tuned for performance. When using the Sun ONE Application Server examine the HotSpot documentation to see if the JVM is tuned appropriately.

The following web pages are recommended:

- Java HotSpot VM Options
  http://java.sun.com/docs/hotspot/VMOptions.html
- Frequently Asked Questions About the Java HotSpot Virtual Machine
  http://java.sun.com/docs/hotspot/PerformanceFAQ.html

Chapter 6

Tuning Operating System

Tuning Solaris TCP/IP settings benefits programs that open and close many sockets. The Sun ONE Application Server operates with a small fixed set of connections and the performance gain may not be as significant on the Application Server node. Improvements for the Web Server, configured as a Web front-end to Sun ONE Application Server, can have significant benefits. The following topics are discussed:

- Tuning Parameters
- Solaris File Descriptor Setting
- Linux Configuration

Tuning Parameters

The following table shows the operating system tuning, for Solaris, used when benchmarking for performance and scalability. These values are an example of how you may tune your system to achieve the desired result.

Table 6-1 Tuning the Solaris Operating System

Parameter	Scope	Default Value	Tuned Value	Comments
rlim_fd_max	/etc/system	1024	8192	Process open file descriptors limit; should account for the expected load (for the associated sockets, files, pipes if any).
rlim_fd_cur	/etc/system	1024	8192	

Table 6-1 Tuning the Solaris Operating System *(Continued)*

sq_max_size	/etc/system	2	0	Controls streams driver queue size; setting to 0 makes it infinity so the performance runs wont be hit by lack of buffer space. Set on clients too.
tcp_close_wait_interval	ndd /dev/tcp	240000	60000	Set on clients as well.
tcp_time_wait_interval	ndd /dev/tcp	240000	60000	
tcp_conn_req_max_q	ndd /dev/tcp	128	1024	
tcp_conn_req_max_q0	ndd /dev/tcp	1024	4096	
tcp_ip_abort_interval	ndd /dev/tcp	480000	60000	
tcp_keepalive_interval	ndd /dev/tcp	7200000	900000	For high traffic web sites lower this value.
tcp_rexmit_interval_initial	ndd /dev/tcp	3000	3000	If retransmission is greater than 30-40%, you should increase this value.
tcp_rexmit_interval_max	ndd /dev/tcp	240000	10000	
tcp_rexmit_interval_min	ndd /dev/tcp	200	3000	
tcp_smallest_anon_port	ndd /dev/tcp	32768	1024	Set on clients too.
tcp_slow_start_initial	ndd /dev/tcp	1	2	Slightly faster transmission of small amounts of data.
tcp_xmit_hiwat	ndd /dev/tcp	8129	32768	To increase the transmit buffer.
tcp_recv_hiwat	ndd /dev/tcp	8129	32768	To increase the transmit buffer.
tcp_conn_hash_size	ndd /dev/tcp	512	8192	The connection hash table keeps all the information for active TCP connections (ndd -get /dev/tcp tcp_conn_hash). This value does not limit the number of connections, but it can cause connection hashing to take longer. To make lookups more efficient, set the value to half of the number of concurrent TCP connections that you expect on the server (netstat -nP tcp | wc -l, gives you a number). It defaults to 512. This can only be set in /etc/system and becomes effective at boot time.

Solaris File Descriptor Setting

On Solaris, setting the maximum number of open files property using `ulimit` has the biggest impact on your efforts to support the maximum number of RMI/IIOP clients.

To increase the hard limit, add the following command to `/etc/system` and reboot it once:

```
set rlim_fd_max = 8192
```

You can verify this hard limit by using the following command:

```
ulimit -a -H
```

Once the above hard limit is set, you can increase the value of this property explicitly (up to this limit) using the following command:

```
ulimit -n 8192
```

You can verify this limit by using the following command:

```
ulimit -a
```

For example, with the default `ulimit` of 64, a simple test driver can support only 25 concurrent clients, but with `ulimit` set to 8192, the same test driver can support 120 concurrent clients. The test driver spawned multiple threads, each of which performed a JNDI lookup and repeatedly called the same business method with a think (delay) time of 500ms between business method calls, exchanging data of about 100KB.

These settings apply to RMI/IIOP clients (on Solaris). Refer to Solaris documentation on the Sun Microsystems documentation web site (www.docs.sun.com) for more information on setting the file descriptor limits.

Linux Configuration

The following parameters must be added to the `/etc/rc.d/rc.local` file that gets executed furing system start-up.

```
<-- begin

#max file count updated ~256 descriptors per 4Mb. Based on the
amount of RAM you have on the system, specify the number of file
descriptors.
echo “65536“ > /proc/sys/fs/file-max
```

```
#inode-max 3-4 times the file-max
#file not present!!!!!
#echo “262144“ > /proc/sys/fs/inode-max

#make more local ports available
echo 1024 25000 > /proc/sys/net/ipv4/ip_local_port_range

#increase the memory available with socket buffers
echo 2621143 > /proc/sys/net/core/rmem_max
echo 262143 > /proc/sys/net/core/rmem_default

#above configuration for 2.4.X kernels
echo 4096 131072 262143 > /proc/sys/net/ipv4/tcp_rmem
echo 4096 13107262143 > /proc/sys/net/ipv4/tcp_wmem

#disable “RFC2018 TCP Selective Acknowledgements,“ and “RFC1323 TCP
timestamps“
echo 0 > /proc/sys/net/ipv4/tcp_sack
echo 0 > /proc/sys/net/ipv4/tcp_timestamps

#double maximum amount of memory allocated to shm at runtime
echo “67108864“ > /proc/sys/kernel/shmmax

#improve virtual memory VM subsystem of the Linux
echo “100 1200 128 512 15 5000 500 1884 2“> /proc/sys/vm/bdflush

#we also do a sysctl
sysctl -p /etc/sysctl.conf

-- end -->
```

Additionally, create an `/etc/sysctl.conf` file and append it with the following values:

```
<-- begin
#Disables packet forwarding
net.ipv4.ip_forward = 0
#Enables source route verification
net.ipv4.conf.default.rp_filter = 1
#Disables the magic-sysrq key
kernel.sysrq = 0
fs.file-max=65536

vm.bdflush = 100 1200 128 512 15 5000 500 1884 2

net.ipv4.ip_local_port_range = 1024 65000
net.core.rmem_max= 262143
net.core.rmem_default = 262143

net.ipv4.tcp_rmem = 4096 131072 262143
net.ipv4.tcp_wmem = 4096 131072 262143
net.ipv4.tcp_sack = 0
net.ipv4.tcp_timestamps = 0
```

```
kernel.shmmax = 67108864
```

Chapter 7

Common Performance Problems

This section discusses a few common web site performance problems to check for:

- check-acl Server Application Functions
- Low-Memory Situations
- Under-Throttled Server
- Cache Not Utilized
- Keep-Alive Connections Flushed
- Log File Modes

check-acl Server Application Functions

For optimal performance of your server, use ACLs only when required.

The default server is configured with an ACL file containing the default ACL allowing write access to the server only to `all', and an es-internal ACL for restricting write access for `anybody'. The latter protects the manuals, icons, and search UI files in the server.

The default `obj.conf` file has `NameTrans` lines mapping the directories that need to be read-only to the es-internal object, which in turn has a check-acl SAF for the es-internal ACL.

The default object also contains a check-acl SAF for the "default" ACL.

You can improve your server's performance by removing the aclis properties from virtual server tags in `server.xml`. This stops any ACL processing.

You can also improve performance by removing the check-acl SAF from the default object for URIs that are not protected by ACLs.

Low-Memory Situations

If you need Sun ONE Application Server to run in low-memory situations, reduce the thread limit to a bare minimum by lowering the value of `RqThrottle`. Also, you may want to reduce the maximum number of processes that the Sun ONE Application Server will spawn by lowering the value of the `MaxProcs` value.

Under-Throttled Server

The server does not allow the number of active threads to exceed the thread limit value. If the number of simultaneous requests reaches that limit, the server stops servicing new connections until the old connections are freed up. This can lead to increased response time.

In Sun ONE Application Server, the server's default `RqThrottle` value is 128. If you want your server to process more requests concurrently, you need to increase the `RqThrottle` value.

The symptom of an under-throttled server is a server with a long response time. Making a request from a browser establishes a connection fairly quickly to the server, but on under-throttled servers it may take a long time before the response comes back to the client.

The best way to tell if your server is being throttled is to see if the number of active sessions is close to, or equal to, the maximum number allowed via `RqThrottle`. To do this, see Maximum Simultaneous Requests.

Cache Not Utilized

If the cache is not utilized, your server is not performing optimally. Since most sites have lots of GIF or JPEG files that should always be cacheable, you need to use your cache effectively.

Some sites, however, do almost everything through CGIs, SHTML, or other dynamic sources. Dynamic content is generally not cacheable, and inherently yields a low cache hit rate. Don't be too alarmed if your site has a low cache hit rate. The most important thing is that your response time is low. You can have a very low cache hit rate and still have very good response time. As long as your response time is good, you may not care that the cache hit rate is low.

Check your Hit Ratio using statistics from `perfdump` or the Monitor Current Activity page of the web-based Admin Console. The hit ratio is the percentage of times the cache was used with all hits to your server. A good cache hit rate is anything above 50%. Some sites may even achieve 98% or higher.

In addition, if you are doing a lot of CGI or NSAPI calls, you may have a low cache hit rate. If you have custom NSAPI functions, you may have a low cache hit rate.

Keep-Alive Connections Flushed

A web site that might be able to service 75 requests per second without keep-alive connections, may be able to do 200-300 requests per second when keep-alive is enabled. Therefore, as a client requests various items from a single page, it is important that keep-alive connections are being used effectively. If the `KeepAliveCount` exceeds the `MaxKeepAliveConnections`, subsequent keep-alive connections will be closed, or `flushed', instead of being honored and kept alive.

Check the `KeepAliveFlushes` and `KeepAliveHits` values using statistics from `perfdump` or the Monitor Current Activity page of the web-based Admin Console. On a site where keep-alive connections are running well, the ratio of `KeepAliveFlushes` to `KeepAliveHits` is very low. If the ratio is high (greater than 1:1), your site is probably not utilizing keep-alive connections as well as it could.

To reduce keep-alive flushes, increase the `MaxKeepAliveConnections` value in the init.conf file or the web-based Admin Console. The default value is 200. By raising the value, you keep more waiting keep-alive connections open.

CAUTION On Unix/Linux systems, if you increase the `MaxKeepAliveConnections` value too high, the server can run out of open file descriptors. Typically 1024 is the limit for open files on Unix/Linux, so increasing this value above 500 is not recommended.

Log File Modes

Keeping the log files on verbose mode can have a significant affect of performance. You can set `LogVerbose` to any level higher than `FINE` using the web-based Admin Console.

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