# Table of Contents

## Welcome to LoadRunner
- xi

## Online Resources
- xi

## LoadRunner Documentation Set
- xii

## Using the LoadRunner Documentation Set
- xiii

## Typographical Conventions
- xiv

## Part I: Understanding LoadRunner

### Chapter 1: Introduction
- 3
  - Application Load Testing
  - The LoadRunner Solution
  - Using LoadRunner
  - Working with LoadRunner
  - LoadRunner Vuser Technology
  - LoadRunner Vuser Types

### Chapter 2: The LoadRunner Testing Process
- 15
  - Step I: Planning the Test
  - Step II: Creating the Vuser Scripts
  - Step III: Creating the Scenario
  - Step IV: Running the Scenario
  - Step V: Monitoring a Scenario
  - Step VI: Analyzing Test Results

### Chapter 3: Load Test Planning
- 19
  - About Load Test Planning
  - Analyzing the Application
  - Defining Testing Objectives
  - Planning LoadRunner Implementation
  - Examining Load Testing Objectives
<table>
<thead>
<tr>
<th>Chapter 4: The LoadRunner Controller at a Glance</th>
<th>35</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening the Controller</td>
<td>35</td>
</tr>
<tr>
<td>Introducing the LoadRunner Controller</td>
<td>38</td>
</tr>
<tr>
<td>Managing Scenario Files</td>
<td>42</td>
</tr>
<tr>
<td>Running a Scenario</td>
<td>44</td>
</tr>
</tbody>
</table>

**PART II: DESIGNING A SCENARIO**

<table>
<thead>
<tr>
<th>Chapter 5: Creating a Manual Scenario</th>
<th>49</th>
</tr>
</thead>
<tbody>
<tr>
<td>About Creating a Scenario</td>
<td>50</td>
</tr>
<tr>
<td>Creating Vuser Groups</td>
<td>50</td>
</tr>
<tr>
<td>Configuring Vusers in a Vuser Group</td>
<td>56</td>
</tr>
<tr>
<td>Configuring Load Generators</td>
<td>59</td>
</tr>
<tr>
<td>Configuring Load Generator Settings</td>
<td>62</td>
</tr>
<tr>
<td>Configuring WAN Emulation Settings</td>
<td>70</td>
</tr>
<tr>
<td>Configuring Scripts</td>
<td>76</td>
</tr>
<tr>
<td>Using Relative Paths for Scripts</td>
<td>79</td>
</tr>
</tbody>
</table>

**Chapter 6: Creating a Manual Scenario Using the Percentage Mode** 81

<table>
<thead>
<tr>
<th>About Creating a Manual Scenario Using the Percentage Mode</th>
<th>81</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defining the Total Number of Vusers</td>
<td>82</td>
</tr>
<tr>
<td>Assigning Properties to Scripts</td>
<td>83</td>
</tr>
<tr>
<td>Configuring Scripts</td>
<td>86</td>
</tr>
<tr>
<td>Converting a Scenario to the Vuser Group Mode</td>
<td>89</td>
</tr>
</tbody>
</table>

**Chapter 7: Creating a Goal-Oriented Scenario** 91

<table>
<thead>
<tr>
<th>About Planning a Goal-Oriented Scenario</th>
<th>91</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defining Scenario Goals</td>
<td>94</td>
</tr>
<tr>
<td>Assigning Properties to Scripts</td>
<td>99</td>
</tr>
<tr>
<td>Configuring Scripts</td>
<td>102</td>
</tr>
</tbody>
</table>

**Chapter 8: Scheduling a Scenario** 107

<table>
<thead>
<tr>
<th>About Scenario Scheduling</th>
<th>108</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delaying the Start of a Scenario</td>
<td>109</td>
</tr>
<tr>
<td>Selecting a Schedule</td>
<td>110</td>
</tr>
<tr>
<td>Scheduling a Scenario</td>
<td>111</td>
</tr>
<tr>
<td>Scheduling Vuser Groups</td>
<td>115</td>
</tr>
<tr>
<td>Adding Vusers to a Scheduled Scenario</td>
<td>119</td>
</tr>
</tbody>
</table>
Chapter 9: Using Rendezvous Points ...............................................121
  About Using Rendezvous Points ..................................................121
  Setting the Rendezvous Attributes .............................................123
  Setting the Rendezvous Policy ..................................................125
  Disabling and Enabling Rendezvous Points ..................................127
  Disabling and Enabling Vusers at Rendezvous Points .....................127
  Viewing Rendezvous Information .............................................129

Chapter 10: Configuring a Scenario .............................................131
  About Configuring a Scenario ..................................................131
  Configuring Scenario Run-Time Settings .....................................132
  Setting Timeout Intervals ......................................................133
  Setting the Run-Time File Location ..........................................136
  Specifying Path Translation ...................................................138

Chapter 11: Preparing to Run a Scenario ....................................139
  About Preparing to Run a Scenario ..........................................139
  Specifying a Results Location ................................................140
  Results Directory File Structure .............................................142
  Collating Results ......................................................................143
  Setting Scenario Summary Information ......................................145

Chapter 12: Managing Scenarios Using TestDirector ......................147
  About Managing Scenarios Using TestDirector ............................147
  Connecting to and Disconnecting from TestDirector ....................148
  Opening Scenarios from a TestDirector Project ...........................151
  Saving Scenarios to a TestDirector Project ..................................152
  Saving Results to a TestDirector Project ....................................154
  Adding Vuser Scripts from a TestDirector Project .......................155

PART III: EXECUTING A SCENARIO

Chapter 13: Running a Scenario ..............................................161
  About Running a Scenario ......................................................161
  Running an Entire Scenario ....................................................163
  Controlling Vuser Groups .......................................................164
  Controlling Individual Vusers ...............................................167
  Manually Releasing Vusers from a Rendezvous ............................169
  Manually Adding Vusers to a Running Scenario ...........................170
# Table of Contents

**Chapter 18: Remote Performance Monitoring** ...........................................241  
About Remote Performance Monitoring ................................................241  
Installing the Remote Performance Monitor Server ..........................242  
Connecting to the Remote Performance Monitor ..........................243  
Monitoring Load Test Data ..........................................................245  
Viewing Online Graphs...............................................................245  
Customizing Online Graph Settings.................................................248

**Chapter 19: Run-Time and Transaction Monitoring** ...............................253  
About Run-Time and Transaction Graphs ........................................253  
Run-Time Graphs .................................................................254  
User-Defined Data Points Graph ..................................................255  
Transaction Monitor Graphs .......................................................256  
Enabling the Transaction Monitor ..............................................257  
Adding Transactions to a Script ..................................................258  
Enabling Web Page Breakdown ...................................................259

**Chapter 20: Web Resource Monitoring** ..............................................261  
About Web Resource Monitoring...................................................261  
Hits per Second Graph ..............................................................262  
Throughput Graph .................................................................262  
HTTP Responses per Second Graph ...............................................263  
Pages Downloaded per Second Graph ..........................................265  
Retries per Second Graph ..........................................................266

**Chapter 21: System Resource Monitoring** ...........................................269  
About System Resource Monitoring...............................................269  
Configuring the Windows Resources Monitor ................................271  
Configuring the UNIX Resources Monitor .....................................276  
Configuring an rstatd Daemon on UNIX ........................................279  
Configuring the SNMP Resources Monitor .....................................280  
Configuring the TUXEDO Monitor ..............................................283  
Configuring the Antara FlameThrower Monitor ..............................287

**Chapter 22: Network Monitoring** .....................................................301  
About Network Monitoring........................................................301  
Network Monitoring from a UNIX Source Machine ..........................303  
Configuring the Network Monitor ...............................................306  
Viewing the Network Delay Time Graph .......................................310

**Chapter 23: Firewall Server Performance Monitoring** ..........................313  
About the Firewall Server Monitor ..............................................313  
Configuring the Check Point FireWall-1 Server Monitor ...................313
Chapter 24: Web Server Resource Monitoring
About Web Server Resource Monitors ...................................................... 317
Configuring the Apache Monitor ............................................................ 318
Configuring the Microsoft IIS Monitor .................................................. 321
Configuring the iPlanet/Netscape Monitor ......................................... 323
Configuring the iPlanet (SNMP) Monitor ........................................... 328
Monitoring Using a Proxy Server ......................................................... 331

Chapter 25: Web Application Server Resource Monitoring .......... 333
About Web Application Server Resource Monitors ....................... 334
Configuring the Ariba Monitor ............................................................ 334
Configuring the ATG Dynamo Monitor .............................................. 338
Configuring the BroadVision Monitor .............................................. 344
Configuring the ColdFusion Monitor .............................................. 354
Configuring the Fujitsu INTERSTAGE Monitor ............................... 357
Configuring the Microsoft Active Server Pages Monitor ............. 359
Configuring the Oracle9iAS HTTP Monitor ...................................... 361
Configuring the SilverStream Monitor .............................................. 367
Configuring the WebLogic (SNMP) Monitor ................................... 370
Configuring the WebLogic (JMX) Monitor ...................................... 374
Configuring the WebSphere Monitor .............................................. 380
Configuring the WebSphere (EPM) Monitor ................................... 392

Chapter 26: Database Resource Monitoring .................................... 403
About Database Resource Monitoring .............................................. 403
Configuring the DB2 Monitor ............................................................. 404
Configuring the Oracle Monitor ............................................................ 421
Configuring the SQL Server Monitor .............................................. 427
Configuring the Sybase Monitor .......................................................... 430

Chapter 27: Streaming Media Monitoring ........................................ 439
About Streaming Media Monitoring ................................................. 439
Configuring the Windows Media Server Monitor .......................... 440
Configuring the RealPlayer Server Monitor ..................................... 442
Viewing the RealPlayer Client Online Graph .................................. 444
Viewing the Media Player Client Online Graph ............................... 445

Chapter 28: ERP Server Resource Monitoring ............................... 447
About ERP Server Resource Monitoring ........................................... 447
Setting Up the SAP Monitor ............................................................. 448
Configuring the SAP Monitor ............................................................ 448
# Table of Contents

**Chapter 29: Java Performance Monitoring**
- About Java Performance Monitoring ................................................453
- EJB Performance Monitoring ............................................................454
- JProbe Performance Monitoring .......................................................470
- Sitraka JMonitor Performance Monitoring .......................................473
- TowerJ Performance Monitoring.......................................................492

**Chapter 30: Troubleshooting Online Monitors** ................................497
- Troubleshooting Server Resource Monitors ......................................497
- Troubleshooting the Network Delay Monitor ..................................500
- Network Considerations....................................................................502

## PART V: APPENDIXES

**Appendix A: Interpreting LoadRunner Online Graphs** .....................507
- Online Monitoring Graphs ..............................................................507

**Appendix B: Performing Path Translation** ........................................511
- Understanding Path Translation ....................................................511
- Adding Entries to the Path Translation Table ................................513
- Editing the Path Translation Table ................................................514
- Path Translation Examples............................................................516

**Appendix C: Working in Expert Mode** .............................................517
- Entering Expert Mode .......................................................................517
- Options - Agent Settings ...............................................................518
- Options - General Settings ...............................................................519
- Options - Debug Information Settings .............................................520
- Options - Output Settings ...............................................................521
- Options - Monitor Settings ...............................................................523
- Load Generator Information - UNIX Environment Settings ...........524
- Load Generator Information - Connection Log Settings .................525

**Appendix D: Troubleshooting the Controller** ...................................527
- About Troubleshooting .....................................................................527
- LoadRunner Communications .........................................................528
- Failure to Communicate with a Load Generator ..............................529
- Failure to Connect to the AUT Database .........................................535
- Failure to Access Files .....................................................................535
- Failed Vusers or Transactions..........................................................537
- Increasing the Number of Vusers on a Windows Machine ..............541
- Troubleshooting Firewalls...............................................................542
Appendix E: Working with Server Monitor Counters ........................................... 551
Changing a Monitor's Default Counters ....................................................... 551
Useful Counters for Stress Testing .............................................................. 552

Appendix F: Configuring Multiple IP Addresses ........................................... 555
About Multiple IP Addresses ....................................................................... 555
Adding IP Addresses to a Load Generator .................................................. 556
Using the IP Wizard .................................................................................. 556
Configuring Multiple IP Addresses on UNIX ............................................. 561
Updating the Routing Table ....................................................................... 562
Enabling Multiple IP Addressing from the Controller ............................... 563

Appendix G: Controller Command Line Arguments ...................................... 565
About Controller Command Line Arguments .............................................. 565
Invoking the Controller from the Command Line ....................................... 565
TestDirector Arguments ............................................................................ 566
Run-Time Arguments ................................................................................ 567

Appendix H: Working with Digital Certificates ............................................ 569
Using Digital Certificates with Firewalls .................................................... 569
Creating and Using Digital Certificates .................................................... 570

Index ......................................................................................................... 575
Welcome to LoadRunner

Welcome to LoadRunner, Mercury Interactive’s tool for testing the performance of applications. LoadRunner stresses your entire application to isolate and identify potential client, network, and server bottlenecks.

LoadRunner enables you to test your system under controlled and peak load conditions. To generate load, LoadRunner runs thousands of Virtual Users that are distributed over a network. Using a minimum of hardware resources, these Virtual Users provide consistent, repeatable, and measurable load to exercise your application just as real users would. LoadRunner’s in-depth reports and graphs provide the information that you need to evaluate the performance of your application.

Online Resources

LoadRunner includes the following online tools:

**Read Me First** provides last-minute news and information about LoadRunner.

**Books Online** displays the complete documentation set in PDF format. Online books can be read and printed using Adobe Acrobat Reader, which is included in the installation package. Check Mercury Interactive’s Customer Support Web site for updates to LoadRunner online books.

**LoadRunner Function Reference** gives you online access to all of LoadRunner’s functions that you can use when creating Vuser scripts, including examples of how to use the functions. Check Mercury Interactive’s Customer Support Web site for updates to the online *LoadRunner Function Reference.*
LoadRunner Context Sensitive Help provides immediate answers to questions that arise as you work with LoadRunner. It describes dialog boxes, and shows you how to perform LoadRunner tasks. To activate this help, click in a window and press F1. Check Mercury Interactive's Customer Support Web site for updates to LoadRunner help files.

Technical Support Online uses your default Web browser to open Mercury Interactive's Customer Support Web site. This site enables you to browse the knowledge base and add your own articles, post to and search user discussion forums, submit support requests, download patches and updated documentation, and more. The URL for this Web site is http://support.mercuryinteractive.com.

Support Information presents the locations of Mercury Interactive’s Customer Support Web site and home page, the e-mail address for sending information requests, and a list of Mercury Interactive's offices around the world.

Mercury Interactive on the Web uses your default Web browser to open Mercury Interactive's home page (http://www.mercuryinteractive.com). This site enables you to browse the knowledge base and add your own articles, post to and search user discussion forums, submit support requests, download patches and updated documentation, and more.

LoadRunner Documentation Set

LoadRunner is supplied with a set of documentation that describes how to:

- install LoadRunner
- create Vuser scripts
- use the LoadRunner Controller
- use the LoadRunner Analysis
Using the LoadRunner Documentation Set

The LoadRunner documentation set consists of one installation guide, a Controller user’s guide, an Analysis user’s guide, and two guides for creating Virtual User scripts.

Installation Guide

For instructions on installing LoadRunner, refer to the Installing LoadRunner guide. The installation guide explains how to install:

- the LoadRunnerController —on a Windows-based machine
- Virtual User components—for both Windows and UNIX platforms

Controller User’s Guide

The LoadRunner documentation pack includes one Controller user’s guide:

The LoadRunner Controller User’s Guide describes how to create and run LoadRunner scenarios using the LoadRunner Controller in a Windows environment. The Vusers can run on UNIX and Windows-based platforms. The Controller user’s guide presents an overview of the LoadRunner testing process.

Analysis User’s Guide

The LoadRunner documentation pack includes one Analysis user’s guide:

The LoadRunner Analysis User’s Guide describes how to use the LoadRunner Analysis graphs and reports after running a scenario in order to analyze system performance.

Guides for Creating Vuser Scripts

The LoadRunner documentation pack has two guides that describe how to create Vuser scripts:

- The Creating Vuser Scripts guide describes how to create all types of Vuser scripts. When necessary, supplement this document with the online LoadRunner Function Reference and the following guide.
The WinRunner User’s Guide describes in detail how to use WinRunner to create GUI Vuser scripts. The resulting Vuser scripts run on Windows platforms. The TSL Online Reference should be used in conjunction with this document.

<table>
<thead>
<tr>
<th>For information on</th>
<th>Look here...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installing LoadRunner</td>
<td>Installing LoadRunner guide</td>
</tr>
<tr>
<td>The LoadRunner testing process</td>
<td>LoadRunner Controller User’s Guide</td>
</tr>
<tr>
<td>Creating Vuser scripts</td>
<td>Creating Vuser Scripts guide</td>
</tr>
<tr>
<td>Creating and running scenarios</td>
<td>LoadRunner Controller User’s Guide</td>
</tr>
<tr>
<td>Analyzing test results</td>
<td>LoadRunner Analysis User’s Guide</td>
</tr>
</tbody>
</table>

**Typographical Conventions**

This book uses the following typographical conventions:

- **1, 2, 3** Bold numbers indicate steps in a procedure.
- ▶ Bullets indicate options and features.
- > The greater than sign separates menu levels (for example, **File > Open**).
- **Stone Sans** The **Stone Sans** font indicates names of interface elements on which you perform actions (for example, “Click the **Run** button.”).
- **Bold** **Bold** text indicates method or function names
- **Italics** **Italic** text indicates method or function arguments, file names or paths, and book titles.
- **Helvetica** The **Helvetica** font is used for examples and text that is to be typed literally.
Welcome to LoadRunner

<> Angle brackets enclose a part of a file path or URL address that may vary from user to user (for example, <Product installation folder>\bin).

[ ] Square brackets enclose optional arguments.

{} Curly brackets indicate that one of the enclosed values must be assigned to the current argument.

... In a line of syntax, an ellipsis indicates that more items of the same format may be included.
Part I

Understanding LoadRunner
Introduction

To load test your application, LoadRunner emulates an environment where multiple users work concurrently. While the application is under load, LoadRunner accurately measures, monitors, and analyzes a system’s performance and functionality.

Application Load Testing

Modern system architectures are complex. While they provide an unprecedented degree of power and flexibility, these systems are difficult to test. Whereas single-user testing focuses primarily on functionality and the user interface of a system component, application testing focuses on performance and reliability of an entire system.

For example, a typical application testing scenario might depict 1000 users that log in simultaneously to a system on Monday morning: What is the response time of the system? Does the system crash? To be able to answer these questions—and more—a complete application performance testing solution must:

➤ test a system that combines a variety of software applications and hardware platforms
➤ determine the suitability of a server for any given application
➤ test the server before the necessary client software has been developed
➤ emulate an environment where multiple clients interact with a single server application
➤ test an application under the load of tens, hundreds, or even thousands of potential users
Manual Testing Limitations

Traditional or manual testing methods offer only a partial solution to load testing. For example, you can test an entire system manually by constructing an environment where many users work simultaneously on the system. Each user works at a single machine and submits input to the system. However, this manual testing method has the following drawbacks:

➤ it is expensive, requiring large amounts of both personnel and machinery
➤ it is complicated, especially coordinating and synchronizing multiple testers
➤ it involves a high degree of organization, especially to record and analyze results meaningfully
➤ the repeatability of the manual tests is limited

The LoadRunner Solution

The LoadRunner automated solution addresses the drawbacks of manual performance testing:

➤ LoadRunner reduces the personnel requirements by replacing human users with virtual users or Vusers. These Vusers emulate the behavior of real users—operating real applications.
➤ Because numerous Vusers can run on a single computer, LoadRunner reduces the hardware requirements.
➤ The LoadRunner Controller allows you to easily and effectively control all the Vusers—from a single point of control.
➤ LoadRunner monitors the application performance online, enabling you to fine-tune your system during test execution.
➤ LoadRunner automatically records the performance of the application during a test. You can choose from a wide variety of graphs and reports to view the performance data.
➤ LoadRunner checks where performance delays occur: network or client delays, CPU performance, I/O delays, database locking, or other issues at the database server. LoadRunner monitors the network and server resources to help you improve performance.
Because LoadRunner tests are fully automated, you can easily repeat them as often as you need.

### Using LoadRunner

**Scenarios**

Using LoadRunner, you divide your application performance testing requirements into *scenarios*. A scenario defines the events that occur during each testing session. Thus, for example, a scenario defines and controls the number of users to emulate, the actions that they perform, and the machines on which they run their emulations.

In the scenario, LoadRunner replaces human users with *virtual users* or *Vusers*. When you run a scenario, Vusers emulate the actions of human users working with your application. While a workstation accommodates only a single human user, many Vusers can run concurrently on a single workstation. In fact, a scenario can contain tens, hundreds, or even thousands of Vusers.

**Vuser Scripts**

The actions that a Vuser performs during the scenario are described in a Vuser script. When you run a scenario, each Vuser executes a *Vuser script*. The Vuser scripts include functions that measure and record the performance of your application’s components.

**Transactions**

To measure the performance of the server, you define *transactions*. A transaction represents an action or a set of actions that you are interested in measuring. You define transactions within your Vuser script by enclosing the appropriate sections of the script with *start* and *end* transaction statements. For example, you can define a transaction that measures the time it takes for the server to process a request to view the balance of an account and for the information to be displayed at the ATM.

**Rendezvous points**

You insert *rendezvous points* into Vuser scripts to emulate heavy user load on the server. *Rendezvous points* instruct Vusers to wait during test execution for multiple Vusers to arrive at a certain point, in order that they may simultaneously perform a task. For example, to emulate peak load on the bank server, you can insert a rendezvous point instructing 100 Vusers to deposit cash into their accounts at the same time.
LoadRunner Controller User's Guide • Understanding LoadRunner

You use the LoadRunner Controller to manage and maintain your scenarios. Using the Controller, you control all the Vusers in a scenario from a single workstation.

When you execute a scenario, the LoadRunner Controller distributes each Vuser in the scenario to a load generator. The load generator is the machine that executes the Vuser script, enabling the Vuser to emulate the actions of a human user.

Vuser scripts include functions that measure and record system performance during load-testing sessions. During a scenario run, you can monitor the network and server resources. Following a scenario run, you can view performance analysis data in reports and graphs.

Working with LoadRunner

Suppose you want to test an online banking Web server that is accessed by many Internet users. The Web site provides a full range of banking services to the customers—such as the ability to transfer funds and check account balances. To test this server, you create a scenario. The scenario defines the actions that are performed on the server during the load test.

During the scenario that loads and monitors the bank server, you want to:

➤ emulate conditions of controlled load on the server
➤ emulate conditions of maximum load on the server
➤ measure server performance under load
➤ check where performance delays occur: network or client delays, CPU performance, I/O delays, database locking, or other issues at the server
➤ monitor the network and server resources under load
LoadRunner Vuser Technology

On each Windows load generator, you install the Remote Agent Dispatcher (Process) and a LoadRunner Agent.

The Remote Agent Dispatcher (Process) enables the Controller to start applications on the load generator machine.

The LoadRunner Agent enables the Controller and the load generator to communicate with each other. When you run a scenario, the Controller instructs the Remote Agent Dispatcher (Process) to launch the LoadRunner agent. The agent receives instructions from the Controller to initialize, run, pause, and stop Vusers. At the same time, the agent also relays data on the status of the Vusers back to the Controller.
LoadRunner Vuser Types

LoadRunner has various types of Vusers. Each type is designed to handle different aspects of today’s system architectures. You can use the Vuser types in any combination in a scenario in order to create a comprehensive application test. The following Vuser types are available:

➤ Client/Server
For MSSQLServer, ODBC, Oracle (2-tier), DB2 CLI, Sybase Ctlib, Sybase Dblib, Windows Sockets and DNS protocols.

➤ Custom
For C templates, Visual Basic templates, Java templates, Javascript and VBScript type scripts.

➤ Distributed Components
For COM/DCOM, Corba-Java, and Rmi-Java protocols.

➤ E-business
For FTP, LDAP, Media Player, Multi Protocol Web/WS, Web (HTTP, HTML), Palm, and RealPlayer protocols.

➤ Enterprise Java Beans
For EJB Testing and Rmi-Java protocols.

➤ ERP
For Oracle NCA, Peoplesoft (Tuxedo), SAP, and Siebel protocols.

➤ Legacy
For Terminal Emulation (RTE).

➤ Mailing Services
Internet Messaging (IMAP), MS Exchange (MAPI), POP3, and SMTP.

➤ Middleware
For the Tuxedo (6, 7) protocol.

➤ Wireless
For i-Mode, VoiceXML, and WAP protocols.
GUI Vusers

GUI Vusers operate graphical user interface (GUI) applications. These applications can run in a Microsoft Windows environment. Each GUI Vuser that you develop emulates a real user by submitting input to, and receiving output from, GUI applications. For example, a GUI Vuser could operate Microsoft Paint as follows:

1. Select Open from the File menu.
2. Select a graphic file called test.bmp.
3. Click the Open button.
4. Select Flip/Rotate from the Image menu.
5. Click the Flip Horizontal radio button.
6. Click the OK button.
7. Select Save from the File menu.
The operations that a GUI Vuser performs on an application are defined in a GUI Vuser script. You create GUI Vuser scripts using Mercury Interactive’s GUI testing tools: WinRunner (for Microsoft Windows applications), and Astra QuickTest (for Web applications).

You can run only a single GUI Vuser on a Windows-based load generator. Use Citrix to run multiple GUI Vusers. Refer to the Readme file for additional information about configuring your load generators using Citrix. For additional information on Windows-based GUI Vusers, refer to the LoadRunner Creating Vuser Scripts User’s Guide.

Note: You can run GUI and SAP Vusers on remote load generators only if you install the Remote Agent Dispatcher as a process. If you install the Remote Agent Dispatcher as a service, you cannot run GUI Vusers on remote load generators.

Vuser Technology

Vusers (except for GUI and RTE Vusers) generate load on a server by submitting input directly to the server. Vusers do not operate client applications—they access the server using LoadRunner API functions. These API functions emulate the input from an actual application.

Because Vusers are not reliant on client software, you can use Vusers to test server performance even before the client software has been developed. Further, since Vusers do not have a user interface, the amount of system resources required is minimal. This allows you to run large numbers of Vusers on a single workstation.
Chapter 1 • Introduction

The following example illustrates the use of Vusers: Suppose that you have a Web-based database server that maintains your customer information. The information is accessed by numerous customer service personnel who are located throughout the country. The server receives the queries, processes the requests, and returns responses, via the Web, to field personnel.

You want to test the response times of the entire system when numerous service personnel simultaneously access the server. Using LoadRunner, you could create several hundred Vusers, each Vuser accessing the server database. The Vusers enable you to emulate and measure the performance of your database and Web servers under the load of many users.

You develop a Vuser script to define the actions of a Vuser. A Vuser script includes functions that control the script execution, specify the input that the Vuser submits to the server, and measure the server performance.

You develop Vuser scripts either by recording with LoadRunner’s Vuser Script Generator (VuGen) or by using LoadRunner’s Vuser script templates.

For the database server example above, you could create a Vuser script that performs the following actions:

➤ logs in to the Web application
➤ connects to the database server
➤ submits an SQL query
➤ retrieves and processes the server response
➤ disconnects from the server and the Web

You can create Vuser scripts on a Windows-based platform, or program them on a UNIX platform. For a list of the supported UNIX platforms, see the LoadRunner Readme file. For more information about Vusers, refer to the LoadRunner Creating Vuser Scripts User’s Guide.
RTE Vusers

RTE Vusers operate character-based applications. Each RTE Vuser that you develop emulates a real user by submitting input to, and receiving output from, character-based applications.

The following example illustrates the use of RTE Vusers: Suppose that you have a database server that maintains customer information. The information is accessed by numerous field service representatives who are located throughout the country. Every time a field service representative makes a repair, he accesses the server database by modem. Using a character-based application, the service representative records the customer complaint and accesses additional information about the customer.

You want to test the response times of the server when many service personnel simultaneously access the server. Using LoadRunner, you could create several hundred RTE Vusers, each Vuser accessing the server database using a character-based application. The RTE Vusers enable you to emulate and measure the performance of your server under the load of many users.
Chapter 1 • Introduction

The operations that an RTE Vuser performs on an application are defined in an RTE Vuser script. You create RTE Vuser scripts by using the Vuser Script Generator (VuGen). The generator enables you to record the actions that you perform on a character-based application.

For further information on RTE Vusers, refer to the LoadRunner Creating Vuser Scripts User's Guide.
You can easily create and run load-test scenarios by following the LoadRunner testing process below. The following illustration outlines the testing process:

1. **Planning the Test**
2. **Creating Vuser Scripts**
3. **Creating the Scenario**
4. **Running the Scenario**
5. **Monitoring the Scenario**
6. **Analyzing Test Results**
This chapter gives you an overview of LoadRunner’s six-step process for testing your Web-based application under load.

**Step I: Planning the Test**

Successful load testing requires that you develop a thorough test plan. A clearly defined test plan will ensure that the LoadRunner scenarios that you develop will accomplish your load testing objectives. For more information, see Chapter 3, “Load Test Planning.”

**Step II: Creating the Vuser Scripts**

Vusers emulate human users interacting with your Web-based application. A Vuser script contains the actions that each virtual user performs during scenario execution.

In each Vuser script you determine the tasks that will be:

- performed by each Vuser
- performed simultaneously by multiple Vusers
- measured as transactions

For more information on creating Vuser scripts, refer to the *LoadRunner Creating Vuser Scripts User’s Guide.*

**Step III: Creating the Scenario**

A scenario describes the events that occur during a testing session. A scenario includes a list of machines on which Vusers run, a list of scripts that the Vusers run, and a specified number of Vusers or Vuser groups that run during the scenario. You create scenarios using the LoadRunner Controller. For an introduction to the Controller, see Chapter 4, “The LoadRunner Controller at a Glance.”
Creating a Manual Scenario

You create a scenario by defining Vuser groups to which you assign a quantity of individual Vusers, Vuser scripts, and load generators to run the scripts. For instructions on creating a manual scenario, see Chapter 5, “Creating a Manual Scenario.”

You can also create a scenario using the Percentage Mode, in which you define the total number of Vusers to be used in the scenario, and the load generator machines and percentage of the total number of Vusers to be assigned to each Vuser script. For instructions on creating a manual scenario in Percentage Mode, see Chapter 6, “Creating a Manual Scenario Using the Percentage Mode.”

Creating a Goal-Oriented Scenario

For Web tests, you can create a goal-oriented scenario, in which you define the goals you want your test to achieve. LoadRunner automatically builds a scenario for you, based on these goals. For instructions on creating a goal-oriented scenario, see Chapter 7, “Creating a Goal-Oriented Scenario.”

Step IV: Running the Scenario

You emulate user load on the server by instructing multiple Vusers to perform tasks simultaneously. You can set the level of load by increasing and decreasing the number of Vusers that perform tasks at the same time. For more information, see Chapter 9, “Using Rendezvous Points.”

Before you run a scenario, you set the scenario configuration and scheduling. This determines how all the load generators and Vusers behave when you run the scenario. For more information, see Chapter 10, “Configuring a Scenario” and Chapter 8, “Scheduling a Scenario.”

You can run the entire scenario, groups of Vusers (Vuser groups), or individual Vusers. While a scenario runs, LoadRunner measures and records the transactions that you defined in each Vuser script. You can also monitor your system’s performance online. For more information, see Part III, “Executing a Scenario.”
Step V: Monitoring a Scenario

You can monitor scenario execution using the LoadRunner online run-time, transaction, system resource, Web resource, Web server resource, Web application server resource, database server resource, network delay, streaming media resource, firewall server resource, ERP server resource, and Java performance monitors. For more information, see Part IV, “Monitoring a Scenario.”

Step VI: Analyzing Test Results

During scenario execution, LoadRunner records the performance of the application under different loads. You use LoadRunner’s graphs and reports to analyze the application’s performance. For more information about LoadRunner’s reports and graphs, see the LoadRunner Analysis User’s Guide.
Load Test Planning

Developing a comprehensive test plan is a key to successful load testing. A clearly defined test plan ensures that the LoadRunner scenarios you develop will accomplish your load testing objectives.

This chapter introduces the load test planning process:

➤ Analyzing the Application
➤ Defining Testing Objectives
➤ Planning LoadRunner Implementation
➤ Examining Load Testing Objectives

About Load Test Planning

As in any type of system testing, a well-defined test plan is the first essential step to successful testing. Planning your load testing helps you to:

➤ Build test scenarios that accurately emulate your working environment.

Load testing means testing your application under typical working conditions, and checking for system performance, reliability, capacity, etc.

➤ Understand which resources are required for testing.

Application testing requires hardware, software, and human resources. Before you begin testing, you should know which resources are available and decide how to use them effectively.

➤ Define success criteria in measurable terms.

Focused testing goals and test criteria ensure successful testing. For example, it’s not enough to define vague objectives like “Check server response time
under heavy load.” A more focused success criteria would be “Check that 50 customers can check their account balance simultaneously, and that the server response time will not exceed one minute.”

Load test planning is a three-step process:

1. **Analyzing the Application**
   The first step to load test planning is analyzing your application. You should become thoroughly familiar with the hardware and software components, the system configuration, and the typical usage model. This analysis ensures that the testing environment you create using LoadRunner will accurately reflect the environment and configuration of the application under test.

2. **Identifying System Components**
   Draw a schematic diagram to illustrate the structure of the application. If possible, extract a schematic diagram from existing documentation. If the application under test is part of a larger network system, you should identify the component of the system to be tested. Make sure the diagram includes all system components, such as client machines, network, middleware, and servers.

   The following diagram illustrates an online banking system which is accessed by many Web users. The Web users each connect to the same
Chapter 3 • Load Test Planning

database to transfer funds and check balances. The customers connect to the database server through the Web, using multiple browsers.

Describing the System Configuration

Enhance the schematic diagram with more specific details. Describe the configuration of each system component. You should be able to answer the following questions:

➤ How many users are anticipated to connect to the system?
➤ What is the application client’s machine configuration? (hardware, memory, operating system, software, development tool, etc.)
➤ What types of database and Web servers are used? (hardware, database type, operating system, file server, etc.)
➤ How does the server communicate with the application client?
➤ What is the middleware configuration and application server between the front-end client and back-end server?
➤ What other network components may affect response time? (modems etc.)
➤ What is the throughput of the communications devices? How many concurrent users can each device handle?
For example, the schematic diagram above specified that there are multiple application clients accessing the system.

<table>
<thead>
<tr>
<th>Front-End Client Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anticipated number of application clients</td>
</tr>
<tr>
<td>Hardware / Memory</td>
</tr>
<tr>
<td>Operating system &amp; version</td>
</tr>
<tr>
<td>Client browser</td>
</tr>
</tbody>
</table>

**Analyzing the Usage Model**

Define how the system is typically used, and decide which functions are important to test. Consider who uses the system, the number of each type of user, and each user's common tasks. In addition, consider any background load that might affect the system response time.

For example, suppose 200 employees log on to the accounting system every morning, and the same office network has a constant background load of 50 users performing various word processing and printing tasks. You could create a LoadRunner scenario with 200 virtual users signing in to the accounting database, and check the server response time.

To check how background load affects the response time, you could run your scenario on a network where you also simulate the load of employees performing word processing and printing activities.

**Task Distribution**

In addition to defining the common user tasks, examine the distribution of these tasks. For example, suppose the bank uses a central database to serve clients across many states and time zones. The 250 application clients are located in two different time zones, all connecting to the same Web server. There are 150 in Chicago and 100 in Detroit. Each begins their business day at 9:00 AM, but since they are in different time zones, there should never be more than 150 users signing in at any given time.

You can analyze task distribution to determine when there is peak database activity, and which activities typically occur during peak load time.
### Defining Testing Objectives

Before you begin testing, you should define exactly what you want to accomplish.

Following are common application testing objectives that LoadRunner helps you test, as described in Robert W. Buchanan, Jr's *The Art of Testing Network Systems* (John Wiley & Sons, Inc., 1996).

<table>
<thead>
<tr>
<th>Objective</th>
<th>Answers the Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring end-user response time</td>
<td>How long does it take to complete a business process?</td>
</tr>
<tr>
<td>Defining optimal hardware configuration</td>
<td>Which hardware configuration provides the best performance?</td>
</tr>
<tr>
<td>Checking reliability</td>
<td>How hard or long can the system work without errors or failures?</td>
</tr>
<tr>
<td>Checking hardware or software upgrades</td>
<td>How does the upgrade affect performance or reliability?</td>
</tr>
<tr>
<td>Evaluating new products</td>
<td>Which server hardware or software should you choose?</td>
</tr>
<tr>
<td>Measuring system capacity</td>
<td>How much load can the system handle without significant performance degradation?</td>
</tr>
<tr>
<td>Identifying bottlenecks</td>
<td>Which element is slowing down response time?</td>
</tr>
</tbody>
</table>

A more detailed description of each objective appears at the end of this chapter.
Stating Objectives in Measurable Terms

Once you decide on your general load testing objectives, you should provide more focused goals by stating your objectives in measurable terms. To provide a baseline for evaluation, determine exactly what constitutes acceptable and unacceptable test results.

For example:

**General Objective** - Product Evaluation: choose hardware for the Web server.

**Focused Objective** - Product Evaluation: run the same group of 300 virtual users on two different servers, HP and NEC. When all 300 users simultaneously browse the pages of your Web application, determine which hardware gives a better response time.

Deciding When to Test

Load testing is necessary throughout the product life cycle. The following table illustrates what types of tests are relevant for each phase of the product life cycle:

<table>
<thead>
<tr>
<th>Planning and Design</th>
<th>Development</th>
<th>Deployment</th>
<th>Production</th>
<th>Evolution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Evaluate new products</td>
<td>Check response time</td>
<td>Measure response time</td>
<td>Check HW or SW upgrades</td>
</tr>
<tr>
<td></td>
<td>Measure response time</td>
<td>Check reliability</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Check optimal hardware configuration</td>
<td>Measure response time</td>
<td>Identify bottlenecks</td>
<td>Measure system capacity</td>
</tr>
<tr>
<td></td>
<td>Check HW or SW upgrades</td>
<td>Measure system capacity</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Check reliability</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Planning LoadRunner Implementation

The next step is to decide how to use LoadRunner to achieve your testing goals.

Defining the Scope of Performance Measurements

You can use LoadRunner to measure response time at different points in the application. Determine where to run the Vusers and which Vusers to run according to the test objectives:

- Measuring end-to-end response time:

  You can measure the response time that a typical user experiences by running a GUI Vuser or RTE Vuser at the front end. GUI Vusers emulate real users by submitting input to and receiving output from the client application; RTE Vusers emulate real users submitting input to and receiving output from a character-based application.

  You can run GUI or RTE Vusers at the front end to measure the response time across the entire network, including a terminal emulator or GUI front end, network, and server.

- Measuring network and server response times:

  You can measure network and server response time, excluding response time of the GUI front end, by running Vusers (not GUI or RTE) on the client machine. Vusers emulate client calls to the server without the user interface. When you run many Vusers from the client machine, you can measure how the load affects network and server response time.
➤ Measuring GUI response time:

You can determine how the client application interface affects response time by subtracting the previous two measurements:

\[ \text{GUI response time} = \text{end-to-end} - \text{network and server} \]

➤ Measuring server response time:

You can measure the time it takes for the server to respond to a request without going across the network. When you run Vusers on a machine directly connected to the server, you can measure server performance.

➤ Measuring middleware-to-server response time:

You can measure response time from the server to middleware if you have access to the middleware and its API. You can create Vusers with the middleware API and measure the middleware-server performance.
Chapter 3 • Load Test Planning

Defining Vuser Activities
Create Vuser scripts based on your analysis of Vuser types, their typical tasks and your test objectives. Since Vusers emulate the actions of a typical end-user, the Vuser scripts should include the typical end-user tasks. For example, to emulate an online banking client, you should create a Vuser script that performs typical banking tasks. You would browse the pages that you normally visit to transfer funds or check balances.

You decide which tasks to measure based on your test objectives and define transactions for these tasks. Transactions measure the time that it takes for the server to respond to tasks submitted by Vusers (end-to-end time). For example, to check the response time of a bank Web server supplying an account balance, define a transaction for this task in the Vuser script.

In addition, you can emulate peak activity by using rendezvous points in your script. Rendezvous points instruct multiple Vusers to perform tasks at exactly the same time. For example, you can define a rendezvous to emulate 70 users simultaneously updating account information.

Selecting Vusers
Before you decide on the hardware configuration to use for testing, determine the number and type of Vusers required. To decide how many Vusers and which types to run, look at the typical usage model, combined with the testing objectives. Some general guidelines are:

- Use one or a few GUI users to emulate each type of typical user connection.
- Use RTE Vusers to emulate terminal users.
- Run multiple non-GUI or non-RTE Vusers to generate the rest of the load for each user type.
For example, suppose that you have five kinds of users, each performing a different business process:

<table>
<thead>
<tr>
<th>Usage Model</th>
<th>GUI</th>
<th>RTE</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 customer service users in New York (LAN connection)</td>
<td>2</td>
<td>_</td>
<td>98</td>
</tr>
<tr>
<td>30 customers in Europe (dial-in ISDN connection)</td>
<td>2</td>
<td>_</td>
<td>28</td>
</tr>
<tr>
<td>5 background batch processes</td>
<td>_</td>
<td>_</td>
<td>5</td>
</tr>
<tr>
<td>150 customers (terminal connection)</td>
<td>_</td>
<td>150</td>
<td>_</td>
</tr>
<tr>
<td>6 managers (2 users with 486 PCs, 4 with 586 PCs)</td>
<td>1 (486 PC)</td>
<td>_</td>
<td>4</td>
</tr>
</tbody>
</table>

**Choosing Testing Hardware/Software**

The hardware and software should be powerful and fast enough to emulate the required number of virtual users.

To decide on the number of machines and correct configuration, consider the following:

- It is advisable to run the LoadRunner Controller on a separate machine.
- Each GUI Vuser requires a separate Windows-based machine; several GUI Vusers can run on a single UNIX machine.
- Configuration of the test machine for GUI Vusers should be as similar as possible to the actual user's machine.

Refer to the following tables to estimate the required hardware for each LoadRunner testing component. These requirements are for optimal performance.
### Windows Configuration Requirements

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Controller with Online Monitors</th>
<th>Virtual Vuser Generator</th>
<th>Virtual Users</th>
<th>Analysis Module</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer/Processor</td>
<td>Pentium 300 MHZ or higher</td>
<td>Pentium 300 MHZ or higher</td>
<td>Pentium 500 MHZ CPU or higher</td>
<td>Pentium 300 MHZ or higher</td>
</tr>
<tr>
<td>Operating System</td>
<td>Windows NT service pack 3 or higher, Windows 2000</td>
<td>Windows NT service pack 3 or higher, Windows 2000</td>
<td>Windows NT service pack 3 or higher, Windows 2000</td>
<td>Windows 2000</td>
</tr>
<tr>
<td>Memory</td>
<td>64 MB or more</td>
<td>128 MB or more</td>
<td>At least 1 MB RAM for non-multithreaded Vuser or at least 400 KB multi-threaded Vuser</td>
<td>128 MB or more</td>
</tr>
<tr>
<td>Swap Space</td>
<td>Two times the total physical memory</td>
<td>Two times the total physical memory</td>
<td>Two times the total physical memory</td>
<td>Two times the total physical memory</td>
</tr>
<tr>
<td>Free Hard Disk Space</td>
<td>200 MB</td>
<td>200 MB</td>
<td>Minimum 500 MB</td>
<td>200 MB</td>
</tr>
<tr>
<td>Browser</td>
<td>IE 4.x or higher, Netscape Navigator 4.x</td>
<td>IE 4.x or higher, Netscape Navigator 4.x</td>
<td>N/A</td>
<td>IE 4.x or higher, Netscape Navigator 4.x</td>
</tr>
</tbody>
</table>

**Note:** The results file requires a few MB of disk space for a long scenario run with many transactions. The load generator machines also require a few MB of disk space for temporary files if there is no NFS. See Chapter 10, “Configuring a Scenario” for more information about run-time file storage.
**UNIX Configuration Requirements**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>GUI Vuser (per user)</th>
<th>Vuser (per user)</th>
<th>Web Vuser (per user)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory</td>
<td>4-5 MB plus client application requirements</td>
<td>At least 1.5 MB (depends on application)</td>
<td>~0.5 MB</td>
</tr>
<tr>
<td>Swap Space</td>
<td>Four times the total physical memory</td>
<td>Four times the total physical memory</td>
<td>Two times the total physical memory</td>
</tr>
<tr>
<td>Disk Space</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>No. of Processes</td>
<td>4</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>No. of pty's</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>1 CPU supports x users</td>
<td>30-50 or more</td>
<td>200-300 or more</td>
<td>300-400 or more</td>
</tr>
</tbody>
</table>

The results file requires a few MB of disk space for a long scenario run with many transactions. The load generator machines also require a few MB of disk space for temporary files if there is no NFS. Refer to Chapter 10, “Configuring a Scenario” for more information about run-time file storage.
Examining Load Testing Objectives

Your test plan should be based on a clearly defined testing objective. This section presents an overview of common testing objectives:

➤ Measuring end-user response time
➤ Defining optimal hardware configuration
➤ Checking reliability
➤ Checking hardware or software upgrades
➤ Evaluating new products
➤ Identifying bottlenecks
➤ Measuring system capacity

Measuring End-user Response Time

Check how long it takes for the user to perform a business process and receive a response from the server. For example, suppose that you want to verify that while your system operates under normal load conditions, the end users receive responses to all requests within 20 seconds. The following graph presents a sample load vs. response time measurement for a banking application:

![Graph showing response time vs. number of users]
Defining Optimal Hardware Configuration

Check how various system configurations (memory, CPU speed, cache, adaptors, modems) affect performance. Once you understand the system architecture and have tested the application response time, you can measure the application response for different system configurations to determine which settings provide the desired performance levels.

For example, you could set up three different server configurations and run the same tests on each configuration to measure performance variations:

- Configuration 1: 200MHz, 64MB RAM
- Configuration 2: 200MHz, 128MB RAM
- Configuration 3: 266MHz, 128MB RAM

Checking Reliability

Determine the level of system stability under heavy or continuous workloads. You can use LoadRunner to create stress on the system: force the system to handle extended activity in a compressed time period to simulate the kind of activity a system would normally experience over a period of weeks or months.

Checking Hardware or Software Upgrades

Perform regression testing to compare a new release of hardware or software to an older release. You can check how an upgrade affects response time (benchmark) and reliability. Application regression testing does not check new features of an upgrade; rather it checks that the new release is as efficient and reliable as the older release.

Evaluating New Products

You can run tests to evaluate individual products and subsystems during the planning and design stage of a product’s life cycle. For example, you can choose the hardware for the server machine or the database package based on evaluation tests.
Identifying Bottlenecks

You can run tests which identify bottlenecks on the system to determine which element is causing performance degradation, for example, file locking, resource contention and network overload. Use LoadRunner in conjunction with the new network and machine monitoring tools to create load and measure performance at different points in the system. For more information, see Part IV, “Monitoring a Scenario.”

Measuring System Capacity

Measure how much excess capacity the system can handle without performance degradation. To check capacity, you can compare performance versus load on the existing system, and determine where significant response-time degradation begins to occur. This is often called the “knee” of the response time curve.

Once you determine the current capacity, you can decide if resources need to be increased to support additional users.
The LoadRunner Controller at a Glance

This chapter introduces the Controller window and explains how to perform basic scenario operations.

This chapter describes:

➤ Opening the Controller
➤ Introducing the LoadRunner Controller
➤ Managing Scenario Files
➤ Running a Scenario

Opening the Controller

Set up the LoadRunner environment according to the instructions in the LoadRunner Installation Guide.
To open the Controller:

Select **Start > Programs > LoadRunner > Controller**. The Controller opens with the New Scenario dialog box inside.

You can select one of two methods to create a scenario: **Manual Scenario** or **Goal-Oriented Scenario**. In a manual scenario, you create the scenario yourself by defining the number of Vuser groups you want to run, and building a schedule for LoadRunner to run these groups. You can also create a manual scenario by defining the total number of Vusers to be used in the scenario, and assigning a percentage of the total number of Vusers to each script. If you want to create a scenario using the Percentage Mode, select **Use the Percentage Mode to distribute the Vusers among the scripts**.

In a goal-oriented scenario, you define the goals you want your test to achieve, and LoadRunner automatically builds a scenario for you, based on these goals.
Chapter 4 • The LoadRunner Controller at a Glance

For instructions on creating a manual scenario, see Chapter 5, “Creating a Manual Scenario.” For instructions on creating a manual scenario using the Percentage Mode, see Chapter 6, “Creating a Manual Scenario Using the Percentage Mode.”

For instructions on creating a goal-oriented scenario, see Chapter 7, “Creating a Goal-Oriented Scenario.”

To select the script or scripts that you want to use in your scenario:

1 Select a script from the Available Scripts list. By default, the list displays the fifty most recently used scripts.

Note: You can change the maximum number of scripts displayed in the Available Scripts list by modifying the following registry key:
HKEY_CURRENT_USER\Software\Mercury Interactive\RecentScripts\max_num_of_scripts

You can also click the Browse button to locate the script you want to use. To view the directory path of a script listed in the Available Scripts list, right-click the script and select Show Paths.

To select a script saved in the TestDirector database, click the TestDirector button. To record a new script using VuGen, click Record.

Note: To select a VB Vuser script, browse to locate the .usr file.

2 Click the Add button to copy the script you selected to the Scripts in Scenario list.

3 Click the Remove button to remove a script from the Scripts in Scenario list.

4 To bypass this dialog box the next time you create a new scenario, clear the Show at startup check box. You will be able to add scripts later on, while building your scenario.

5 Click OK to close the dialog box.
Introducing the LoadRunner Controller

The LoadRunner Controller window contains the following elements:

- **Title bar**: Displays the name of the scenario on which you are currently working.
- **Menu bar**: Displays the menus from which you select commands.
- **Toolbar**: Provides shortcuts for selecting commands. Clicking on a button executes a command.
- **Status Bar**: Displays tool tips for the Controller menu items, as well as the following, if they are enabled: TestDirector Connection, IP Spoof, Auto Collate Results, Auto Load Analysis, and WAN Emulator.
Chapter 4 • The LoadRunner Controller at a Glance
The Controller window has two tabs which correspond to two views:

**Design view**
This view displays a list of all the Vuser groups/scripts in a scenario, and the load generator machines, and number of Vusers assigned to each group/script. This view also displays basic information about the scenario schedule (manual scenario) or goal (goal-oriented scenario).

**Run view**
Displays information on the running Vusers and Vuser groups, as well as online monitor graphs.

In addition, if you select **View > Show Output**, the Controller opens the **Output** window which displays error, warning, notification, debug, and batch messages generated during scenario execution.

**Choosing Commands from the Toolbar**
You can execute many LoadRunner commands by clicking a button on the toolbar in the LoadRunner Controller. There are some variations in the buttons the toolbar displays, depending on whether you are in Design view or Run view, and depending on whether you are creating a manual scenario or a goal-oriented scenario.
Chapter 4 • The LoadRunner Controller at a Glance

Toolbar in Design view

New  Save  Virtual User Generator  Quick Test for R/3

Open  Load Generators  Analysis

Toolbar in Run view, manual scenario

New  Save  Load Generators  Run Vusers  Stop Vusers  Virtual User Generator  Quick Test for R/3

Open  Schedule Builder  Initialize Vusers  Gradually Stop Vusers  Analyze Results  Analysis

Toolbar in Run view, goal-oriented scenario

New  Save  Load Generators  Run Vusers  Stop Vusers  Virtual User Generator  Quick Test for R/3

Open  Edit Scenario Goal  Initialize Vusers  Gradually Stop Vusers  Analyze Results  Analysis

41
Managing Scenario Files

A scenario describes the events that occur during each load testing session. You create a scenario using the Design view of LoadRunner Controller.

After you create the scenario, LoadRunner saves the information in a scenario file (.lrs). You use the commands in the File menu to create, open, save, and close scenario files. Some of these commands are available from the toolbar.

Creating a New Scenario

The New command creates a completely new scenario. Note that the New command clears all the information displayed in the Controller windows. To create a new scenario, choose File > New, or click the New button on the Controller toolbar.

Opening an Existing Scenario

The Open command opens any existing scenario.

To open an existing scenario:

1. Choose File > Open, or click the Open button. The Open Scenario dialog box opens.

2. Click a file in the File Name list or type a file name in the File Name box.
Click Open. The File Open dialog box closes and the scenario appears in the LoadRunner Controller.

**Saving a Scenario**

The Save command saves the current scenario.

**To save a scenario:**

1. Choose File > Save, or click the Save button. The Save Scenario dialog box opens the first time you save a scenario.

2. Type a scenario name in the File Name text box. Note that by default scenario files have the extension .lrs.

3. Click Save. The scenario is saved in the location you specified.

**Closing a Scenario**

Closing a scenario closes all the Controller windows. To close the scenario, choose File > Close. If you made changes to the scenario, a Save Changes message appears. Choose Yes to save the changes you made. All open windows and icons in the Controller close.
Running a Scenario

Once you have designed your scenario, you are ready to run it. You can control the Vusers and Vuser groups and monitor their performance online using the Run view of the LoadRunner Controller.
Chapter 4 • The LoadRunner Controller at a Glance

During scenario execution, you use the Scenario Groups window in the Run view to monitor the actions of all the Vusers and Vuser groups in the scenario. The Status field of each Vuser group displays the current state of each Vuser in the group.

You can also manipulate individual Vusers within the Vuser groups you have defined by selecting a group and clicking the Vusers button. The Vusers dialog box appears, with a list of the ID, Status, Script, Load Generator, and Elapsed Time (since the beginning of the scenario) for each of the Vusers in the group.

In addition, you can view a synopsis of the running scenario in the box at the top right-hand corner of the Run view.
Note that you can detach the Scenario Status window from the Run view, thereby enlarging the Scenario Groups window.

While the scenario runs, the Vusers and load generators send error, notification, warning, debug, and batch messages to the Controller. You can view these messages in the Output window (View > Show Output).

For more information on the Output window, see “Viewing the Output Window” on page 183.

You use the online monitors and online monitor graphs to monitor Vuser status, transactions, system resources, database server resources, network delay, streaming media resources, firewall server resources, ERP server resources, and Java performance, while running a scenario. For more information on online monitors, see Chapter 16, “Online Monitoring.”
Part II

Designing a Scenario
5

Creating a Manual Scenario

You can build a manual scenario by creating groups and specifying the scripts, the load generators, and the number of Vusers included in each group. You can also build a manual scenario using the Percentage Mode, which allows you to define the total number of Vusers to be used in the scenario, and assign load generators and a percentage of the total number of Vusers to each script.

This chapter describes how to create a manual scenario using the Vuser Group Mode. For information on creating a manual scenario using the Percentage Mode, see Chapter 6, “Creating a Manual Scenario Using the Percentage Mode.”

This chapter discusses:

➤ Creating Vuser Groups
➤ Configuring Vusers in a Vuser Group
➤ Configuring Load Generators
➤ Configuring Load Generator Settings
➤ Configuring WAN Emulation Settings
➤ Configuring Scripts
➤ Using Relative Paths for Scripts
About Creating a Scenario

To test your system with LoadRunner, you must create a scenario—a file with information about the test session. The scenario is the means by which you emulate a real-life user. The scenario contains information about how to emulate real users: the groups of virtual users (Vusers), the test scripts the Vusers will run, and the load generator machines upon which to run the scripts.

If you chose to create a regular manual scenario, each script you selected in the New Scenario dialog box is assigned to a Vuser group. To each Vuser group you then assign a number of virtual users. You can instruct all Vusers in a group to run the same script on the same load generator machine, or you can assign different scripts and load generators to the various Vusers in a group.

Once you create your Vuser groups, you select or build a schedule for your scenario. See Chapter 8, “Scheduling a Scenario” for more information on creating a scenario schedule.

Creating Vuser Groups

A scenario consists of groups of Vusers which emulate human users interacting with your application. When you run a scenario, the Vusers generate load on the server, and LoadRunner monitors the server and transaction performance.
Chapter 5 • Creating a Manual Scenario

You create Vuser groups from the Scenario Groups window of the Controller.
To create Vuser Groups:

1. Click the Add Group button to the right of the Scenario Groups window. The Add Group dialog box opens:

![Add Group Dialog Box]

2. In the Group Name box, enter a name for the Vuser group.

   **Note:** The name used in the Group Name box is limited to a maximum of 55 characters.

3. From the Vuser Quantity box, select the number of Vusers that you want to create in the group.

4. Select a load generator from the Load Generator Name list. The Load Generator list contains all load generators that you previously added to the scenario.
To use a load generator that does not appear, select **Add** from the Load Generator Name list. The Add Load Generator dialog box opens:

Type the name of the load generator in the Name box. In the Platform box, select the type of platform on which the load generator is running.

By default, LoadRunner stores temporary files on the load generator during scenario execution, in a temporary directory specified by the load generator’s TEMP or TMP environment variables. To override this default for a specific load generator, type a location in the Temporary Directory box.

To allow the load generator to take part in the scenario, check **Enable load generator to take part in the scenario**.

Click **More** to expand the dialog box and show the Add Load Generator tabs. For information on configuring settings for each load generator, see “Configuring Load Generator Settings” on page 62.

Click **OK** to close the Add Load Generator dialog box.

5 Select a script from the script list. The script list contains all scripts that you previously added to the scenario.

To use a script that does not appear, click the **Browse** button. Browse to select the path and file name of the new script. To use a VB Vuser script, select the `.usr` file.

**Note:** When you specify the location of a script, you can specify a location that is relative to the current scenario directory. For details, see “Using Relative Paths for Scripts” on page 81.

6 Click **OK** to close the Add Group dialog box. The new group's properties appear in the Scenario Groups window.
Disabling a Vuser Group

By default, all the Vuser groups displayed in the Scenario Groups window are enabled to run in the scenario. To disable a Vuser group, click the box to the left of the Vuser group name. The color of the group changes to gray, indicating that the group will not take part in the scenario. To re-enable the Vuser group, click the same box again.

Deleting a Vuser Group

To delete a Vuser, click the Remove Group button to the right of the Scenario Groups window, or right-click the Vuser group and select Remove Group.

Modifying a Vuser Group

You can modify the script, vuser quantity, and load generator for a Vuser group directly from the Scenario Groups window of the Controller, or by using the Group Information dialog box.

To modify a Vuser Group directly from the Scenario Groups window:

1. Select the Group Name, Script Path, Quantity, or Load Generator you want to modify.
2. Enter or select another name or number for the property.
3. To modify a Vuser group script’s run-time settings, click the Run-Time Settings button to the right of the Scenario Groups window. For more information about run-time settings, see “Configuring Scripts” on page 78.
Chapter 5 • Creating a Manual Scenario

To edit a Vuser group’s script, click the **View Script** button to the right of the Scenario Groups window. LoadRunner’s script generation tool, VuGen, opens. For more information on editing scripts, see the *LoadRunner Creating Vuser Scripts User’s Guide*.

**To modify a Vuser Group using the Group Information dialog box:**

1. Click the **Details** button to the right of the Scenario Groups window, or right-click the property you want to modify and select **Details**. The Group Information dialog box opens.

2. In the **Group Name** box, enter the Vuser group name.

3. From the **Vuser Quantity** box, select the number of Vusers that you want to run in the group.

4. Select a load generator from the **Load Generator Name** list. To use a load generator that does not appear, select **Add** from the Load Generator Name list and add a new load generator using the Add Load Generator dialog box.

5. To modify the run-time settings you specified while recording a script using VuGen, click **Run-Time Settings**. For more information about run-time settings, see “Configuring Scripts” on page 78.

6. To edit a Vuser group’s script, click **View Script**. LoadRunner’s script generation tool, VuGen, opens. For more information on editing scripts, see “Configuring Scripts” on page 78.

7. Click **OK** to close the Group Information dialog box.
Sorting Vuser Groups in the Scenario Groups Window

Once you have created your Vuser groups, you can sort them by group name, script name, load generator name, or quantity of Vusers assigned to the group.

To sort Vuser groups:

- Select the column by which you want to sort the groups. Click the column header.
- Alternatively, you can right-click anywhere within the column you want to sort, and select Sort Groups. Choose to sort by name, path, quantity, or generator.
- To instruct the Controller to automatically sort a new Vuser group entry, right-click the entry and select Auto Sort.

Configuring Vusers in a Vuser Group

You can define properties for individual Vusers within the Vuser groups you have defined using the Vusers dialog box. To each Vuser you can assign a different script and/or load generator machine.
To define properties for individual Vusers:

1. Select the Vuser group whose Vusers you want to modify, and click the Vusers button to the right of the Scenario Groups window. The Vusers dialog box opens.

   ![Vusers dialog box]

2. To change the script for an individual Vuser, select a different script in the Script column. Alternatively, you can click the Details button, and select a different script from the script list in the Vuser Information dialog box.

3. To change the load generator on which a Vuser runs, select a different load generator in the Load Generator column. Alternatively, you can click the Details button, and select a different load generator from the Load Generator Name list in the Vuser Information dialog box.

   To use a load generator that does not appear, select Add from the Load Generator Name list and add a new load generator using the Add Load Generator dialog box.
Adding Vusers to a Vuser Group

You add Vusers to a Vuser group and define their properties using the Add Vusers dialog box.

Note: You can activate additional Vusers while the scenario is running, using the Run/Stop Vusers dialog box. For more information, see “Manually Adding Vusers to a Running Scenario” on page 172.

To add Vusers to a Vuser group:

1. In the Vusers dialog box, click the Add Vuser(s) button. The Add Vusers dialog box opens.

2. From the Group Name box, select the name of the Vuser group.

3. From the Quantity to add box, select the number of Vusers that you want to add to the group.

4. Select a load generator from the Load Generator Name list. To use a load generator that does not appear, select Add from the Load Generator Name list and add a new load generator using the Add Load Generator dialog box.
Chapter 5 • Creating a Manual Scenario

5 Select a script from the script list. The script list contains all scripts that you previously added to the scenario.

To use a script that does not appear, click the **Browse** button. Browse to select the path and file name of the new script. To use a VB Vuser script, select the \*.usr file.

---

**Note:** When you specify the location of a script, you can specify a location that is relative to the current scenario directory. For details, see “Using Relative Paths for Scripts” on page 81.

---

To modify the run-time settings you specified while recording a script using VuGen, click **Run-Time Settings**. Note that modifying the run-time settings for the new Vuser will modify the run-time settings for all the Vusers in the group. For more information about run-time settings, see “Configuring Scripts” on page 78.

6 Click **OK** to close the Add Vusers dialog box. The new Vuser’s properties appear in the Vusers dialog box.

---

**Configuring Load Generators**

You can set a load generator’s attributes while adding it to the load generator list, or modify the attributes of an existing load generator at any time, using the Load Generators dialog box.

To configure global settings for all load generators participating in the scenario, use LoadRunner’s Options dialog box. For more information, see Chapter 10, “Configuring a Scenario.” To set properties specific for each load generator, use the Load Generators dialog box as described below.

You can also indicate which load generators will run Vusers in the scenario. For example, if a load generator is unavailable for a particular scenario run, you can exclude it temporarily instead of removing it entirely from your list of load generators.
You select which load generators will take part in the scenario by using the Enable and Disable commands. Disabling a load generator temporarily removes it from the list. Enabling a load generator reinstates it. Disabling load generators is particularly useful if you want to isolate a specific machine to test its performance.

To configure a load generator:

1. Click the Generators button, or select Scenario > Load Generators. The Load Generators dialog box opens. The Name of the load generator, its Status, Platform, and Details are displayed.

2. Click Connect to change the Status of the load generator from Down to Ready. Click Disconnect to change the Status of the load generator from Ready to Down.

3. To disable a load generator, select the load generator and click Disable. The load generator name changes from blue to gray, and the load generator is disabled. To enable a load generator, select the load generator and click Enable. The load generator name changes from gray to blue, and the load generator is enabled.

4. To view details of a load generator, select the load generator and click Details. The Load Generator Information dialog box opens with information about the load generator you selected.
To add a load generator, or modify information for an existing load generator, click **Add**. The Add Load Generator dialog box opens.

Type the name of the load generator in the **Name** box. In the Platform box, select the type of platform on which the load generator is running.

By default, LoadRunner stores temporary files on the load generator during scenario execution, in a temporary directory specified by the load generator’s TEMP or TMP environment variables. To override this default for a specific load generator, type a location in the Temporary Directory box.

To allow the load generator to take part in the scenario, check **Enable load generator to take part in the scenario**.

Click **More** to expand the dialog box and show the Add Load Generator tabs. For information on configuring these settings, see “Configuring Load Generator Settings” on page 62.

To remove a load generator, click **Delete**.

Click **Close** to close the Load Generators dialog box. The load generator name you entered appears in the Load Generators list; its status is set to **Down**.
Configuring Load Generator Settings

You can configure additional settings for individual load generators using the tabs in the Add Load Generator or Load Generator Information dialog boxes. The settings that can be configured are: Status, Run-Time File Storage, UNIX Environment, Run-Time Quota, Vuser Limits, Connection Log (Expert mode), Firewall, and WAN Emulation.

You can configure global settings for all load generators participating in the scenario, using the Options dialog box. For more information, see Chapter 10, “Configuring a Scenario.”

To configure load generator settings:

1. From the Add Load Generator or Load Generator Information dialog box, click More to expand the box and show the Status, Run-Time File Storage, UNIX Environment, Run-Time Quota, Vuser Limits, WAN Emulation, and Firewall (when the load generator is not the localhost) tabs.

2. Select the Status tab to display details of the Load Generator Status.
3 Select the **Run-Time File Storage** tab to specify the result directory for the performance data that LoadRunner gathers from each load generator during a scenario.

![Load Generator Information](image)

- **Name:** delta
- **Platform:** Windows
- **Temporary directory:**

**Note:** If you are monitoring over the firewall, the Run-Time File Storage settings are not relevant.

To store the results as specified in the global settings, click **As defined in Tools > Options > Run-Time File Storage**. To store the results temporarily on a hard drive of the load generator computer, click **In temporary directory on <load generator name>**. To store the scenario scripts or results on a shared network drive, click **On a shared network drive**. To set the network location for the results, see Chapter 11, “Preparing to Run a Scenario.”
LoadRunner Controller User’s Guide • Designing a Scenario

**Note:** If the load generator is *localhost*, then LoadRunner stores the scripts and results on a shared network drive, and the checkboxes and radio buttons for setting the location are all disabled.

4 Select the **UNIX Environment** tab to configure the login parameters and shell type for each UNIX load generator.

![Load Generator Information](image)

**Note:** If you are monitoring or running Vusers over the firewall, the UNIX Environment settings are not relevant.

To specify a login name other than the current Windows user, select the **Name** check box and specify the desired UNIX login name. To login with lower case characters, select the **Use lower case for login names** check box.
Chapter 5 • Creating a Manual Scenario

Note: For information on the Local User setting available in Expert mode, see “Working in Expert Mode” on page 519.

From the Default Shell box, select **csh** (C Shell—the default), **bsh** (Bourne Shell), or **ksh** (Korn Shell).

To allow LoadRunner to run your application under the Korn shell, you first need to make sure that the `.profile` file contains all of the LoadRunner environment settings—for example, the M_LROOT definition and the LicenseManager variable. These environment settings already exist in your `.cshrc` file. Your UNIX `$M_LROOT/templates` directory contains a template for the `.profile` file, called *dot profile*. Use the template as a guide for modifying your `.profile` file with the LoadRunner environment settings.

Note: If you are using a Korn shell (ksh), you must delete all LoadRunner settings from the `.cshrc` file (e.g. M_LROOT) before executing the scenario.

In the Initialization Command box, enter any command line options that LoadRunner will use when logging on to a UNIX system. This initialization command will run as soon as the shell opens.

For example, you could select **ksh** and use the following initialization command:

```
. .profile;
```
5 Select the Run-Time Quota tab to specify the maximum number of Vuser types that the load generator will initialize or stop simultaneously.

Click Defaults to use the Default values.

Initializing or stopping a large number of Vusers simultaneously places large stress on a load generator. To reduce stress on a load generator, you can initialize or stop smaller batches of Vusers.

You can set run-time quotas for an entire scenario using the Run-Time Settings tab in the Options dialog box. For information on setting quotas globally for an entire scenario, see Chapter 10, “Configuring a Scenario.”
Select the **Vuser Limits** tab to modify the maximum number of GUI, RTE, and other Vusers that a load generator can run.

In the Maximum Active boxes enter the maximum number of Vusers of each type that the load generator can run.

**Note:** The maximum number of active Vusers that you specify must not exceed the number of Vusers that you are licensed to run. To check your Vuser licensing limitations, choose **Help > About LoadRunner**.
7 Select the **Firewall** tab to enable monitoring to occur through a firewall.

![Load Generator Information](image)

Note: If the load generator is connected, you cannot change values in the **Firewall** tab.

If you change the name of the load generator to the name of the local host, you cannot set any values in the **Firewall** tab.

To obtain information for the monitors configured inside the firewall, or to run Vusers inside the firewall, select the **Enable firewall** check box and specify the Firewall Settings.
To enable LoadRunner to run Vusers over the firewall, click **Enable running Vusers over Firewall**. To enable LoadRunner to monitor the load generator machine over the firewall, click **Enable Monitoring over Firewall**. In the MI Listener box, specify the name of MI Listener the load generator is using.

**Note:** If you monitor or run Vusers over the firewall, the Temporary Directory option for storing files is disabled. Any location in the Temporary Directory box is erased.

If the load generator machine is connected, you can view the **Vuser Status** tab, which displays the number of GUI/WinRunner, RTE, and other Vusers that are **Pending**, **Initializing**, and **Active** on the selected load generator machine.
Note: For information on the Connection Log tab available in Expert mode, see “Working in Expert Mode” on page 519.

9 Click OK to close the Add Load Generator or Load Generator Information dialog box and save your settings.

Configuring WAN Emulation Settings

You can emulate the behavior of a wide variety of network infrastructures in your load testing scenario using the Shunra WAN Emulator.

About WAN Emulation

WAN emulation enables you to accurately test point-to-point performance of WAN-deployed products under real-world network conditions in your test environment. By introducing highly probable WAN effects such as latency, packet loss, link faults, and dynamic routing effects over your LAN, you can characterize many aspects of the WAN cloud and efficiently control your emulation in a single network environment. You can observe the effects of your emulation settings on the network performance in the WAN emulation monitoring reports.

For an explanation of the WAN emulation parameters and their default settings, see “WAN Emulation Parameters,” on page 76.

Note: WAN Emulation is only available for load generators running on a Windows platform. The WAN Emulation tab is disabled for load generators running on a UNIX platform.
Setting up the WAN Emulator

To use the Shunra WAN Emulator, you must first install the WAN Emulator Driver on the Load Generator machine from the LoadRunner Controller 7.6 CD. For instructions, refer to the LoadRunner Controller Installation Guide.

Note: WAN Emulation requires a special license. Contact Mercury Interactive’s Customer Support Web site (http://support.mercuryinteractive.com) for licensing information.

Configuring the WAN Emulator

Once you have set up the Shunra WAN Emulator on the load generator machine, you can configure the settings from the Controller machine.

To configure WAN emulation settings:

1. From the Load Generator Information dialog box, select the **WAN Emulation** tab.
Note: WAN emulation is disabled if the load generator is *Localhost*.

2. **Select the Enable WAN Emulation on Load Generator** check box to enable WAN emulation to start automatically on scenario execution.

   **Note:** You cannot change WAN emulation settings while a load generator is connected. To disconnect a load generator, select the load generator in the Load Generators dialog box, and click **Disconnect**. The load generator status changes to *Down*, and you can make changes to the settings.

3. **Set the Latency and Packet Loss parameters.** To set a profile value manually, move the **Latency** and **Packet Loss** slider to the desired setting. To use a predefined WAN profile, select a profile from the **Set Predefined Profile** drop-down list.

   The following profile settings are available:

<table>
<thead>
<tr>
<th>Profile</th>
<th>Description</th>
<th>Parameter Values</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No Profile</strong></td>
<td>This is the default setting. No profile has been selected, or a predefined profile has been changed manually.</td>
<td>Latency Value: 0ms Packet Loss Value: 1%</td>
</tr>
<tr>
<td><strong>Metropolitan Area Network link</strong></td>
<td>Emulates a metropolitan area network link.</td>
<td>Latency Value: 20ms Packet Loss Value: 1%</td>
</tr>
<tr>
<td><strong>Mainland Low Congestion link (Terrestrial)</strong></td>
<td>Emulates a mainland terrestrial link with low network traffic congestion.</td>
<td>Latency Value: 40ms Packet Loss Value: 1%</td>
</tr>
<tr>
<td><strong>Mainland Congested link (Terrestrial)</strong></td>
<td>Emulates a mainland terrestrial link with high network traffic congestion.</td>
<td>Latency Value: 100ms Packet Loss Value: 3%</td>
</tr>
</tbody>
</table>
Transatlantic Low Congestion link (Terrestrial)
Emulates an overseas terrestrial link with low network traffic congestion.
Latency Value: 60ms
Packet Loss Value: 1%

Transatlantic Congested link (Terrestrial)
Emulates an overseas terrestrial link with high network traffic congestion.
Latency Value: 120ms
Packet Loss Value: 3%

Transatlantic Low Congestion link (Satellite)
Emulates a satellite link with low network traffic congestion.
Latency Value: 280ms
Packet Loss Value: 1%

Transatlantic Congested link (Satellite)
Emulates a satellite link with high network traffic congestion.
Latency Value: 400ms
Packet Loss Value: 3%

The profile values are displayed beneath the setting range. To restore the default settings, click the Defaults button.

4 To set the advanced options, click the Advanced button. The WAN Emulation Advanced options dialog box opens.
5 To enable an advanced option, select the option’s check box. By default, all the options are enabled. To adjust an option setting, move the slider to the desired value. The profile values are displayed beneath the setting range.

Click the **Defaults** button to restore the default settings. To disable an option, clear the option’s check box. A disabled option does not take part in the WAN emulation. Click **OK** to accept the advanced settings and close the WAN Emulation Advanced options dialog box.

6 To apply the WAN emulation settings to all load generators listed in the Load Generators dialog box, click the **Apply All** button.

7 Click **OK** to close the Add Load Generator or Load Generator Information dialog box and save your settings.

**Excluding IP Addresses from WAN Emulation**

In some situations you may want to exclude certain IP addresses from the WAN emulation. You can do this by setting the WAN emulator to refrain from affecting traffic to specified IP addresses. Network traffic which is not affected by the emulation will not suffer any WAN effects and will not be included in the WAN emulation monitoring reports.

---

**Note:** You do not need to exclude the Controller machine and the network file server (if you have the Network Installation configuration), as they are automatically excluded from the emulated WAN.

---

Examples of situations where you might choose to exclude IP addresses from an emulated WAN include the following:

- In a Multiprotocol scenario that includes a Web server and a database server; where information from the database server is not required as a part of the load test.

- Where a user runs and stores scripts on a shared network drive.
To exclude an IP address from WAN emulation:

1. Select **Exclude IPs** from the **WAN Emulation** tab in the Load Generator Information dialog box. The Exclude IPs dialog box opens.

2. To exclude an IP address from WAN emulation, click the **Add** button. The Add IP dialog box opens.

3. Type the name or IP address of the machine you want to exclude from WAN emulation. Click **OK** to add the IP address to the Exclude IPs from WAN Emulation list.

   **Note:** If you type the name of a machine, LoadRunner resolves the name and replaces it with the machine's IP address in the Exclude IPs list.

You can edit an IP address by selecting it from the list and clicking the **Edit** button. Edit the IP address in the Edit Machine dialog box. Click **OK** to save your changes and close the dialog box.

You can remove an IP address from the list by selecting it and clicking the **Remove** button.
Stopping and Restarting WAN Emulation

You can stop and restart WAN emulation at any time during a scenario run.

To stop or restart WAN emulation during scenario execution:

1. To stop WAN emulation select **Scenario > Stop WAN Emulation**.
2. To restart WAN emulation, select **Scenario > Restart WAN Emulation**.

WAN Emulation Parameters

You can set values for the following WAN emulation parameters:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Default Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latency</td>
<td>The time, in milliseconds, it takes an IP packet to cross the WAN. This is usually effected by the geographical distance, the available bandwidth, the network load on the route between the two ends, and whether this is a terrestrial link or not.</td>
<td>The default setting is 20ms.</td>
</tr>
<tr>
<td>Packet Loss</td>
<td>The chance of losing IP packets while data travels through a WAN. Packets can get lost due to link faults or due to extreme network load.</td>
<td>The default setting is 0%.</td>
</tr>
<tr>
<td>Packet Reordering</td>
<td>The chance of a packet order changing while it travels through the WAN cloud.</td>
<td>The default setting is 1%.</td>
</tr>
<tr>
<td>Parameter</td>
<td>Description</td>
<td>Default Setting</td>
</tr>
<tr>
<td>------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Packet Duplication</td>
<td>The chance of a packet duplication occurring while it travels through the WAN cloud. Count is the number of copies of each packet that will be created when duplication occurs.</td>
<td>Default Chance setting is 1%. Default Count setting is 1.</td>
</tr>
<tr>
<td>Packet Fragmentation</td>
<td>The chance of a packet fragmentation occurring (due to a short Maximum Transmission Unit) while it travels through the WAN cloud. MTU is the largest size packet or frame (specified in bytes), that can be sent in a packet- or frame-based network such as the internet.</td>
<td>Default Chance setting is 1%. Default MTU setting is 512 Bytes.</td>
</tr>
<tr>
<td>Bit Errors</td>
<td>The chance of bit errors occurring while a packet travels through the WAN cloud.</td>
<td>Default Chance setting is 100,000 Bits.</td>
</tr>
<tr>
<td>Link Disconnection</td>
<td>The chance (average frequency) of a network disconnection occurring while a packet travels through the WAN cloud, and the disconnection time span.</td>
<td>Default Chance setting is one disconnection every 256 seconds. Default Duration is one second.</td>
</tr>
</tbody>
</table>
Configuring Scripts

Once you have selected a script for a Vuser or Vuser group, you can edit the script, or view the details of the script you selected, from the Vusers or Group Information dialog boxes.

To edit and view the details of a script used by a Vuser group:

1. Select the Vuser group whose script you want to modify, and click the Details button to the right of the Scenario Groups window, or right-click the Vuser group and select Details. The Group Information dialog box opens displaying the Name, Path, and Type of the script.

2. Click Run-Time Settings to set the script’s run-time settings (optional), which allow you to customize the way the Controller executes a Vuser script. The Run-Time Settings dialog box opens, displaying the settings you previously set using VuGen. If you did not set run-time settings for a script in VuGen, the default VuGen settings are displayed for all but the Log and Think Time tabs, which display the default Controller settings. Note that several protocols, such as Web and Java, have specific settings.

3. For information on configuring the run-time settings, refer to the LoadRunner Creating Vuser Scripts User’s Guide.

Note: If you modify the run-time settings from the Controller, LoadRunner runs the script using the modified settings. To restore the initial settings, click the Refresh button and select Run-Time Settings.
Chapter 5 • Creating a Manual Scenario

4 To edit the script, click View Script. The script generation tool, VuGen, opens. For more information on editing scripts, see the LoadRunner Creating Vuser Scripts User’s Guide.

Note: If you use VuGen to make changes to a script while the Controller is running, click the Refresh button and select Script to update the script details in the scenario.

5 Click More to expand the Group Information dialog box and view additional script information.

6 In the Command Line box, type any command line options to use when running the script. For example: -x value -y value

For information about passing command line argument values to a script, refer to the LoadRunner Creating Vuser Scripts User’s Guide.
To see the rendezvous points included in the selected script, click the Rendezvous tab.

To see the list of Vusers associated with the selected script, click the Vusers tab. If you have not yet created Vusers, the box will be empty.

To see the list of files used by the script, click the Files tab. By default this list shows all files in the script's directory (only after your script has been added to the script list). These files include the configuration settings file, the init, run, and end portions of the script, the parameterization definitions file, and the .usr file. To add a file to the list, click Add and add the file name. Note that you can delete the files that you add, but not the other files listed.

Click OK to close the Group Information dialog box.

To edit and view the details of a script used by an individual Vuser:

1. Click the Vusers button to the right of the Scenario Groups window. The Vusers dialog box opens.

To view details of a script, click Details. The script's name and path are displayed in the Vuser Information dialog box. To select a different script, click the Browse button and select the path and file name of the new script. To select a VB Vuser script, browse to locate the .usr file.
Chapter 5 • Creating a Manual Scenario

Note: When you specify the location of a script, you can specify a location that is relative to the current scenario directory. For details, see “Using Relative Paths for Scripts” on page 81.

2 To edit a script, right-click the script in the Vusers dialog box, and select View Script. The script generation tool, VuGen, opens. For more information on editing scripts, see the LoadRunner Creating Vuser Scripts User’s Guide.

3 To modify the run-time settings you specified while recording a script using VuGen, right-click the script in the Vusers dialog box, and select Run-Time Settings. Note that modifying the run-time settings for one Vuser will modify the run-time settings for all the Vusers in the group that are using the same script. For more information about run-time settings, see the LoadRunner Creating Vuser Scripts User’s Guide.

Using Relative Paths for Scripts

When you specify the location of a script, you can specify a relative location. The location can be relative to the current scenario directory, or the LoadRunner installation directory.

You can specify a path relative to the current scenario directory by typing either of the following notations at the start of the script path:

.\  indicates that the path is relative to the location of the scenario directory.

..\  indicates that the path is relative to the location of the parent directory of the scenario directory.

For example, if the current scenario is located at F:\scenarios, to specify a script located at F:\scenarios\scripts\user1.usr, you could type:

\scripts\user1.usr
You can specify a path relative to the LoadRunner installation directory by typing a percent sign (%) at the beginning of the script path. For example, if the LoadRunner installation directory is located at F:\LoadRunner, to specify a script located at F:\LoadRunner\scripts\user1.usr, you could type:

```
%\scripts\user1
```

**Note:** When specifying a relative path, you can include standard DOS notation (.\ and ..\) inside the path, as shown in the following example: M:\LR\my_tests\..\..\test.usr.

When you run a scenario, by default, the script is copied to a temporary directory on the Vuser group machine. This enables the Vuser group load generator to access the script locally instead of over a network.

You can instruct the Controller to store the script on a shared network drive (see Chapter 10, “Configuring a Scenario.”) If you configure the Controller to save the script to a network drive, you must ensure that the Vuser load generator recognizes the drive. The Script window contains a list of all the Vuser scripts and their paths. A script’s path is based on the Controller load generator’s mapping of that location. If a Vuser load generator maps to the script’s path differently, path translation is required. Path translation converts the Controller load generator’s mapping to the Vuser load generator’s mapping. For more information see Appendix B, “Performing Path Translation.”
Creating a Manual Scenario Using the Percentage Mode

You build a manual scenario in the Percentage Mode by defining the total number of Vusers to be used in the scenario, and assigning load generators and a percentage of the total number of Vusers to each script. This chapter describes how to create a manual scenario in the Percentage Mode.

This chapter discusses:

➤ Defining the Total Number of Vusers
➤ Assigning Properties to Scripts
➤ Configuring Scripts
➤ Converting a Scenario to the Vuser Group Mode

About Creating a Manual Scenario Using the Percentage Mode

When you design a regular manual scenario, you create Vuser groups, assign them scripts, load generator machines, and virtual users. When you work in the Percentage Mode, you define the total number of Vusers to be used in the scenario, and assign load generators and a percentage of the total number of Vusers to each script.
When you create a new scenario, you can access the Percentage Mode directly by selecting **Use the Percentage Mode to distribute the Vusers among the scripts** in the New Scenario dialog box. You can also convert a scenario created in the Vuser Group Mode to the Percentage Mode by selecting **Scenario > Convert Scenario to the Percentage Mode**.

When converting your scenario from Vuser Group Mode to Percentage Mode, note the following:

- If you defined multiple scripts for a Vuser group, the number of Vuser scripts created in the Percentage Mode will equal the number of scripts defined for the group.
- <All Load Generators> will be assigned to all Vuser scripts created in the Percentage Mode. If you defined multiple load generators for a Vuser group, the Vusers you assign to the script(s) in the Percentage Mode will be distributed evenly among the load generators you previously assigned to the group.
- All Vuser group schedule settings will be lost. All profiles will contain scenario schedule settings only.

**Defining the Total Number of Vusers**

When you build a scenario in the Percentage Mode, you define a total number of Vusers to be used in the scenario, rather than a number of Vusers per script. You enter this number in the Scenario Schedule window.
Chapter 6 • Creating a Manual Scenario Using the Percentage Mode

For information on creating a scenario schedule, see Chapter 8, “Scheduling a Scenario.” Note that the Vuser Group settings are not available for the Percentage Mode.

Assigning Properties to Scripts

The Scenario Scripts window displays a list of scripts you selected in the New Scenario dialog box, or defined in the Vuser Group Mode.

The % column indicates the percentage of the total number of Vusers that is automatically distributed to each Vuser script. During scenario execution, each script runs the percentage of Vusers assigned to it. The Load Generators column automatically contains <All Load Generators> for each Vuser script.

Note: If you defined multiple load generators for a Vuser group, the Vusers you assign to the script(s) in the Percentage Mode will be distributed evenly among the load generators you previously assigned to the group.
For each script you can modify:

- the percentage of the total number of Vusers assigned to the script
- the load generator(s) on which the Vusers will execute the script

**To modify the percentage of Vusers assigned to a script:**

In the script’s % column, enter a percentage of the total number of Vusers you defined in the Scenario Schedule window. The percentages assigned to the other scripts change to create a total of 100 percent for all of the Vuser scripts.

**To modify the load generator(s) for a script:**

1. In the script’s Load Generators column, select one or more machine(s) from the Load Generator Name list, and click **OK**. If you select multiple machines, the Vusers assigned to the script are distributed evenly among the load generators.

2. Alternatively, you can choose **Add** to add a load generator to the list. The Add Load Generator dialog box opens:

   ![Add Load Generator dialog box](image)

   Type the name of the load generator in the Name box. In the Platform box, select the type of platform on which the load generator is running.

   By default, LoadRunner stores temporary files on the load generator during scenario execution, in a temporary directory specified by the load generator’s TEMP or TMP environment variables. To override this default for a specific load generator, type a location in the Temporary Directory box.

   To allow the load generator to take part in the scenario, check **Enable load generator to take part in the scenario**.
Chapter 6 • Creating a Manual Scenario Using the Percentage Mode

Click **More** to expand the dialog box and show the Add Load Generator tabs. For information on configuring settings for each load generator, see “Configuring Load Generator Settings” on page 62.

Click **OK** to close the Add Load Generator dialog box. LoadRunner adds the new load generator to the Load Generator Name list. To include the new load generator in your scenario, select it from the Load Generator Name list, and click **OK**.

Repeat the above procedure for each load generator you want to add to your scenario.

---

**Note:** The Controller monitors a Windows load generator machine’s CPU usage and automatically stops loading Vusers on a load generator when it becomes overloaded. You can monitor the status of a machine’s CPU usage using the icons in the Load Generators dialog box. When the CPU usage of a load generator becomes problematic, the icon to the left of the load generator name contains a yellow bar. When the machine becomes overloaded, the icon contains a red bar.

---

**Configuring Load Generators**

You can set a load generator’s attributes while adding it to the load generator list, or modify the attributes of an existing load generator at any time, using the Load Generators dialog box. You can also use the Load Generators dialog box to indicate which load generators will run Vusers in the scenario. For example, if a load generator is unavailable for a particular scenario run, you can use the Load Generators dialog box to exclude it temporarily instead of removing it entirely from your list of load generators. For instructions on using the Load Generators dialog box, see “Configuring Load Generators” on page 59. To configure additional load generator settings, see “Configuring Load Generator Settings” on page 62.

To configure global settings for all load generators participating in the scenario, use LoadRunner’s Options dialog box. For more information, see Chapter 10, “Configuring a Scenario.”
Configuring Scripts

You can add a script to the Scenario Scripts list using the Add Script dialog box. Once you have added the script to the list, you can view the details of the script you selected, edit the script, enable/disable it, or change its runtime settings.

To add a script:

1. Click the Add Script button to the right of the Scenario Scripts window, or right-click within a column and select Add Script. The Add Script dialog box opens.

2. Click the Browse button to the right of the path box. The Open Test dialog box opens.

   Select the path and file name of the new script. To select a VB Vuser script, browse to locate the .usr file.

---

Note: When you specify the location of a script, you can specify a location that is relative to the current scenario directory. For details, see “Using Relative Paths for Scripts” on page 81.
Chapter 6 • Creating a Manual Scenario Using the Percentage Mode

3 Click Open to select the files. The Open Test dialog box closes, and the new script name appears in the Add Script dialog box.

4 Click OK to close the Add Script dialog box and enter the new script information in the Scenario Scripts window.

To view script details:

1 Select the script and click the Details button to the right of the Scenario Scripts window, or right-click the script and select Details. The Script Information dialog box opens, displaying the Path, Name, and Type of the script you selected.

2 Click Run-Time Settings to set the script’s run-time settings (optional), which allow you to customize the way the Controller executes a Vuser script. The Run-Time Settings dialog box opens, displaying the settings you previously set using VuGen. If you did not set run-time settings for a script in VuGen, the default VuGen settings are displayed for all but the Log and Think Time tabs, which display the default Controller settings. Note that several protocols, such as Web and Java, have specific settings.

For information on configuring the run-time settings, refer to the LoadRunner Creating Vuser Scripts User’s Guide.

Note: If you modify the run-time settings from the Controller, LoadRunner runs the script using the modified settings. To restore the initial settings, click the Refresh button and select Run-Time Settings.
3 To edit the script, click **View Script**. The script generation tool, VuGen, opens. For more information on editing scripts, see the *LoadRunner Creating Vuser Scripts User's Guide*.

**Note:** If you use VuGen to make changes to a script while the Controller is running, click the **Refresh** button and select **Script** to update the script details in the scenario.

4 Click **More** to expand the Script Information dialog box and view additional script information.

5 In the Command Line box, type any command line options to use when running the script. For example: `-x value -y value`

For information about passing command line argument values to a script, refer to the *LoadRunner Creating Vuser Scripts User's Guide*. 
6 To see the rendezvous points included in the selected script, click the **Rendezvous** tab.

7 To see the list of Vusers associated with the selected script, click the **Vusers** tab.

8 To see the list of files used by the script, click the **Files** tab. By default this list shows all files in the script’s directory (only after your script has been added to the script list). These files include the configuration settings file, the init, run, and end portions of the script, the parameterization definitions file, and the *usr* file. To add a file to the list, click **Add** and add the file name. Note that you can delete the files that you add, but not the other files listed.

9 Click **OK** to close the Script Information dialog box.

**To delete a script:**

Select the script and click the **Remove Script** button to the right of the Scenario Scripts window, or right-click the script and select **Remove Script**.

**To disable a script**

Click the box to the left of the Vuser script name. The color of the script entry changes to gray, indicating that the script will not take part in the scenario. To re-enable the Vuser script, click the same box again.

---

**Converting a Scenario to the Vuser Group Mode**

You can convert a scenario created in the Percentage Mode to the Vuser Group Mode by selecting **Scenario > Convert Scenario to the Vuser Group Mode**.

When converting your scenario from Percentage Mode to Vuser Group Mode, note the following:

- Each script will be converted to a Vuser group.
- If you defined multiple load generators for a Vuser script, the Vuser group that is created when converting the scenario will also contain multiple load generators.
- All schedule settings will be kept.
Creating a Goal-Oriented Scenario

You build a goal-oriented scenario for an application by defining the goals you want your test to achieve. This chapter describes how to create a goal-oriented scenario.

This chapter discusses:
➤ Defining Scenario Goals
➤ Assigning Properties to Scripts
➤ Configuring Scripts

About Planning a Goal-Oriented Scenario

In a goal-oriented scenario, you define the goals you want your test to achieve, and LoadRunner automatically builds a scenario for you, based on these goals. You can define five types of goals in a goal-oriented scenario: the number of virtual users, the number of hits per second (Web Vusers only), the number of transactions per second, the number of pages per minute (Web Vusers only), or the transaction response time you want your scenario to reach. You define one of these scenario goals using the Edit Scenario Goal dialog box. For more information on this dialog box, see “Defining Scenario Goals” on page 96.

Note: To run a Transactions per Second or Transaction Response Time goal type, your script must contain transactions. For each of these goal types, you define the transaction in your script that you want to test.
Virtual Users Goal Type

If you want to test how many Vusers your application can run simultaneously, it is recommended that you define a Virtual Users goal type. Running this type of goal-oriented scenario is similar to running a manual scenario. For more information on defining this goal type, see “Defining Scenario Goals” on page 96.

Pages per Minute and Hits/Transactions per Second Goal Types

If you want to test the strength of your server, it is recommended that you define a Hits per Second, Pages per Minute, or Transactions per Second goal type. Specify a minimum-maximum range of Vusers for LoadRunner to run, and a Transaction Name for the Transactions per Second goal type.

The Controller attempts to reach the goal you defined using a minimum number of Vusers. If it cannot reach this goal using the minimum number of Vusers, the Controller increases the number of Vusers until the maximum number you defined is reached. If your goal cannot be reached with the maximum number of Vusers you specified, increase this number and execute your scenario again. For more information regarding the formula used by the Controller in running the Pages per Minute and Hits/Transactions per Second goal types, see page 100.
Chapter 7 • Creating a Goal-Oriented Scenario

**Transaction Response Time Goal Type**

If you want to test how many Vusers can be run simultaneously without exceeding a desired transaction response time, it is recommended that you define a Transaction Response Time goal type. Specify the name of the transaction in your script that you want to test, and a minimum-maximum range of Vusers for LoadRunner to run. The transaction response time you specify should be a pre-defined threshold value. For example, if you do not want a customer to wait more than five seconds to log in to your e-commerce site, specify a maximum acceptable transaction response time of five seconds. Set the minimum and maximum number of Vusers to the minimum-maximum range of customers you want to be able to serve simultaneously.

If the scenario does not reach the maximum transaction response time that you defined, your server is capable of responding within a reasonable period of time to the number of customers you want to be able to serve simultaneously. If the defined response time is reached after only a portion of the Vusers has been executed, or if you receive a message that the defined response time will be exceeded if the Controller uses the maximum number of Vusers defined, you should consider revamping your application and/or upgrading your server software and hardware.

---

**Note:** In order for a Transaction Response Time goal-oriented scenario to be effective, you must choose your transaction carefully, ensuring that it performs effective hits on the server.
Defining Scenario Goals

When you choose to create a goal-oriented scenario, the Controller displays the Scenario Goal and Scenario Scripts windows.

The Scenario Goal window contains basic scenario information, as defined in the Edit Scenario Goal dialog box.
Chapter 7 • Creating a Goal-Oriented Scenario

To define a scenario goal:

1 Click the **Edit Scenario Goal** button. The Edit Scenario Goal dialog box opens.

![Edit Scenario Goal dialog box]

2 Select a **Goal Profile Name**. To enter a new name, click **New**, type the new goal profile name in the New Goal Profile dialog box, and click **OK**. The new goal profile name appears in the selector.

   To rename a goal profile, click **Rename** and enter the new goal profile name in the New Goal Profile dialog box.

   To delete a goal profile, select it and click **Delete**.

3 In the Define Scenario Goal box, select a **Goal Type**.

   - If you select **Virtual Users**, enter a target number of virtual users that you would like your scenario to reach.

   - If you select **Hits per Second**, enter a target number of hits per second (HTTP requests per second) that you would like your scenario to reach, and select a minimum and maximum number of Vusers for the scenario.
• Designing a Scenario

➤ If you select **Transactions per Second**, enter a target number of transactions per second that you would like your scenario to reach, and select a minimum and maximum number of Vusers for the scenario. In addition, select a static script transaction for your scenario to test, or enter the name of an automatic script transaction that you have recorded in the Transaction Name box.

---

**Note:** VuGen automatically defines each *Init, Action, and End* unit as a transaction. In a Web protocol, each recorded Web page is also defined automatically as a transaction. In addition, you can insert a static transaction in your script using the Start Transaction and End Transaction functions.

---

➤ If you select **Transaction Response Time**, enter a target transaction response time that you would like your scenario to reach, and select a minimum and maximum number of Vusers for the scenario. In addition, select a static script transaction for your scenario to test, or enter the name of a dynamic script transaction that you have recorded in the Transaction Name box.

➤ If you select **Pages per Minute**, enter a target number of downloaded pages per minute that you would like your scenario to reach, and select a minimum and maximum number of Vusers for the scenario.

4 In the Scenario Settings tab, select the amount of time that you want your scenario to run after your target has been reached.

5 Choose whether you want to stop the scenario and save the scenario results or continue the scenario, if LoadRunner does not succeed in reaching the target that you defined. If you want LoadRunner to send you an error message indicating that your target was not reached, select **Receive notification**.
6 Select the **Load Behavior** tab. If you selected the Transactions per Second or Transaction Response Time goal types, choose whether you want LoadRunner to reach your target by automatically running a default number of Vusers in every batch, or after a certain period of the scenario has elapsed. If you selected the Pages per Minute, Virtual Users, or Hits per Second goal types, choose whether you want LoadRunner to reach your target by automatically running a default number of Vusers in every batch, after a certain period of the scenario has elapsed, or by gradation (x number of Vusers/pages/hits every x amount of time).

---

**Note:** The Load Preview graph visually displays the load behavior you define.

---

7 Select **Do not change recorded think time** if you want LoadRunner to run the scenario using the think time recorded in your script. Note that if you select this option, you may need to increase the number of Vusers in your scenario in order to reach your target.

8 Click **OK** to close the Edit Scenario Goal dialog box. The scenario target information you entered appears in the Scenario Goal window.

---

**Note:** When you run a goal-oriented scenario, the goal you defined is displayed in the appropriate graph, along with the scenario results. This enables you to compare the results with your target goal.
Understanding the Hits/Transactions per Second and Pages per Minute Goal Types

When you define a Pages per Minute or Hits/Transactions per Second goal type, the Controller divides the target you defined by the minimum number of Vusers you specified, and determines the target number of hits/transactions per second or pages per minute that each Vuser should reach. The Controller then begins loading the Vusers according to the load behavior settings you defined, as follows:

➤ If you selected to run the Vusers automatically, LoadRunner loads fifty Vusers in the first batch. If the maximum number of Vusers defined is less than fifty, LoadRunner loads all of the Vusers simultaneously.

➤ If you chose to reach your target after a certain period of the scenario elapses, LoadRunner attempts to reach the defined target within this period of time. It determines the size of the first batch of Vusers based on the time limit you defined and the calculated target number of hits, transactions, or pages per Vuser.

➤ If you chose to reach your target by gradation (x number of pages/hits every x amount of time), LoadRunner calculates the target number of hits or pages per Vuser and determines the size of the first batch of Vusers accordingly.

Note: The last load behavior option is not available for the Transactions per Second goal type.

After running each batch of Vusers, LoadRunner evaluates whether the target for the batch was achieved. If the batch target was not reached, LoadRunner recalculates the target number of hits, transactions, or pages per Vuser, and readjusts the number of Vusers for the next batch in order to be able to achieve the defined goal. Note that, by default, a new batch of Vusers is released every two minutes.

If the goal has not been reached once the Controller has launched the maximum number of Vusers, LoadRunner attempts to reach the defined target once more by recalculating the target number of hits, transactions, or pages per Vuser, and running the maximum number of Vusers simultaneously.
A Pages per Minute or Hits/Transactions per Second goal-oriented scenario is assigned a "Failed" status if:

➤ the Controller has twice attempted to reach the goal using the maximum number of Vusers specified, and the goal could not be reached.
➤ no pages per minute or hits/transactions per second were registered after the first batch of Vusers was run.
➤ the number of pages per minute or hits/transactions per second did not increase after the Controller ran a certain number of Vuser batches.
➤ all the Vusers that were run failed.
➤ there were no available load generators for the type of Vusers you attempted to run.

**Assigning Properties to Scripts**

The Scenario Scripts window displays a list of scripts you selected for the scenario.

<table>
<thead>
<tr>
<th>Script Name</th>
<th>Script Path</th>
<th>% of Target</th>
<th>Load Generators</th>
</tr>
</thead>
<tbody>
<tr>
<td>mode</td>
<td>D:\LoadRunner\scripts\mode</td>
<td>25 %</td>
<td>&lt;All Load Generators&gt;</td>
</tr>
<tr>
<td>sb complète</td>
<td>D:\LoadRunner\scripts\sb complète</td>
<td>25 %</td>
<td>&lt;All Load Generators&gt;</td>
</tr>
<tr>
<td>1E6不行</td>
<td>D:\LoadRunner\scripts\1E6不行</td>
<td>25 %</td>
<td>&lt;All Load Generators&gt;</td>
</tr>
<tr>
<td>test2</td>
<td>D:\LoadRunner\scripts\test2</td>
<td>25 %</td>
<td>&lt;All Load Generators&gt;</td>
</tr>
</tbody>
</table>

The % of Target column indicates the percentage of the overall target number of Vusers, pages per minute, hits per second, transactions per second, or transaction response time that is automatically distributed to each Vuser script. The Load Generators column automatically contains <All Load Generators> for each Vuser script.
To modify the percentage of Vusers assigned to a script:

In the script's % of Target column, enter a percentage of the total target number of Vusers, pages per second, hits per second, transactions per second, or transaction response time you want LoadRunner to reach during the scenario. During the scenario, LoadRunner attempts to reach the percentage of the total that you stipulate for each script in the scenario.

To modify the load generator(s) for a script:

1. In the script's Load Generators column, select one or more machine(s) from the Load Generator Name list, and click OK. If you select multiple machines, the Vusers assigned to the script are distributed evenly among the load generators.

2. Alternatively, you can choose Add to add a load generator to the list. The Add Load Generator dialog box opens:

Type the name of the load generator in the Name box. In the Platform box, select the type of platform on which the load generator is running.

By default, LoadRunner stores temporary files on the load generator during scenario execution, in a temporary directory specified by the load generator's TEMP or TMP environment variables. To override this default for a specific load generator, type a location in the Temporary Directory box.

To allow the load generator to take part in the scenario, check Enable load generator to take part in the scenario.

Click More to expand the dialog box and show the Add Load Generator tabs. For information on configuring settings for each load generator, see “Configuring Load Generator Settings” on page 62.

Click OK to close the Add Load Generator dialog box. LoadRunner adds the new load generator to the Load Generator Name list. To include the new
load generator in your scenario, select it from the Load Generator Name list, and click OK. Note that you can select multiple load generators.

Repeat the above procedure for each load generator you want to add to your scenario.

**Configuring Load Generators**

You can set a load generator's attributes while adding it to the load generator list, or modify the attributes of an existing load generator at any time, using the Load Generators dialog box. You can also use the Load Generators dialog box to indicate which load generators will run Vusers in the scenario. For example, if a load generator is unavailable for a particular scenario run, you can use the Load Generators dialog box to exclude it temporarily instead of removing it entirely from your list of load generators. For instructions on using the Load Generators dialog box, see “Configuring Load Generators” on page 59. To configure additional load generator settings, see “Configuring Load Generator Settings” on page 62.

To configure global settings for all load generators participating in the scenario, use LoadRunner’s Options dialog box. For more information, see Chapter 10, “Configuring a Scenario.”

**Load Balancing**

Load balancing evenly distributes the load generated by Vusers among the requested load generator machines, ensuring an accurate load test.

When a Windows load generator machine's CPU usage becomes overloaded, the Controller stops loading Vusers on the overloaded load generator, and automatically distributes them among load generators taking part in the scenario. Only where there are no other load generators in the scenario does the Controller stop loading Vusers.

You can monitor the status of a machine's CPU usage using the icons in the Load Generators dialog box. When the CPU usage of a load generator becomes problematic, the icon to the left of the load generator name contains a yellow bar. When the machine becomes overloaded, the icon contains a red bar.
Note: Load balancing is only available in goal-oriented scenarios and manually controlled scenarios in the Percentage Mode.

Configuring Scripts

You can add a script to the Scenario Scripts list using the Add Script dialog box. Once you have added the script to the list, you can view the details of the script you selected, edit the script, or change its run-time settings.

To add a script:

1. Click the Add Script button to the right of the Scenario Scripts window, or right-click within a column and select Add Script. The Add Script dialog box opens.

2. Click the Browse button to the right of the path box. The Open Test dialog box opens.

Select the path and file name of the new script. To select a VB Vuser script, browse to locate the .usr file.
Chapter 7 • Creating a Goal-Oriented Scenario

Note: When you specify the location of a script, you can specify a location that is relative to the current scenario directory. For details, see “Using Relative Paths for Scripts” on page 81.

3 Click Open to select the files. The Open Test dialog box closes, and the new script name appears in the Add Script dialog box.

4 Click OK to close the Add Script dialog box and enter the new script information in the Scenario Scripts window.

Note: A script’s rendezvous points are disabled in a goal-oriented scenario.

To view script details:

1 Click the Details button to the right of the Scenario Scripts window, or right-click a script and select Details. The Script Information dialog box opens, displaying the Path, Name, and Type of the script you selected.
2 Click Run-Time Settings to set the script’s run-time settings (optional), which allow you to customize the way the Controller executes a Vuser script. The Run-Time Settings dialog box opens, displaying the settings you previously set using VuGen. If you did not set run-time settings for a script in VuGen, the default VuGen settings are displayed for all but the Log and Think Time tabs, which display the default Controller settings. Note that several protocols, such as Web and Java, have specific settings.

For information on configuring the run-time settings, refer to the LoadRunner Creating Vuser Scripts User’s Guide.

---

**Note:** If you modify the run-time settings from the Controller, LoadRunner runs the script using the modified settings. To restore the initial settings, click the Refresh button and select Run-Time Settings.

---

3 To edit the script, click View Script. The script generation tool, VuGen, opens. For more information on editing scripts, see the LoadRunner Creating Vuser Scripts User’s Guide.

---

**Note:** If you use VuGen to make changes to a script while the Controller is running, click the Refresh button and select Script to update the script details in the scenario.
4 Click More to expand the Script Information dialog box and view additional script information.

5 In the Command Line box, type any command line options to use when running the script. For example: \(-x\ value \ -y\ value\)

For information about passing command line argument values to a script, refer to the LoadRunner Creating Vuser Scripts User's Guide.

6 To see the rendezvous points included in the selected script, click the Rendezvous tab.

7 To see the list of Vusers associated with the selected script, click the Vusers tab. If you have not yet created Vusers, the box will be empty.

8 To see the list of files used by the script, click the Files tab. By default this list shows all files in the script’s directory (only after your script has been added to the script list). These files include the configuration settings file, the init, run, and end portions of the script, the parameterization definitions file, and the \(usr\) file. To add a file to the list, click Add and add the file name. Note that you can delete the files that you add, but not the other files listed.
9 Click **OK** to close the Script Information dialog box.

**To delete a script:**

Click the **Remove Script** button to the right of the Scenario Scripts window, or right-click the script and select **Remove Script**.

**To disable a script:**

Click the box to the left of the Vuser script name. The color of the script entry changes to gray, indicating that the script will not take part in the scenario. To re-enable the Vuser script, click the same box again.
After you create a scenario, you can set the time at which the scenario will begin running. In addition, for a manual scenario, you can set the duration time of the scenario or of the Vuser groups within the scenario. You can also select to gradually run and stop the Vusers within the scenario or within a Vuser group.

Note: The Vuser group settings are not applicable to the Percentage Mode.

This chapter describes:

➢ Delaying the Start of a Scenario
➢ Selecting a Schedule
➢ Scheduling a Scenario
➢ Scheduling Vuser Groups
➢ Adding Vusers to a Scheduled Scenario
About Scenario Scheduling

An important factor in the creation of a scenario, is developing a test that accurately portrays user behavior—the types of actions and the timing of those actions, represented by Vuser scripts.

Using the Scenario Start dialog box, you can instruct LoadRunner to begin executing a scenario with a delay. You can specify either the number of minutes you want LoadRunner to wait from the time a Run command is issued, or the specific time at which you want the scenario to begin.

Using the Schedule Builder, you can set the timing aspect of a manual scenario, limiting the execution duration of the scenario or of a Vuser group within the scenario. You limit the execution time duration by specifying the number of minutes a scenario or Vuser group should be in the RUNNING state. When the scenario or group reaches its time limitation, it finishes.

Note: The Vuser group settings are not applicable to the Percentage Mode.

For manual scenarios, you can also stipulate how many Vusers LoadRunner starts and stops within a certain time frame. You specify whether LoadRunner should start or stop all Vusers in a scenario or Vuser group simultaneously, or start/stop only a certain number of Vusers within a specified amount of time.

The schedule you define is visually displayed in the Load Preview graph.

Note: Rendezvous points in a Vuser script interfere with a scheduled scenario. If your script contains rendezvous points, your scenario will not run as scheduled.
Delaying the Start of a Scenario

For both manual and goal-oriented scenarios, you can instruct LoadRunner to start running the scenario at a later point in time. You can specify either the number of minutes you want LoadRunner to wait from the time a Run command is issued, or the specific time at which you want the scenario to begin.

**To delay the start of the scenario:**

1. Select **Scenario > Start Time**. The Scenario Start dialog box opens, with the default option—**without delay**—selected.

![Scenario Start dialog box](image)

2. Select **with a delay of X (HH:MM:SS)** and enter the amount of time (in hours:minutes:seconds format) by which you want to delay the start of your scenario.

Alternatively, you can select **at X (HH:MM:SS) on X** and specify the time (in hours:minutes:seconds format) and date for the start of the scenario.

3. Click **OK** to close the dialog box and save your settings.
Selecting a Schedule

You select the schedule you want to use for your manual scenario from the Scenario Name box in the Scenario Schedule window. You can select one of the existing schedules—Slow Ramp Up or Ramp Up—or New Schedule, if you want to create a schedule with new properties using the Schedule Builder.

Note that you can also change the properties for one of the three existing schedules using the Schedule Builder.

To create a new schedule:

1. Select <new schedule> from the Scenario Name box in the Scenario Schedule window. The New Schedule dialog box opens.

2. In the Name text box, type the name of the New Schedule and click OK. The Schedule Builder dialog box opens.

To modify the properties of an existing schedule:

1. Select Slow Ramp Up or Ramp Up from the Scenario Name box in the Scenario Schedule window.
2 Select **Scenario > Schedule Builder**, or click the **Edit Schedule** button. The Schedule Builder dialog box opens.

![Schedule Builder dialog box]

To rename a schedule, click **Rename**. Enter the new name you want to use in the dialog box that opens. To delete a schedule, click **Delete**.

**Scheduling a Scenario**

Using the Schedule Builder, you can control the execution of your scenario by:

- limiting the scenario duration
- gradually running Vusers within a scenario
- gradually stopping Vusers within a scenario
To set the scheduling options for a scenario:

1. Select the **Schedule By Scenario** option.

2. To determine how to start the scenario, click the **Ramp Up** tab. Choose one of the following options:

   - **Load all Vusers simultaneously**: Starts all the Vusers in the scenario at once.
   - **Start X Vusers every X (HH:MM:SS)**: Begins running the specified number of Vusers concurrently, and waits the specified time between Vuser ramp ups.

3. To initialize all Vusers before beginning to load them, select the **Initialize all Vusers before Run** check box. The running of Vusers begins only after all Vusers reach the READY state.

Note: While a scenario is running, you can add Vuser groups/scripts to a scenario and enable them. In the gradual ramp up mode, if you add a Vuser group/script after all the Vusers in the scenario have been ramped up, the new group/script will start loading immediately.
To set the duration of the scenario, click the **Duration** tab.

Choose one of the following options:

- **Run until completion**
- **Run for X (HH:MM:SS) after the ramp up has been completed**: Runs the scenario for a specified amount of time, once all the Vusers have been ramped up.
- **Run indefinitely**

**Note:** The duration setting overrides the Vuser iteration settings. This means that if the duration is set to five minutes, the Vusers will continue to run as many iterations as required in five minutes, even if the run-time settings specify only one iteration.

In a scenario of limited duration, the duration time begins to run from the start of the scenario. Vusers that take a long time to initialize may not reach the **RUNNING** state before the scenario ends. To ensure that all Vusers run in the scenario, check the **Initialize all Vusers before Run** check box.
To determine how to stop the scenario, click the **Ramp Down** tab.

Choose one of the following options:

- **Stop all Vusers simultaneously**: Stops all the Vusers in the scenario at once.
- **Stop X Vusers every X (HH:MM:SS)**: Stops a certain number of Vusers within a specified time frame.

**Note**: The Ramp Down tab settings will only be applied if you select the second option in the Duration tab.

To instruct LoadRunner to initialize Vusers before beginning to load them, select **Initialize all Vusers before ramp up**. Note that LoadRunner will only begin to load the Vusers once they have all reached the **READY** state.

Click **OK** to close the Schedule Builder and save your settings.
Scheduling Vuser Groups

After you create a Vuser group, you can schedule the group’s script execution by setting:

➤ the amount of time after the start of the scenario that the group must wait before it starts running
➤ the number of Vusers that will run within a specified period of time
➤ the number of Vusers that will be stopped within a specified period of time
➤ the amount of time the group will run

Note: The Vuser group settings are not applicable to the Percentage Mode.

To schedule a Vuser Group:

1 Select the Schedule By Group option.

2 Select a group from the box on the left.
3 To set the start time for the group, click the **Start Time** tab. Choose one of the following three options:

➤ **Start the group at the beginning of the scenario**

➤ **Start X after the scenario begins**: Waits the specified amount of time before running the group.

➤ **Start when group X finishes**: Begins running the group after the specified group has finished running.

4 To set the ramp up for the group, click the **Ramp Up** tab.

Choose one of the following options:

➤ **Load all of the Vusers simultaneously**: Starts all the Vusers in the scenario at once.

➤ **Start X Vusers every X (HH:MM:SS)**: Begins running the specified number of Vusers concurrently, and waits the specified time between Vuser ramp ups.

---

**Note**: While a scenario is running, you can add Vuser groups to a scenario and enable them. In the gradual ramp up mode, if you add a Vuser group after all the Vusers in the scenario have been ramped up, the new group will start loading immediately.
5 To initialize all Vusers before beginning to load them, select the **Initialize all Vusers before Run** check box. The running of Vusers begins only after all Vusers reach the READY state.

6 To set the duration of the group, click the **Duration** tab.

Choose one of the following options:

- **Run until completion**
- **Run for X (HH:MM:SS) after the ramp has been completed**: Runs the group for the specified amount of time, once all the Vusers have been ramped up.

---

**Note:** The duration setting overrides the Vuser iteration settings. This means that if the duration is set to five minutes, the Vusers will continue to run as many iterations as required in five minutes, even if the run-time settings specify only one iteration.

In a scenario of limited duration, the duration time begins to run from the start of the scenario. Vusers that take a long time to initialize may not reach the RUNNING state before the scenario ends. To ensure that all Vusers run in the scenario, check the **Initialize all Vusers before Run** check box.
7 To determine how to stop the Vuser group, click the **Ramp Down** tab.

Choose one of the following options:

- **Stop all Vusers simultaneously**: Stops all the Vusers in the group at once.
- **Stop X Vusers every X (HH:MM:SS)**: Stops a certain number of Vusers within a specified time frame.

**Note:** The Ramp Down tab settings will only be applied if you select the second option in the Duration tab.

8 To instruct LoadRunner to initialize Vusers before beginning to load them, select **Initialize all Vusers before ramp up**. Note that LoadRunner will only begin to load the Vusers once they have all reached the **READY** state.

9 Click **OK** to close the Schedule Builder and save your settings.
Adding Vusers to a Scheduled Scenario

If you are running a scenario or Vuser group using Schedule Builder settings, these settings will be applied to all Vusers that are manually added to the scenario or Vuser group during the scenario run. For example, if a running scenario or Vuser group has a set duration of five minutes, all Vusers subsequently added to the scenario or Vuser group will only run for the remaining part of this time period.

Vusers added to a scheduled scenario or Vuser group which has finished running will not be affected by Schedule Builder settings and will run according to the scenario run-time settings.

For more information on manually controlled Vusers, see “Manually Adding Vusers to a Running Scenario,” on page 172.
Using Rendezvous Points

LoadRunner allows you to check your system's response under specific load. To do this, you can use rendezvous points to cause multiple Vusers to perform tasks at exactly the same time, thereby creating intense user load on the server.

This chapter describes:

➤ Setting the Rendezvous Attributes
➤ Setting the Rendezvous Policy
➤ Disabling and Enabling Rendezvous Points
➤ Disabling and Enabling Vusers at Rendezvous Points
➤ Viewing Rendezvous Information

About Using Rendezvous Points

During a scenario run you can instruct multiple Vusers to perform tasks simultaneously by using rendezvous points. A rendezvous point creates intense user load on the server and enables LoadRunner to measure server performance under load.

Suppose you want to measure how a web-based banking system performs when ten Vusers simultaneously check account information. In order to emulate the required user load on the server, you instruct all the Vusers to check account information at exactly the same time.

You ensure that multiple Vusers act simultaneously by creating a rendezvous point. When a Vuser arrives at a rendezvous point, it is held there by the Controller. The Controller releases the Vusers from the rendezvous either
when the required number of Vusers arrives, or when a specified amount of
time has passed. For details on the release criteria, see “Setting the
Rendezvous Policy,” on page 127.

You define rendezvous points in the Vuser script. For information about
inserting rendezvous points into Vuser scripts, refer to the LoadRunner
Creating Vuser Scripts User’s Guide.

Using the Controller, you can influence the level of server load by selecting:

► which of the rendezvous points will be active during the scenario
► how many Vusers will take part in each rendezvous

For example, to test a bank server, you could create a scenario that contains
two rendezvous points. The first rendezvous ensures that one thousand
Vusers simultaneously deposit cash. The second rendezvous ensures that
another thousand Vusers simultaneously withdraw cash. If you want to
measure how the server performs when only five hundred Vusers deposit
cash, you can deactivate (disable) the “withdraw” rendezvous, and instruct
only five hundred Vusers to participate in the “deposit” rendezvous.

The following procedure outlines how to control load peaks on the server:

1 Create the Vuser scripts, inserting the necessary rendezvous points.

2 Create a scenario.

When you add a Vuser group to a scenario, LoadRunner scans the group’s
associated script for the names of the rendezvous points and adds them to
the list in the Rendezvous Information dialog box (Scenario > Rendezvous).
If you create another Vuser group that runs the same script, the Controller
adds the new Vusers to the rendezvous and updates the list.

3 Set the level of emulated user load.

You determine the exact level of load by selecting the rendezvous points
that will take part in the scenario, and how many Vusers will participate in
each rendezvous.

4 Set the attributes for the rendezvous (optional).

For each rendezvous you can set Policy attributes. For more information, see
“Setting the Rendezvous Policy,” on page 127.

5 Run the scenario.
Setting the Rendezvous Attributes

You can set the following rendezvous attributes from the Rendezvous Information dialog box (Scenario > Rendezvous):

➤ Rendezvous Policy
➤ Enabling and Disabling of Rendezvous Points
➤ Enabling and Disabling of Vusers
In addition, the dialog box displays general information about the rendezvous point: which script is associated with the rendezvous, and release history.

For information on manipulating the Vusers during scenario execution using the Release command, see Chapter 13, “Running a Scenario.”
Setting the Rendezvous Policy

Setting the rendezvous policy determines how the Vusers handle a rendezvous point. You set the following policy attributes for each rendezvous:

- **release policy** sets how many Vusers will be released from a rendezvous at a time.
- **timeout** how long the Controller waits before releasing Vusers from a rendezvous.

To set the rendezvous policy attributes:

1. Choose **Scenario > Rendezvous**. The Rendezvous Information dialog box opens.
2. Select a rendezvous from the Rendezvous box, and click the **Policy** button. The Policy dialog box opens.
In the Policy section, select one of the following three options:

- **Release when X% of all Vusers arrive at the rendezvous:** Releases the Vusers only when the specified percentage of all Vusers arrives at the rendezvous point.

  **Note:** This option interferes with the scheduling of your scenario. If you select this option, therefore, your scenario will not run as scheduled.

- **Release when X% of all running Vusers arrive at the rendezvous:** Releases the Vusers only when the specified percentage of all Vusers running in the scenario arrives at the rendezvous point.

- **Release when X Vusers arrive at the rendezvous:** Releases the Vusers only when the specified number arrives at the rendezvous point.

Enter a timeout value in the Timeout between Vusers box. After each Vuser arrives at the rendezvous point, LoadRunner waits up to the maximum timeout period you set for the next Vuser to arrive. If the next Vuser does not arrive within the timeout period, the Controller releases all the Vusers from the rendezvous.

Each time a new Vuser arrives, the timer is reset to zero. The default timeout is thirty seconds.

Click **OK** to save your settings and close the Policy dialog box.
Disabling and Enabling Rendezvous Points

You can temporarily disable a rendezvous and exclude it from the scenario. By disabling and enabling a rendezvous, you influence the level of server load.

You use the Disable Rendezvous/Enable Rendezvous button in the Rendezvous Information dialog box, to change the status of a rendezvous.

To disable a rendezvous:
1. In the Rendezvous box, select the rendezvous you want to disable.
2. Click the Disable Rendezvous button. The button changes to Enable Rendezvous and the rendezvous becomes disabled.

To enable a rendezvous:
1. In the Rendezvous box, select the disabled rendezvous that you want to enable.
2. Click the Enable Rendezvous button. The button changes to Disable Rendezvous and the rendezvous becomes enabled.

Disabling and Enabling Vusers at Rendezvous Points

In addition to disabling a rendezvous point for all Vusers in a scenario, LoadRunner lets you disable it for specific Vusers. By disabling Vusers at a rendezvous, you temporarily exclude them from participating in the rendezvous. Enabling disabled Vusers returns them to the rendezvous. You use the Disable and Enable commands to specify which Vusers will take part in a rendezvous.

To disable a Vuser in a rendezvous:
1. In the Rendezvous box, select the rendezvous for which you want to disable Vusers.
2 In the Vusers box, select the Vuser(s) you want to exclude from the rendezvous. Select multiple Vusers using the CTRL key.

3 Click the Disable Vuser button below the Vusers box. The disabled Vusers change from black to gray and will not take part in the rendezvous.

To enable a Vuser, select it and click Enable Vuser.
Chapter 9 • Using Rendezvous Points

Viewing Rendezvous Information

During and after a scenario, you can view the rendezvous status in the Rendezvous Information dialog box. The following information is provided:

**Time**: The time at which the Vusers at the rendezvous point were released.

**Reason**: The reason the Vusers at the rendezvous point were released. The possible reasons are *Timeout* or *Arrived*.

**Current Status**: The number of Vusers that arrived at the rendezvous point, out of the total number of Vusers assigned to the rendezvous.

**To view rendezvous information**:

Select the rendezvous whose information you want to view. The rendezvous status is displayed in the Status Information section.
You can configure how load generators and Vusers behave when you run a scenario so that the scenario accurately emulates your working environment.

This chapter describes:

➤ Configuring Scenario Run-Time Settings
➤ Setting Timeout Intervals
➤ Setting the Run-Time File Location
➤ Specifying Path Translation

About Configuring a Scenario

Before you run a scenario, you can configure both the load generator and Vuser behaviors for the scenario. Although the default settings correspond to most environments, LoadRunner allows you to modify the settings in order to customize the scenario behavior. The settings apply to all future scenario runs and generally only need to be set once.

The settings described in this chapter apply to all the load generators in a scenario. To change the settings for individual load generator machines, refer to Chapter 5, “Creating a Manual Scenario.” If the global scenario settings differ from those of an individual load generator, the load generator settings override them.

The settings discussed in this chapter are unrelated to the Vuser run-time settings. These settings, which apply to individual Vusers or scripts, contain information about logging, think time, and the network, the number of
Designing a Scenario

Configuring Scenario Run-Time Settings

The scenario run-time settings relate to:

➤ Vuser Quotas
➤ Stopping Vusers
➤ Random Sequence Seed

**Vuser quotas:** To prevent your system from overloading, you can set quotas for Vuser activity. The Vuser quotas apply to Vusers on all load generators. You can limit the number of Vusers initialized at one time (when you send an Initialize command).

**Stopping Vusers:** LoadRunner lets you control the way in which Vusers stop running when you click the Stop button. You can instruct LoadRunner to allow a Vuser to complete the iteration it is running before stopping, to complete the action it is running before stopping, or to stop running immediately.

**Random sequence seed:** LoadRunner lets you set a seed number for random sequencing. Each seed value represents one sequence of random values used for test execution. Whenever you use this seed value, the same sequence of values is assigned to the Vusers in the scenario. This setting applies to parameterized Vuser scripts using the Random method for assigning values from a data file. Enable this option if you discover a problem in the test execution and want to repeat the test using the same sequence of random values.
Chapter 10 • Configuring a Scenario

To set the scenario run-time settings:

1 Choose **Tools > Options**. The Options dialog box opens. Click the **Run-Time Settings** tab.

2 To set a Vuser quota, specify the desired value.

3 Select the way in which you want LoadRunner to stop running Vusers.

4 To specify a seed value for a random sequence, select the **Use random sequence with seed** check box and enter the desired seed value.

**Setting Timeout Intervals**

LoadRunner enables you to set the timeout interval for commands and Vuser elapsed time.

The command timeouts are the maximum time limits for various LoadRunner commands. When a command is issued by the Controller, you set a maximum time for the load generator or Vuser to execute the command. If it does not complete the command within the timeout interval, the Controller issues an error message.
The command timeouts relate to load generators and Vusers. The load generator commands for which you can specify a timeout interval are Connect and Disconnect. The Vuser commands for which you can specify a timeout interval are Init, Run, Pause, and Stop.

For example, the default Init timeout is 180 seconds. If you select a Vuser and click the Initialize button, LoadRunner checks whether the Vuser reaches the ready state within 180 seconds; if it does not, the Controller issues a message indicating that the Init command timed out.

In the Vuser view, the Elapsed column (the last column) indicates the amount of time that elapsed from the beginning of the scenario. You can specify the frequency in which LoadRunner updates this value. The default is 4 seconds.

**Note:** LoadRunner’s calculations consider the number of active Vusers and their influence on the timeout values. For example, 1000 Vusers trying to initialize will take much longer than 10 Vusers. LoadRunner adds an internal value, based on the number of active Vusers, to the specified timeout value.
Chapter 10 • Configuring a Scenario

To set timeout intervals:

1 Choose Tools > Options. The Options dialog box opens. Click the Timeout tab.

![Options dialog box]

2 Clear the Enable timeout checks check box to disable the timeout test. LoadRunner waits an unlimited time for the load generators to connect and disconnect, and for the Initialize, Run, Pause, and Stop commands to be executed.

3 To specify a command timeout interval, select the Enable timeout checks check box and specify the appropriate timeouts.

4 Specify the frequency at which LoadRunner updates the Elapsed time, in the Update Vuser elapsed time every box.
Setting the Run-Time File Location

When you run a scenario, by default the run-time files are stored locally on each Vuser load generator (the machine running the Vuser script). The default location of the files is under the temporary directory specified by the load generator's environment variables (on Windows, TEMP or TMP and on UNIX, $TMPDIR or $TMP). If no environment variable is defined, the files are saved to the /tmp directory.

Note: The run-time file storage settings that are described in this chapter apply to all the load generators in a scenario. You can change the settings for individual load generator machines as described in “Configuring Load Generators” on page 59.

The primary run-time files are Vuser script and result files:

**Script files:** When you run a Vuser, the Controller sends a copy of the associated Vuser script to the Vuser load generator. The script is stored in the load generator's temporary run-time directory.

**Result files:** While you run a scenario, the participating Vusers write their results to the temporary run-time file directory. After scenario execution, these result files are collated or consolidated—results from all of the load generators are transferred to the results directory. You set the location of the results directory as described in Chapter 13, “Running a Scenario.” After collating the results, the temporary run-time directory is deleted.
Chapter 10 • Configuring a Scenario

To specify where LoadRunner stores run-time files:

1 Choose **Tools > Options**. The Options dialog box opens. Click the **Run-Time File Storage** tab.

![Options dialog box](image)

By default, the **On the current Vuser machine** option is selected. This means that all run-time files—including result files and script files—are stored on the Vuser load generators. The only exception is for Vusers running on the local load generator (Controller machine), where you must use the shared drive option.

2 To store script and result files on a shared network drive, click **On a shared network drive**. To set the exact location on the network drive, see Chapter 11, “Preparing to Run a Scenario.”

If you select to save results to a shared network drive, you may need to perform path translation. Path translation ensures that the specified results directory is recognized by the remote load generator. For information about path translation see Appendix B, “Performing Path Translation.”
If you specify that all Vusers access their Vuser scripts directly at some shared location, no transfer of script files occurs at run time. This alternative method may be useful in either of the following situations:

➤ The file transfer facility does not work.
➤ The Vuser script files are large and therefore take a long time to transfer. Remember that Vuser script files are transferred only once during a scenario.

This alternate method often necessitates path translation. For details, see Appendix B, “Performing Path Translation.”

3 Click OK to close the dialog box.

---

Note: If you choose to save result files on the Vuser load generators, you must collate the results before you can perform any analysis. You can wait for LoadRunner to collate the results when you launch the Analysis tool, or you can collate results by selecting Results > Collate Results. Alternatively, select Results > Auto Collate Results to automatically collate the results at the end of each scenario run.

---

Specifying Path Translation

If you specified a shared network drive for run-time file storage, (see “Setting the Run-Time File Location” on page 138), you may need to perform path translation. Path translation is a mechanism used by LoadRunner to convert a remote path names. A typical scenario may contain several load generator machines that map the shared network drive differently. For more information, see the Appendix B, “Performing Path Translation.”
Preparing to Run a Scenario

Before you run a scenario, you specify a location for the scenario results and other run-time related settings.

This chapter describes:

➤ Specifying a Results Location
➤ Results Directory File Structure
➤ Collating Results
➤ Setting Scenario Summary Information

About Preparing to Run a Scenario

Before you run a scenario, you need to specify the location of the results (mandatory), assign a name to the results, schedule the scenario, and provide scenario summary information. In addition, you can specify the applications to invoke at the start of a scenario.

Although most of the pre-scenario settings are optional, by using them you can enhance the testing process. These values are scenario specific—you can set different values for each LoadRunner scenario.

For information on one-time configuration settings such as timeout, output, and quotas, see Chapter 10, “Configuring a Scenario.”
Specifying a Results Location

When you run a scenario, by default the run-time files are stored locally on each load generator. After the scenario, the results are collated together and processed on the Controller machine. Alternatively, you can instruct LoadRunner to save the results on a shared network drive. For information about specifying a file storage method, see the Run-Time File Storage settings in Chapter 10, “Configuring a Scenario.”

LoadRunner allows you to give descriptive names to each result set. This is especially useful for cross results analysis, in which LoadRunner superimposes the results of several scenario runs in a single graph and lets you compare the results of multiple scenario runs. The descriptive graph names enable you to distinguish between the results of the multiple runs.

In the example below, the results of two scenario runs are superimposed. The result sets are res12, and res15.

For more details on cross result graphs, see the LoadRunner Analysis User's Guide.
Note: You can also use Mercury Interactive’s Web-based test management program, TestDirector, to store results to a project. For information, see Chapter 12, “Managing Scenarios Using TestDirector.”

To specify where results are stored:

1 Choose Results > Results Settings. The Set Results Directory dialog box opens.

2 In the Results Name box, enter a name for the results. Avoid using the same name with different paths, since the names will appear identical on the graphs.

3 In the Directory box, type the full path of the results directory. If you are using the default file storage setting (local machine), specify a directory in which to store all of the collated results after the scenario run. If you specified a shared network drive as the file storage method, specify the directory to which Vuser groups should write during scenario execution. Using the results name from step 2, the Controller creates a subdirectory within the results directory. All results are saved within this subdirectory.

4 Select the appropriate check box for subsequent executions: Automatically create a results directory for each scenario execution or Automatically overwrite existing results directory without prompting for confirmation.

5 Click OK to save the results directory setting.
Results Directory File Structure

When you set the results directory, you also specify a results name. LoadRunner creates a subdirectory using the results name, and places all of the data it gathers in that directory. Every set of results contains general information about the scenario in a result file (.lrr) and an event (.eve) file.

During scenario execution, LoadRunner also gathers data from each Vuser and stores it in an event file _t_rep.eve and an output file output.txt. LoadRunner creates a directory for each group in the scenario and a subdirectory for each Vuser. A typical result directory has the following structure:

- results_directory
- results_name
- t_rep.eve
- on_paths.def
- test2.lrr
- output.log
- Data
- g1
  - 1
  - 2
  - 3
  - 4
  - 5
- _t_rep.eve
- output.txt

- _t_rep.eve in the main result directory contains Vuser and rendezvous information.
- *.def are definition files for graphs that describe the online and other custom monitors.
- results_name.lrr is the LoadRunner Analysis document file.
- output.log contains output information about the scenario generated during test execution.
- The Data directory contains the database created by the Analysis (from the results files).
Chapter 11 • Preparing to Run a Scenario

➤ *g1* is a group directory. A separate directory exists for each Vuser group that runs in the scenario. Each group directory consists of Vusers subdirectories.

➤ *t_rep.eve* in each Vuser directory contains transaction information.

➤ *output.txt* in each Vuser directory contains output information generated during replay.

When you generate analysis graphs and reports, the LoadRunner Analysis engine copies all of the scenario result files (*.eve* and *lrr*) to a database. Once the database is created (and stored in the *Data* directory), the Analysis works directly with the database and does not use the result files.

For information on LoadRunner Analysis, see the *LoadRunner Analysis User’s Guide*.

Collating Results

When you run a scenario, by default all Vuser information is stored locally on each load generator. After scenario execution, the results are automatically collated or consolidated—results from all of the load generators are transferred to the results directory. You set the location of the results directory as described in “Specifying a Results Location,” on page 142.

---

**Note:** If you have selected to store all the scenario results directly to a shared network drive, then collation of the results is not required. See “About Configuring a Scenario,” on page 133 for details on changing how results are stored.

---

To disable automatic collation and clear the check mark adjacent to the option, choose *Results > Auto Collate Results*. To manually collate results, choose *Results > Collate Results > Collate*. The Collating Files dialog box opens, displaying the progress of result and log file collation from each load generator. To stop collating the results and close the dialog box, click *Stop* and then *Close*. To resume collating the results, select *Results > Collate Results > Continue stopped collation.*
Note: You can choose to disable log file collation. For more information, see “Options - General Settings,” on page 521.

The log and result directories are only deleted from a load generator once LoadRunner successfully collates the results from the machine. You can therefore close the Controller after saving a scenario, and collate the results once you reopen the scenario in the Controller.

If collation fails due to a lack of disk space, select **Results > Collate**. LoadRunner attempts to collate the results again, without compressing the .eve file.

Before generating the analysis data, LoadRunner automatically collates the results if they have not previously been collated.

Note: If you enabled the **Auto Load Analysis** option in the Results menu, the Analysis may open during a lengthy collation process, displaying Analysis summary data.
Setting Scenario Summary Information

The Controller allows you to provide a detailed description of the scenario. In addition, you can specify the author’s name and a subject title for the scenario. Whenever you open this scenario, the summary information is available to you.

To set the scenario summary information:

1. Choose Scenario > Summary Information. The Summary Information box opens.

2. In the Author box, enter the name of the author.

3. In the Subject box, enter a subject name or short title for the scenario.

4. In the Description box, enter a detailed description about the scenario.

5. Click OK to close the dialog box.
Managing Scenarios Using TestDirector

LoadRunner’s integration with TestDirector lets you manage LoadRunner scenarios using TestDirector. TestDirector helps you organize and manage your scripts, scenarios, and results.

This chapter describes:

➤ Connecting to and Disconnecting from TestDirector
➤ Opening Scenarios from a TestDirector Project
➤ Saving Scenarios to a TestDirector Project
➤ Saving Results to a TestDirector Project
➤ Adding Vuser Scripts from a TestDirector Project

About Managing Scenarios Using TestDirector

LoadRunner works together with TestDirector, Mercury Interactive’s Web-based test management tool. TestDirector provides an efficient method for storing and retrieving scenarios and collecting results. You store scenarios and results in a TestDirector project and organize them into unique groups.

In order for LoadRunner to access a TestDirector project, you must connect it to the Web server on which TestDirector is installed. You can connect to either a local or remote Web server.

For more information on working with TestDirector, refer to the TestDirector User’s Guide.
Connecting to and Disconnecting from TestDirector

If you are working with both LoadRunner and TestDirector, LoadRunner can communicate with your TestDirector project. You can connect or disconnect LoadRunner from a TestDirector project at any time during the testing process.

Connecting LoadRunner to TestDirector

The connection process has two stages. First, you connect LoadRunner to a local or remote TestDirector Web server. This server handles the connections between LoadRunner and the TestDirector project.

Next, you choose the project you want LoadRunner to access. The project stores scenarios and results for the application you are testing. Note that TestDirector projects are password protected, so you must provide a user name and a password.

To connect LoadRunner to TestDirector:

1. In the Controller, choose Tools > TestDirector Connection. The TestDirector Connection dialog box opens.
2 In the Server box, type the URL address of the Web server on which TestDirector is installed.

---

**Note:** You can choose a Web server accessible via a Local Area Network (LAN) or a Wide Area Network (WAN).

---

3 Click Connect. Once the connection to the server is established, the server’s name is displayed in read-only format in the Server box.

4 From the Project box in the Project Connection section, select a TestDirector project.

5 In the User Name box, type a user name.

6 In the Password box, type a password.

7 Click Connect to connect LoadRunner to the selected project.

Once the connection to the selected project is established, the project’s name is displayed in read-only format in the Project box.

8 To automatically reconnect to the TestDirector server and the selected project on startup, select the **Reconnect on startup** check box.

9 If you select **Reconnect on startup**, you can save the specified password to reconnect on startup. Select the **Save password for reconnection on startup** check box.

If you do not save your password, you will be prompted to enter it when LoadRunner connects to TestDirector on startup.

10 Click Close to close the TestDirector Connection dialog box.

The status bar indicates that LoadRunner is currently connected to a TestDirector project.
Disconnecting LoadRunner from TestDirector

You can disconnect LoadRunner from a selected TestDirector project and Web server.

To disconnect LoadRunner from TestDirector:

1. In the Controller, choose Tools > TestDirector Connection. The TestDirector Connection dialog box opens.

2. To disconnect LoadRunner from the selected project, click Disconnect in the Project Connection section.

3. To disconnect LoadRunner from the selected server, click Disconnect in the Server Connection section.

4. Click Close to close the TestDirector Connection dialog box.
Chapter 12 • Managing Scenarios Using TestDirector

Opening Scenarios from a TestDirector Project

When LoadRunner is connected to a TestDirector project, you can open your scenarios from TestDirector. You locate tests according to their position in the test plan tree, rather than by their actual location in the file system.

To open a scenario from a TestDirector project:

1 Connect to the TestDirector server (see “Connecting LoadRunner to TestDirector” on page 150).

2 In the Controller, choose File > Open or click the File Open button. The Open Scenario from TestDirector Project dialog box opens and displays the test plan tree.

To open a scenario directly from the file system, click the File System button. The Open Scenario dialog box opens. (From the Open Scenario dialog box, you may return to the Open Scenario from TestDirector Project dialog box by clicking the TestDirector button.)
3 Click the relevant subject in the test plan tree. To expand the tree and view sublevels, double-click closed folders. To collapse the tree, double-click open folders.

Note that when you select a subject, the scenarios that belong to the subject appear in the Test Name list.

4 Select a scenario from the Test Name list. The scenario appears in the read-only Test Name box.

5 Click OK to open the scenario. LoadRunner loads the scenario. The name of the scenario appears in the Controller’s title bar. The Design tab shows the scripts, the load generators, and the Vusers and Vuser groups in the scenario.

---

**Note:** You can also open scenarios from the recent scenarios list in the File menu. If you select a scenario located in a TestDirector project, but LoadRunner is currently not connected to that project, the TestDirector Connection dialog box opens. Enter your user name and password to log in to the project, and click OK.

---

**Saving Scenarios to a TestDirector Project**

When LoadRunner is connected to a TestDirector project, you can create new scenarios in LoadRunner and save them directly to your project. To save a scenario, you give it a descriptive name and associate it with the relevant subject in the test plan tree. This helps you to keep track of the scenarios created for each subject and to quickly view the progress of test planning and creation.

**To save a scenario to a TestDirector project:**

1 Connect to the TestDirector server (see “Connecting LoadRunner to TestDirector” on page 150).
2 In the Controller, choose **File > Save As**. The Save Scenario to TestDirector Project dialog box opens and displays the test plan tree.

To save a scenario directly in the file system, click the **File System** button. The Save Scenario dialog box opens. (From the Save Scenario dialog box, you may return to the Save Scenario to TestDirector Project dialog box by clicking the TestDirector button.)

3 Select the relevant subject in the test plan tree. To expand the tree and view a sublevel, double-click a closed folder. To collapse a sublevel, double-click an open folder.

4 In the Test Name box, enter a name for the scenario. Use a descriptive name that will help you easily identify the scenario.

5 Click **OK** to save the scenario and close the dialog box.

The next time you start TestDirector, the new scenario will appear in TestDirector's test plan tree.
Saving Results to a TestDirector Project

Before you run a scenario, you set the results location. When LoadRunner is connected to a TestDirector project, results are saved to a test set. You can also save the results to disk using the standard file system.

To save results to a TestDirector project:

1. Connect to the TestDirector server (see “Connecting LoadRunner to TestDirector” on page 150).

2. In the Controller, choose Results > Results Settings. The Set Results Directory dialog box opens.

3. Click TestDirector. The Directory box changes to Test Sets.

4. In the Results Name box, enter a name for the results.

5. In the Test Sets list, accept the default test set name or select a different name.
6 Select the appropriate check box:

- **Automatically create a results directory for each scenario execution:**
  Instructs LoadRunner to create a unique results directory for each scenario execution. By default, the result names are res1, res2, res3, etc.

- **Automatically overwrite existing results directory without prompting for confirmation:**
  Instructs LoadRunner to automatically overwrite previous result sets, without prompting the user.

7 Click **OK** to save the results settings.

**Adding Vuser Scripts from a TestDirector Project**

You can add Vuser scripts from a TestDirector project to the Controller's script list. You can add the script to a manual or goal-oriented scenario.

**Adding a Vuser Script to a Manual Scenario**

When you create a manual scenario, you use the Add Group dialog box to add Vuser scripts.

**To add a Vuser script to a manual scenario:**

1 Connect to the TestDirector server (see “Connecting LoadRunner to TestDirector,” on page 150).
In the Scenario Groups window, click the Add Group button. The Add Group dialog box opens.

Click the Browse button. The Open Test from TestDirector Project dialog box opens and displays the test plan tree.

Select the script and click OK. The Script Path field displays [TD], the full subject path, and the script name. For example:

[TD]\Subject\System\test_td

Click OK to close the Add Group dialog box. The script is displayed in the Scenario Groups window.
Adding a Vuser Script to a Goal-Oriented Scenario

When you create a goal-oriented scenario, you use the Add Script dialog box to add scripts.

To add a Vuser script to a goal-oriented scenario:

1. Connect to the TestDirector server (see “Connecting LoadRunner to TestDirector,” on page 150).

2. In the Scenario Scripts window, click the **Add Script** button. The Add Script dialog box opens.

3. Click the **Browse** button. The Open Test from TestDirector Project dialog box opens and displays the test plan tree opens.

4. Select the script and click **OK**. The Script Path field displays [TD], the full subject path, and the script name. For example:

   [TD]\Subject\System\test_td

5. Click **OK** to close the Add Script dialog box. The script appears in the Script Path column in the Scenario Scripts window.
Part III

Executing a Scenario
Running a Scenario

When you run a scenario, LoadRunner generates load on the application you are testing, and measures the system’s performance.

This chapter describes:
➤ Running an Entire Scenario
➤ Controlling Vuser Groups
➤ Controlling Individual Vusers
➤ Manually Releasing Vusers from a Rendezvous
➤ Manually Adding Vusers to a Running Scenario

About Running a Scenario

When you run a scenario, the Vuser groups are assigned to their load generators and execute their Vuser scripts. During scenario execution, LoadRunner:

➤ records the durations of the transactions you defined in the Vuser scripts
➤ performs the rendezvous included in the Vuser scripts
➤ collects error, warning, and notification messages generated by the Vusers

You can run an entire scenario unattended, or you can interactively select the Vuser groups and Vusers that you want to run. When the scenario starts running, the Controller first checks the scenario configuration information. Next, it invokes the applications that you selected to run with the scenario. Then, it distributes each Vuser script to its designated load generator. When the Vuser groups are ready, they start executing their scripts.
While the scenario runs, you can monitor each Vuser, view error, warning, and notification messages generated by the Vusers, and stop both Vuser groups and individual Vusers. You can instruct LoadRunner to allow an individual Vuser or the Vusers in a group to complete the iterations they are running before stopping, to complete the actions they are running before stopping, or to stop running immediately. For more information, see “Configuring Scenario Run-Time Settings” on page 134.

**Note:** When automatically stopping Vusers in a goal-oriented scenario, LoadRunner stops running the Vusers immediately.

You can also activate additional Vusers while the scenario is running, using the Run/Stop Vusers dialog box. For more information, see “Manually Adding Vusers to a Running Scenario” on page 172.

The scenario ends when all the Vusers have completed their scripts, when the duration runs out, or when you terminate it.

**The following procedure outlines how to run a scenario:**

1. Open an existing scenario or create a new one.
2. Configure and schedule the scenario.
3. Set the results directory.
4. Run and monitor the scenario.

**Note:** When a test runs in VuGen, the full browser is used. This differs from a test run in the Controller, where only the browser basics are used. There may be occasions when a test passes its run in VuGen, but fails when it is run in the Controller. Before running a scenario in the Controller with multiple Vusers, run a single Vuser to ensure the test is bug free.
Running an Entire Scenario

You can run all the Vusers and Vuser groups in a scenario, or you can select the specific Vuser groups and Vusers that you want to run. Note that when you run an entire scenario, LoadRunner does not begin running Vusers until all of them have reached the READY state. However, if you run individual groups or Vusers, LoadRunner runs the Vusers as soon as they reach the READY state.

The following section describes how to run an entire scenario. “Controlling Vuser Groups,” on page 166 and “Controlling Individual Vusers,” on page 169 describe how to manipulate Vuser groups and individual Vusers.

To run an entire scenario:

1. Open an existing scenario or create a new one. Click the Run tab. The Scenario Groups window appears in the top left-hand corner of the screen.

2. Choose Scenario > Start, or click the Start Scenario button. The Controller starts initializing the Vusers and distributing them to their designated load generators—where they begin to execute their Vuser scripts.

Note: The Controller begins running the scenario according to the start time set in the Scenario Start dialog box.

If you have not specified a results directory for the scenario, the Set Results Directory dialog box opens.

During scenario execution you can manipulate individual Vusers and Vuser groups. This is described in “Controlling Vuser Groups,” on page 166 and “Controlling Individual Vusers,” on page 169.

3. Select Scenario > Stop/Resume Ramp Up to stop the ramp up process. Select it again to resume the ramping up of Vusers.

4. Select Scenario > Stop/Resume Ramp Down to stop the ramp down process. Select it again to resume the ramping down of Vusers.
5 Choose **Scenario > Stop**, or click the **Stop** button to terminate the scenario. If you selected the **Exit immediately** option in the Run-Time Settings tab of the Options dialog box, all of the Vusers in the scenario move to the **EXITING** status.

If you selected the **Wait for the current iteration to end before exiting** or **Wait for the current action to end before exiting** options in the Run-Time Settings tab of the Options dialog box, the Vusers in the scenario move to the **GRADUAL EXITING** status and exit the scenario gradually. To stop the Vusers immediately, click **Stop Now**.

6 Choose **Scenario > Reset**, or click the **Reset** button to reset all Vusers to their pre-scenario, **DOWN** status.

**Controlling Vuser Groups**

You can run an entire scenario as described above, or you can manipulate individual Vuser groups in the scenario. This section describes how to initialize, run, and stop Vuser groups.

**Initializing Vuser Groups**

Initializing a Vuser group distributes the Vusers in the group to their designated load generators so that they are ready to execute their script(s). By initializing all of the Vusers in a group before running them, you can ensure that they all begin executing the scenario at the same time.

**To initialize a Vuser group:**

1. Select the Vuser group or groups that you want to initialize.

2. Click the **Initialize Vusers** button, or right-click the Vuser group or groups that you want to initialize and select **Initialize Group/s**. The Vuser group’s status changes from **DOWN** to **PENDING** to **INITIALIZING** to **READY**. If a Vuser group fails to initialize, the Vuser group status changes to **ERROR**.
Running Vuser Groups

Running a Vuser group tells the Vuser group to execute its script.

To run a Vuser group:

1. Select the Vuser group or groups that you want to run.
2. Click the Run Vusers button, or right-click the Vuser group or groups that you want to run and select Run Group/s. The Vuser groups execute their scripts. If you run a Vuser group in the DOWN or ERROR state, LoadRunner initializes and then runs the Vuser group.

Note: You can instruct LoadRunner to randomly run only one Vuser in a group by right-clicking the Vuser group and selecting Run One Vuser. A Vuser script log opens, displaying run-time information about the Vuser. For more information about the Vuser log, see “Viewing the Vuser Script Log” on page 186.

Pausing Vuser Groups

Pausing a Vuser group temporarily stops script execution. The Pause command changes the status of a Vuser group from RUNNING to PAUSED.

Note: Pausing a Vuser group will affect its transaction response time.

To pause a Vuser:

1. Select the Vuser group or groups that you want to pause.
2. Select Pause from the right-click menu. The Vusers groups temporarily stop script execution.
**Stopping Vuser Groups**

Stopping a Vuser group stops script execution. If you stop a Vuser group, the group still appears in the Vuser group list.

**To stop a Vuser group:**

1. Select the Vuser group or groups that you want to stop.

2. Click the **Stop Vusers** button, or right-click the Vuser group or groups and select **Stop**. The Vuser groups stop executing their scripts immediately.

If you selected the **Wait for the current iteration to end before exiting** or **Wait for the current action to end before exiting** options in the Run-Time Settings tab of the Options dialog box and want to gradually stop a Vuser group in the **RUN** state, click the Gradual Stop button, or right-click the Vuser group and select **Gradual Stop**. The Vusers in the group move to the **GRADUAL EXITING** status and exit the scenario gradually.

**Note:** If the Vusers are not in the **RUN** state, the Gradual Stop option is disabled.

---

**Resetting Vuser Groups**

Resetting causes all of the Vusers in a group to revert to their pre-scenario, **DOWN** status.

**To reset a Vuser group:**

1. Select the Vuser group or groups that you want to stop.

2. Right-click the Vuser group or groups that you want to stop, and select **Reset**. The Vuser groups revert to their pre-scenario, **DOWN** status.
Chapter 13 • Running a Scenario

Controlling Individual Vusers

You can also manipulate individual Vusers within the Vuser groups you have defined. This section describes how to initialize, run, and stop individual Vusers.

To control an individual Vuser:

1. Select a Vuser group and click the Vusers button. The Vusers dialog box opens, with a list of the ID, Status, Script, Load Generator, and Elapsed Time (since the beginning of the scenario) for each of the Vusers in the group.

You can control an individual Vuser using the following utilities:

➤ Select a Vuser and click Run to run it.
➤ Select a Vuser and click Stop to stop it immediately from running.

If you selected the Wait for the current iteration to end before exiting or Wait for the current action to end before exiting options in the Run-Time Settings tab of the Options dialog box, and want to gradually stop a Vuser in the RUN state, click the Gradual Stop button. The Vuser moves to the GRADUAL EXITING status and exits the scenario gradually.
LoadRunner Controller User’s Guide • Executing a Scenario

➤ To pause a Vuser, right-click it and select **Pause**.

---

**Note:** Pausing a Vuser will affect its transaction response time.

---

➤ Select a Vuser and click **Reset** to revert its status to **DOWN**.
➤ To initialize a Vuser, right-click it and select **Initialize Vuser/s**.
➤ To renumber the Vusers in a group, right-click the Vusers you want to renumber and select **Renumber**.
➤ To filter the Vusers listed, right-click in one of the columns and select **Filter Vusers**. Select the way in which you want to filter the Vusers. Alternatively, you can select the filter option you want to use from the right-hand filter selector at the top of the Vusers dialog box.
➤ To sort the Vusers listed, right-click in one of the columns and select **Sort Vusers**. Select the way in which you want to sort the Vusers.
➤ To view a Vuser executing its assigned script, select the Vuser and click the **Show** button. The Run-Time Viewer opens, allowing you to see the Vuser executing the script.

To close the Run-Time Viewer, click the **Hide** button.
To view the Vuser script log, click the **Vuser log** button. A script log, such as the following, appears.

To close the Vuser script log, click the **Close Vuser log** button. For more information on the Vuser script log, see page 186.

2 Click **Close** to close the Vusers dialog box.

**Manually Releasing Vusers from a Rendezvous**

While you run a scenario, you can manually release Vusers from a rendezvous before the Controller releases them.

To manually release Vusers from a rendezvous:

1 Choose **Scenario > Rendezvous**. The Rendezvous Information dialog box opens.

2 Select a rendezvous from the Rendezvous list.

3 Click **Release**. The Vusers in the rendezvous are released.
Manually Adding Vusers to a Running Scenario

During a running scenario, you can manually control the addition of new Vusers using the Run/Stop Vusers dialog box. The dialog box differs depending on the scenario mode you are running:

- If you are running a scenario in the Vuser Group Mode, you control the number of new Vusers that can be added to each Vuser Group, and the load generators on which these additional Vusers will run.
- If you are running a scenario in the Percentage Mode, you control the number of new Vusers that can be distributed among the Vuser scripts according to the percentage you define, and the load generators on which these additional Vusers will run.

Note: If you are running a scenario or Vuser group using Schedule Builder settings, these settings will be applied to all Vusers that are manually added to the scenario or Vuser group during the scenario run. For more information, see “Adding Vusers to a Scheduled Scenario,” on page 121.

To add Vusers to a running scenario:

Select Scenario > Run/Stop Vusers, or click the Run/Stop Vusers button in the Scenario Groups window of the Run view. The Run/Stop Vusers dialog box opens. If you are in the Vuser Group Mode, the dialog box displays the Vuser groups included in the scenario.
Chapter 13 • Running a Scenario

If you are in the Percentage Mode, the Run/Stop Vusers dialog box displays the Vuser scripts included in the scenario.

2 If you are in the Vuser Group Mode, enter the number of Vusers you want to run for each group in the Quantity column.

If you are in the Percentage Mode, enter the number of Vusers and the percentage in which you want these Vusers to be distributed among the checked Vuser scripts. LoadRunner automatically distributes the number of Vusers you entered. The % column indicates the percentage of Vusers distributed to each Vuser script. The # column indicates the number of Vusers distributed to each Vuser script.

3 To disable a Vuser group/script, clear the check box to the left of the group/script name. Note that a group/script will automatically appear disabled if it is disabled in the Design view.

Note: If you disable a Vuser group in the Vuser Group Mode, no Vusers will be distributed to it. If you disable a Vuser script in the Percentage Mode, no Vusers will be distributed to it, and the unused percentage of the Vusers will not be distributed among the remaining scripts, unless you define a zero percent value for the disabled script.
4 To change the load generator on which the Vuser group/script will run, select a different load generator from the Load Generator column.

To use a load generator that does not appear, select Add from the Load Generator Name list and add a new load generator using the Add Load Generator dialog box.

If you are in the Percentage Mode, you can select more than one load generator to run the Vuser script. From the Load Generator Name list, select the load generator(s) and click OK. To use all the load generators in the list, click the All Generators button.

Note: If you defined more than one load generator for a script, the added Vusers are proportionally distributed among the defined load generators.

5 Click the Init button to initialize the number of Vusers you added.

The Controller first initializes the Vusers in your scenario that have not yet been run, on the load generator(s) defined in the Run/Stop Vusers dialog box. It then adds additional Vusers, as required, to reach the quantity defined in the Run/Stop Vusers dialog box.

6 Click the Run button, and select one of the following two options:

➤ Run Initialized: Runs the Vusers in the scenario that have already been initialized on the load generators defined in the Run/Stop Vusers dialog box. The Controller runs only those Vusers that have already been initialized, regardless of their quantity.

➤ Run New: Runs the number of Vusers you specified. The Controller first runs the Vusers in your scenario that have not yet been run, on the load generator(s) defined in the Run/Stop Vusers dialog box. It then adds additional Vusers, as required, to reach the quantity defined in the Run/Stop Vusers dialog box.

7 Click Stop to stop the Vusers that are running on the load generator(s) defined in the Run/Stop Vusers dialog box. The Controller stops the Vusers according to the settings you defined in the Run-Time Settings tab of the Options dialog box.
8 Click Close to close the Run/Stop Vusers dialog box.

**Example of a Manually Controlled Scenario**

The example below shows the Run/Stop Vusers dialog box from a scenario running in the Percentage Mode.

![Run/Stop Vusers dialog box](image)

The number of Vusers that are distributed among the checked scripts is 15. The % column indicates that 60% of these Vusers are distributed to the script *flights2002*, and 20% to both *travel* and *test1*. In accordance with these percentages, the # column indicates that nine Vusers are distributed to *flights2002* and three to *travel* and *test1*.

---

**Note**: The unused percentage of the Vusers from *test1* are not distributed among the remaining scripts, because a value has been defined for the disabled script.

---

When an action (Init, Run, Stop) is selected from the Run/Stop Vusers dialog box, the Controller runs only the number of Vusers that appear in the # column. In this example, nine Vuser are initialized, run, or stopped in the *flights2002* script, and three in the *travel* script.

All Vusers distributed to the *flights2002* script are run on the *localhost* load generator. For the *travel* script, Vusers are proportionally distributed among all defined load generators.
**Note:** Load generator balancing is applied to a manually controlled scenario in the Percentage Mode where there are other load generators assigned to Vuser scripts. For more information, see “Load Balancing,” on page 103.
Viewing Vusers During Execution

During scenario execution, you can view the actions that are performed by Vusers.

This chapter describes:

➤ Monitoring Vuser Status
➤ Viewing the Output Window
➤ Viewing the Vuser Script Log
➤ Logging Execution Notes
➤ Viewing the Agent Summary

About Viewing Vusers During Execution

LoadRunner lets you view Vuser activity during a scenario:

➤ On the Controller load generator machines, you can view the Output window, monitor Vuser performance online, and check the status of Vusers executing the scenario.

➤ On remote machines, you can view the Agent summary with information about the active Vusers.
Monitoring Vuser Status

During scenario execution, you can use the Scenario Groups window in the Run view to monitor the actions of all the Vusers and Vuser groups in the scenario.

The Status field of each Vuser group displays the current state of each Vuser in the group. The following table describes the possible Vuser states during a scenario.

<table>
<thead>
<tr>
<th>Status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOWN</td>
<td>The Vuser is down.</td>
</tr>
<tr>
<td>PENDING</td>
<td>The Vuser is ready to be initialized and is waiting for an available load generator, or is transferring files to the load generator. The Vuser will run when the conditions set in its scheduling attributes are met.</td>
</tr>
<tr>
<td>INITIALIZING</td>
<td>The Vuser is being initialized on the remote machine.</td>
</tr>
<tr>
<td>READY</td>
<td>The Vuser already performed the init section of the script and is ready to run.</td>
</tr>
<tr>
<td>RUNNING</td>
<td>The Vuser is running. The Vuser script is being executed on a load generator.</td>
</tr>
<tr>
<td>RENDEZVOUS</td>
<td>The Vuser has arrived at the rendezvous and is waiting to be released by LoadRunner.</td>
</tr>
<tr>
<td>DONE.PASSED</td>
<td>The Vuser has finished running. The script passed.</td>
</tr>
<tr>
<td>DONE.FAILED</td>
<td>The Vuser has finished running. The script failed.</td>
</tr>
<tr>
<td>ERROR</td>
<td>A problem occurred with the Vuser. Check the Status field on the Vuser dialog box or the output window for a complete explanation of the error.</td>
</tr>
<tr>
<td>GRADUAL EXITING</td>
<td>The Vuser is completing the iteration or action it is running (as defined in Tools &gt; Options &gt; Run-Time Settings) before exiting.</td>
</tr>
<tr>
<td>EXITING</td>
<td>The Vuser has finished running or has been stopped, and is now exiting.</td>
</tr>
<tr>
<td>STOPPED</td>
<td>The Vuser stopped when the Stop command was invoked.</td>
</tr>
</tbody>
</table>
You can also view a synopsis of the running scenario in the box at the top right-hand corner of the Run view.

<table>
<thead>
<tr>
<th>Status Summary</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario Status</td>
<td>indicates whether the scenario is RUNNING or DOWN</td>
</tr>
<tr>
<td>Running Vusers</td>
<td>indicates how many Vusers are being executed on a load generator machine</td>
</tr>
<tr>
<td>Elapsed Time</td>
<td>indicates how much time has elapsed since the beginning of the scenario</td>
</tr>
<tr>
<td>Hits/Second</td>
<td>indicates how many hits (HTTP requests) there have been to the Web site being tested per second that each Vuser has been running</td>
</tr>
<tr>
<td>Passed Transactions</td>
<td>indicates how many transactions have been executed successfully</td>
</tr>
<tr>
<td>Failed Transactions</td>
<td>indicates how many transactions have been executed unsuccessfully</td>
</tr>
<tr>
<td>Errors</td>
<td>indicates how many problems have occurred with the Vusers</td>
</tr>
</tbody>
</table>
To view details of the transactions and errors:

1. Click the **Show Snapshot** button to the right of the Passed Transactions or Failed Transactions in the Scenario Status window. The Transactions dialog box opens.

The **Name** column lists the individual transactions in a script. For each transaction, the Transactions dialog box lists information concerning the number of **Transactions Per Second (TPS)**, the number of transactions that **Passed**, the number of transactions that **Failed**, and the number of transactions that **Stopped** before completion.
Choose View > Show Output or click the Show Snapshot button to the right of the Errors listing. The Output window opens, displaying a list of the Error log information.

For each type of error message code, the Output window lists a sample message text, the total number of messages generated, the Vusers and load generators that generated the code, and the scripts in which the errors occurred. To view details of the log information by message, Vuser, script, or load generator, click the link in the respective column. For more information on the Output window, see the following section.
To view a message in detail, select the message and click the **Details** button. The Detailed Message Text box opens in the Output window displaying the complete sample message text.
Viewing the Output Window

While the scenario runs, the Vusers and load generators send error, notification, warning, debug, and batch messages to the Controller. You can view these messages in the Output window.

The total number of messages received is displayed in the title bar. Note that LoadRunner clears the messages in the Output window at the start of each scenario execution. If you reset a scenario, messages remain in the Output window unless you instruct LoadRunner to delete messages from the Output window upon reset. For more information, see Appendix C, “Options - Output Settings.”

Note: You can also specify the maximum number of Vuser logs that may be displayed simultaneously on the Controller machine. For more information, see Appendix C, “Working in Expert Mode.”
The Output window provides the following information in the Summary tab:

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TYPE</td>
<td>the type of message sent: Error, Notify, Warning, Debug, or Batch (each represented by a different icon)</td>
</tr>
<tr>
<td></td>
<td><strong>Note:</strong> Debug messages will only be sent if you enable the debugging feature in Tools &gt; Options &gt; Debug Information (Expert Mode). Batch messages will be sent instead of message boxes appearing in the Controller, if you are using automation.</td>
</tr>
<tr>
<td>MESSAGE CODE</td>
<td>the code assigned to all similar messages. The number in parentheses indicates the number of different codes displayed in the Output window.</td>
</tr>
<tr>
<td>SAMPLE MESSAGE TEXT</td>
<td>an example of the text of a message with the specified code</td>
</tr>
<tr>
<td>TOTAL MESSAGES</td>
<td>the total number of sent messages with the specified code</td>
</tr>
<tr>
<td>VUSERS</td>
<td>the number of Vusers that generated messages with the specified code</td>
</tr>
<tr>
<td>SCRIPTS</td>
<td>the number of scripts whose execution caused messages with the specified code to be generated</td>
</tr>
<tr>
<td>GENERATORS</td>
<td>the number of load generators from which messages with the specified code were generated</td>
</tr>
</tbody>
</table>

You can view and manipulate the log information in the Summary tab using the following utilities:

- To show (or hide) the Output window, choose **View > Show Output**.
- To sort the log information, click the appropriate column header. The messages are sorted in descending/ascending order.
- To filter the Output window to display only certain message types, select the type of message you want to view from the Type of Message box. By default, all types of output messages are displayed, unless you click the Show Snapshot button in the Scenario Status window.
To view a message in detail, select the message and click the Details button. The Detailed Message Text box opens in the Output window displaying the complete message text.

To save the Output window view to a file, click the Export the view button.

To clear all log information from the Output window, click the Remove all messages button.

To halt the updating of the Output window, click the Freeze button. To instruct LoadRunner to resume updating the Output window with messages, click the Resume button. Note that newly updated log information is displayed in a red frame.

**Viewing Log Information Details**

You can view details of each message, Vuser, script, and load generator associated with an error code by clicking the blue link in the respective column. The Output window displays a drilled down view by message, Vuser, script, or load generator in the Detailed tab.

For example, if you drill down on the Vusers column, the Output window displays all the messages with the code you selected, grouped by the Vusers that sent the messages.

![Output Window](image)

Note that the message type, the message code, and the column that you selected to drill down on, are displayed above the grid.
You can drill down further on the entries displayed in blue. Note that when you drill down on a Vuser, the Vuser log opens. When you drill down on a load generator, the Load Generators dialog box opens, displaying the load generator you selected. When you drill down on a script (or Action or Line Number), VuGen opens, displaying the script you selected.

**Note:** To limit the number of rows displayed when you drill down, open the `wlrun7.ini` file in any text editor, and locate the following line:

```
MaxOutputUIRowsToShow=0
```

Change the 0 (no limit) to the number of rows you want to view.

When new messages arrive in the Output window, the Refresh button is enabled. Click **Refresh** to add the new log information to the Detailed tab view.

To move between the various drill down levels, click the **Previous view** and **Next view** buttons in the upper left-hand corner of the Output window.

### Viewing the Vuser Script Log

During scenario execution, you can view a log containing run-time information about each running Vuser.

**To view the Vuser script log for a particular Vuser:**

1. In the Vusers dialog box, select the Vuser whose log you want to view, and click the **Show Vuser Log** button, or right-click the Vuser and select **Show Vuser Log**.
Chapter 14 • Viewing Vusers During Execution

The Vuser script log opens, displaying run-time information about the Vuser that is refreshed, by default, every 1000 milliseconds.

Note: If you disabled the logging feature in the Run-Time Settings Log tab, the Vuser script log will be empty. If you selected the Send messages only when an error occurs option in the Log tab, the Vuser script log will contain output only if there are script errors.

➤ To disable the refreshing of this log, clear the Refresh check box.

➤ To view the information in text format, click the Show Text View button. To revert to the tree view, click the button again.

➤ If you are running a Web Vuser, and want to view a snapshot of the Web page where an error occurred, highlight the error in the Vuser log and click the Display button. Note that this option is only available for Vusers running on Windows load generators.
LoadRunner Controller User’s Guide • Executing a Scenario

Note: In order to view a snapshot of the Web page where an error occurred, you must select the **Activate snapshot on error** option in the General tab of the Run-Time Settings dialog box before running the scenario.

- To search the Vuser log for specific text, click the **Find Text** button, and enter the text you want to search for in the text box.
- To collapse the tree view, click the **Collapse Node** button. To revert to the expanded tree view, click the same button again.

2 Click **Close** to close the Vuser script log.

**Logging Execution Notes**

The Controller provides you with a dialog box in which you can log comments while a scenario is running.
Chapter 14 • Viewing Vusers During Execution

To log execution notes:

1. Select Scenario > Execution Notes. The Execution Notes dialog box opens.
2. Enter the note or notes that you want to log.
3. Click OK to close the dialog box. LoadRunner saves the note(s) you recorded.

Viewing the Agent Summary

When you run a scenario with non-GUI Vusers, the machine running the Vusers invokes an agent that controls the Vuser execution on that load generator. During scenario execution, the agent displays a summary of the Ready, Running, and Paused Vusers.

The Agent window comes forward at the start of the scenario. You can minimize and restore it at any time.
Working with Firewalls

You can run Vusers and monitor your servers, while the Controller is outside of the firewall.

This chapter describes:

➤ Overview of Running or Monitoring over the Firewall
➤ Configuring the LoadRunner Agents in LAN1
➤ Configuring the Firewall to Allow Agent Access
➤ Installing and Configuring the MI_Listener in LAN2
➤ Configuring the Controller to Run Vusers or Monitor over the Firewall

About Using Firewalls in LoadRunner

Working with a firewall means that you can prevent access to the outside world and from the outside world, on specific port numbers.

For example, you can specify that there is no access to any port from the outside world, with the exception of the mail port (23), or you can specify that there is no outside connection to any ports except for the mail port and WEB port (80). The port settings are configured by the system administrator.

In a regular LoadRunner scenario (not over the firewall), the Controller has direct access to the LoadRunner agents running on remote machines. This enables the Controller to connect directly to those machines. However, when running Vusers or monitoring servers over the firewall, this direct connection is blocked due to the firewall. The connection cannot be initiated by the Controller, because it does not have permissions to make an opening in the firewall.
Configure your system according to one of the following configurations to run Vusers or monitor servers over the firewall. Note that these configurations contain a firewall on each LAN. There may also be configurations where there is a firewall only for LAN1:

During installation, the LoadRunner agent is added either as a Windows service or as an executable run from the Startup folder. The MI Listener component serves as a router between the Controller and the LoadRunner agent.

In the above configuration, the MI Listener is on a different machine than the Controller. Every LoadRunner agent can behave as a MI Listener, so you
can use the Controller machine as the MI Listener also, and you do not need a separate installation.

**TCP Configuration**

The TCP configuration requires every LoadRunner agent machine behind the FireWall 1 to be allowed to open a port in the firewall for outgoing communication. If this is the firewall configuration at hand, use the TCP configuration.

**HTTPS Configuration**

In the HTTPS configuration, only one machine (the proxy server) is allowed to open a port in the firewall. Therefore it is necessary to tunnel all outgoing communications through the proxy server.

After installation, you configure the LoadRunner agent to operate over the firewall. You also modify firewall settings to enable communication between the agent machine(s) inside the firewall and machines outside the firewall. In addition, you prepare the Controller to work over the firewall.

Refer to Chapter 17, “Monitoring over a Firewall” for additional information about configuring LoadRunner to monitor servers from outside the firewall.

**Overview of Running or Monitoring over the Firewall**

To prepare for running Vusers or monitoring servers over the firewall, perform the following steps:

1. **Make sure that the LoadRunner agent is installed on the machines running Vusers, or on the servers to be monitored behind the firewall.**

   The agents can run on Windows or Unix machines. See the diagram, “About Using Firewalls in LoadRunner,” on page 191.

2. **Configure the LoadRunner agent to operate over the firewall.**

   Configure the LoadRunner agent on the machines running Vusers, or agents acting as mediators for the servers to be monitored. See “Configuring the LoadRunner Agents in LAN1,” on page 194 for instructions.
3 Configure the firewall(s).

Configure the firewall, to allow communication between the agents inside the firewall, and the machines outside the firewall. See “Configuring the Firewall to Allow Agent Access” on page 202.

4 Install the Monitoring over Firewall Component.

To monitor a server over the firewall, install this component on the machine which sits inside the firewall, and acts as a mediator between the Controller, and the monitored server. See the diagram, “About Using Firewalls in LoadRunner,” on page 191 for information about where to install the Monitoring over the Firewall component, and refer to the Installing LoadRunner guide for installation instructions.

5 Install the MI Listener on a machine outside the firewall.

See the diagram, “About Using Firewalls in LoadRunner,” on page 191 for information about where to install the MI Listener, and refer to the Installing LoadRunner guide for installation instructions.

6 Configure the MI Listener machines.

Configure the security attributes on each MI Listener machine. See “Installing and Configuring the MI_Listener in LAN2,” on page 203.

7 Configure the Controller machine.

Configure the Controller machine to recognize the agent and MI Listener machines. See “Configuring the Controller to Run Vusers or Monitor over the Firewall,” on page 204.

Configuring the LoadRunner Agents in LAN1

The machines within LAN1 can either be Load Generator machines running Vusers, or mediator machines connected to the servers to be monitored by the Controller. You configure the LoadRunner agents in LAN1 to operate over firewall. The Controller machine resides outside the firewall, and LAN1 is inside the firewall.
Configuring and Running the Windows LoadRunner Agent

To configure the LoadRunner agents on Windows machines:

1. Stop the LoadRunner agent by right-clicking its icon in the system tray and selecting Close.

2. Select Agent Settings from Start > Programs > LoadRunner > Advanced Settings (or open `<LR root>/launch_service/dat/br_inch_server.cfg` in a text editor).

3. In the Firewall section set `FireWallServiceActive` to 1, and save your changes.

4. Run Agent Configuration from Start > Programs > LoadRunner > Advanced Settings, or run `<LR>/launch_service/bin/AgentConfig.exe`.

5. Set each option as described in “Agent Configuration Settings” on page 200.

6. Click OK to save your changes, Cancel to cancel them, or Use Defaults.

7. Restart the LoadRunner agent by double-clicking the shortcut on the desktop, or from Start > Programs > LoadRunner > LoadRunner Agent Service/Process.
Configuring and Running the UNIX LoadRunner Agent

To configure the LoadRunner agents on UNIX machines:

1 Open `<LoadRunner root folder>/dat/br_Inch_server.cfg` in a text editor.

2 In the Firewall section, set `FireWallServiceActive` to 1 and save your changes.

3 Run `agent_config` from the `<LoadRunner root folder>/bin` directory to display the following menu:

   ![Menu](image)

   Menu:
   1. Show current settings.
   2. Change a setting.
   3. Save changes and exit.
   4. Exit without saving.
   5. Use default values.

4 Enter 1 to display the current settings:

   ![Settings](image)

   Settings:
   1. HI Listener Name =
   2. Local Machine Key =
   3. Connection Timeout (seconds) = 20
   4. Connection Type = TCP
   5. Use Secure Connection (SSL) = False
   6. Check Server Certificates = False
   7. Client Certificate Owner = False
   8. Private Key User Name =
   9. Private Key Password =
   10. Proxy Name =
   11. Proxy Port =
   12. Proxy User Name =
   13. Proxy Password =
   14. Proxy Domain =

   Menu:
   1. Show current settings.
   2. Change a setting.
   3. Save changes and exit.
   4. Exit without saving.
   5. Use default values.
To change a setting, enter 2 to display the settings menu:

```
Settings:
1. MI Listener Name =
2. Local Machine Key =
3. Connection Timeout (seconds) = 20
4. Connection Type = TCP
5. Use Secure Connection (SSL) = False
6. Check Server Certificates = False
7. Client Certificate Owner = False
8. Private Key User Name =
9. Private Key Password =
10. Proxy Name =
11. Proxy Port =
12. Proxy User Name =
13. Proxy Password =
14. Proxy Domain =
```

Enter the setting and continue according to the menu instructions. Set each option according to the “Agent Configuration Settings” on page 200.

**Examples of Changing Agent Settings in Unix**

To change the MI Listener Name:

1. Enter 1 in the Settings menu to display the following screen:

```
MI Listener Name - The name, full name or IP address of the redirection server.
Old value =
Enter new MI Listener Name.
```

Line one is a description of the setting. Line two shows the current value of the setting.

2. Enter the new value, (For example, 'bunji') to display the following:

```
MI Listener Name - The name, full name or IP address of the redirection server.
Old value =
Enter new MI Listener Name.
'bunji'
Change MI Listener Name from "" to "bunji"? 1.OK 2.CANCEL 3.RTX
```

197
To keep the new value and return to the menu, enter '1'.
To discard the new value and return to the menu, enter '2'.
To discard the new value and change the setting once more, enter '3'.

To change the Connection Type:

1. Enter 4 in the Settings menu to display the following screen:

   ![Connection Type Settings]

   Line one is a description of the setting. Line two shows the current value of the setting.

2. Enter 1 to set the connection type to TCP, or enter 2 to set it to HTTP and display the following:

   ![Change Connection Type]

3. To keep the new value and return to the menu, enter '1'.
To discard the new value and return to the menu, enter '2'.

198
Chapter 15 • Working with Firewalls

**Viewing the Settings and Restarting the Agent**

To view the current settings:

1. Return to the main menu by entering 1.
2. Enter 1 to display the settings. The following example includes the new settings for MI Listener Name and Connection Type:

```
Settings:
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MI Listener Name = bunji</td>
</tr>
<tr>
<td>2</td>
<td>Local Machine Key = qumhi</td>
</tr>
<tr>
<td>3</td>
<td>Connection Timeout (seconds) = 20</td>
</tr>
<tr>
<td>4</td>
<td>Connection Type = HTTP</td>
</tr>
<tr>
<td>5</td>
<td>Use Secure Connection (SSL) = False</td>
</tr>
<tr>
<td>6</td>
<td>Check Server Certificates = False</td>
</tr>
<tr>
<td>7</td>
<td>Client Certificate Owner = False</td>
</tr>
<tr>
<td>8</td>
<td>Private Key User Name =</td>
</tr>
<tr>
<td>9</td>
<td>Private Key Password =</td>
</tr>
<tr>
<td>10</td>
<td>Proxy Name =</td>
</tr>
<tr>
<td>11</td>
<td>Proxy Port =</td>
</tr>
<tr>
<td>12</td>
<td>Proxy User Name =</td>
</tr>
<tr>
<td>13</td>
<td>Proxy Password =</td>
</tr>
<tr>
<td>14</td>
<td>Proxy Domain =</td>
</tr>
</tbody>
</table>
```

Menu:
1. Show current settings.
2. Change a setting.
3. Save changes and exit.
4. Exit without saving.
5. Use default values.

3. To save your changes, enter 3 from the main menu.

To cancel your changes, enter 4.

To use the default values supplied by LoadRunner (as described in “Agent Configuration Settings,” on page 200), enter 5.
To start or remove the LoadRunner agent:

1. To start the LoadRunner agent, run the command ‘m_daemon_setup -install’ from the <LoadRunner root folder>/bin directory.

2. To remove the LoadRunner agent, run the command ‘m_daemon_setup -remove’ from the <LoadRunner root folder>/bin directory.

For more information about running the LoadRunner agent, refer to “UNIX Shell” in Appendix D, “Troubleshooting the Controller.”

**Agent Configuration Settings**

<table>
<thead>
<tr>
<th>Option</th>
<th>Default Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MI Listener name</td>
<td>none</td>
<td>The name, full name or IP address of the Mercury Interactive listener machine, MI Listener.</td>
</tr>
<tr>
<td>Local Machine Key</td>
<td>none</td>
<td>A string identifier used to establish a unique connection between the Controller host and the agent machine, via the MI Listener machine.</td>
</tr>
<tr>
<td>Connection Timeout</td>
<td>20 seconds</td>
<td>The length of time you want the agent to wait before retrying to connect to the MI Listener machine. If zero, the connection is kept open from the time the agent is run.</td>
</tr>
<tr>
<td>Connection Type</td>
<td>TCP</td>
<td>Choose either TCP (default) or HTTP, depending on the configuration you are using.</td>
</tr>
<tr>
<td>Use Secure Connection</td>
<td>False</td>
<td>Choose True to connect using the Secure Sockets Layer protocol.</td>
</tr>
</tbody>
</table>
### Chapter 15 • Working with Firewalls

<table>
<thead>
<tr>
<th>Option</th>
<th>Default Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Check Server Certificates</strong></td>
<td>False</td>
<td>Choose True to authenticate SSL certificates that are sent by servers. This option is relevant only if the <strong>Use Secure Connection</strong> option is set to True.</td>
</tr>
<tr>
<td><strong>Client Certificate Owner</strong></td>
<td>False</td>
<td>Choose True to load the SSL certificate. In some cases the server requests a certificate to allow the connection to be made. This option is relevant only if the <strong>Use Secure Connection</strong> option is set to True.</td>
</tr>
<tr>
<td><strong>Private Key User Name</strong></td>
<td>None</td>
<td>The user name that may be required during the SSL certificate authentication process. This option is relevant only if the <strong>Client Certificate Owner</strong> option is set to True.</td>
</tr>
<tr>
<td><strong>Private Key Password</strong></td>
<td>None</td>
<td>The password that may be required during the SSL certificate authentication process. This option is relevant only if the <strong>Client Certificate Owner</strong> option is set to True.</td>
</tr>
<tr>
<td><strong>Proxy Name</strong></td>
<td>&lt;IE proxy server name&gt; or None</td>
<td>The name of the proxy server. This option is mandatory if the <strong>Connection Type</strong> option is set to HTTP.</td>
</tr>
<tr>
<td><strong>Proxy Port</strong></td>
<td>&lt;IE proxy server port&gt; or None</td>
<td>The proxy server connection port. This option is mandatory if the <strong>Connection Type</strong> option is set to HTTP.</td>
</tr>
<tr>
<td><strong>Proxy User Name</strong></td>
<td>None</td>
<td>The username of a user with connection rights to the proxy server.</td>
</tr>
</tbody>
</table>
### Configuring the Firewall to Allow Agent Access

You modify your firewall settings to enable communication between the machine(s) inside the firewall and machines outside the firewall.

**TCP configuration:**

The LoadRunner agent tries to establish a connection with MI Listener using port 443 at an interval of seconds specified in the Connection Timeout field in the agent configuration. To enable this connection, allow an outgoing connection for HTTPS service on the FireWall for port 443. As a result, the agent connects to MI Listener and MI Listener connects back to the agent. From this point on, the agent listens to commands from the MI Listener.

**HTTPS configuration:**

The LoadRunner agent tries to establish a connection with MI Listener using the proxy port specified in the Proxy Port field and at an interval of seconds specified in the Connection Timeout field in the agent configuration. On successful connection, the proxy server connects to MI Listener. To enable this connection, allow an outgoing connection for HTTPS service on the FireWall for port 443. As a result, the proxy server connects to MI Listener and MI Listener connects back to the agent through the proxy server. From this point on, the agent listens to commands from the MI Listener.

---

<table>
<thead>
<tr>
<th>Option</th>
<th>Default Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proxy Password</td>
<td>None</td>
<td>The user's password.</td>
</tr>
<tr>
<td>Proxy Domain</td>
<td>None</td>
<td>The user's domain if defined in the proxy server configuration. This option is required only if NTLM is used.</td>
</tr>
</tbody>
</table>
Installing and Configuring the MI Listener in LAN2

To enable running Vusers or monitoring over a firewall, you need to install MI Listener on one or more machines in your LAN2. For instructions, refer to the Installing LoadRunner guide.

To configure the MI Listener:

1. Open incoming HTTPS service for port 443.
2. Stop the LoadRunner agent by right-clicking its icon in the system tray and selecting Close from the popup menu.
3. Run MI Listener Configuration from Start > Programs > LoadRunner > Advanced Settings, or run <LR_root_dir>\launch_service\bin\MILsnConfig.exe.
4. Set each option as described in “MI Listener Configuration Settings,” on page 204.
5. Click OK to save your changes, Cancel to cancel them, or Use Defaults.
6. Restart the LoadRunner agent by double-clicking the shortcut on the desktop, or running it from Start > Programs > LoadRunner.
7. Make sure that port 433 is free on the MI Listener machine.
**MI Listener Configuration Settings**

<table>
<thead>
<tr>
<th>Option</th>
<th>Default Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check Client Certificates</td>
<td>False</td>
<td>Choose True to request that the client send an SSL certificate when connecting, and to authenticate the certificate.</td>
</tr>
<tr>
<td>Private Key User Name</td>
<td>None</td>
<td>The user name that may be required during the SSL certificate authentication process.</td>
</tr>
<tr>
<td>Private Key Password</td>
<td>None</td>
<td>The password that may be required during the SSL certificate authentication process.</td>
</tr>
</tbody>
</table>

**Configuring the Controller to Run Vusers or Monitor over the Firewall**

In order to obtain information for the monitors configured inside the firewall, or to run Vusers inside the firewall, you create a unique connection between the Controller and the agent machine, via the Mercury Interactive listener machine, MI Listener. You establish this connection by defining the agent machine as a load generator.

**To configure the Controller for running vusers or monitoring over the firewall:**

1. Run the Controller from Start > Programs > LoadRunner and create a new scenario, or load an existing one.
2. Click **Generators** to display the Load Generators window. In the Name field, enter the symbolic name of the server. This is the same name that you entered in the Local Machine Key setting in the Agent Configuration. In the example below, the server name is *gumbi*. 
If the server is a UNIX server, change the Platform field to UNIX.

3 Select the Load Generator, and click **Details** to display the Load Generator Information.
4 In the Firewall tab, enter the MI Listener machine’s name in the **MI Listener** field. This is the same name that you entered in the Agent Configuration, in the **MI Listener Name** setting.

5 To run Vusers over the Firewall, select the **Enable running Vusers over Firewall** option.

6 To monitor over the firewall, select the **Enable Monitoring over Firewall** option.

7 Click **OK** to return to the Load Generators dialog box.

8 Select the Load Generator and click **Connect**.

---

**Note:** Remember that you cannot change the temporary directory on the host running Vusers over the firewall or monitoring over the firewall.
Part IV

Monitoring a Scenario
You can monitor scenario execution using the LoadRunner online run-time, transaction, Web resource, system resource, network delay, firewall server resource, Web server resource, Web application server resource, database server resource, streaming media resource, ERP server resource, and Java performance monitors.

The specific monitors are discussed in the next few chapters. This chapter describes the online monitor user interface:

➤ Starting the Monitors
➤ Opening Online Monitor Graphs
➤ Customizing the Graph Display View
➤ Configuring Online Monitors
➤ Setting Monitor Options
➤ Configuring Online Graphs
➤ Merging Graphs
➤ Understanding Online Monitor Graphs
➤ Configuring Online Measurements
➤ Exporting Online Monitor Graphs
➤ Viewing Data Offline
About Online Monitoring

LoadRunner provides the following online monitors:

The **Run-Time** monitor displays the number and status of Vusers participating in the scenario, as well as the number and types of errors that the Vusers generate. It also provides the User-Defined Data Point graph that displays the real-time values for user-defined points in a Vuser script.

The **Transaction** monitor displays the transaction rate and response time during scenario execution. For more information, see Chapter 19, “Run-Time and Transaction Monitoring.”

The **Web Resource** monitor measures statistics at the Web server(s) during scenario runs. It provides information about the number of Web connections, throughput volume, HTTP responses, server retries, and downloaded pages during the scenario. For more information on the Web Resource monitor, see Chapter 20, “Web Resource Monitoring.”

The **System Resource** monitors gauge the Windows, UNIX, TUXEDO, SNMP, and Antara FlameThrower resources used during a scenario. To activate the System Resource monitors, you must set the monitor options before you run your scenario. For information on setting these options, see Chapter 21, “System Resource Monitoring.”

The **Network Delay** monitor displays information about the network delays on your system. To activate the Network Delay monitor, you must set up the network paths to monitor before you run your scenario. For more information see Chapter 22, “Network Monitoring.”

The **Firewall** monitor measures statistics at the firewall servers during the scenario. To activate the Firewall monitor, you must set up a list of resources to monitor before you run your scenario. For more information, see Chapter 23, “Firewall Server Performance Monitoring.”

The **Web Server Resource** monitors measure statistics at the Apache, Microsoft IIS, iPlanet (SNMP) and iPlanet/Netscape Web servers during the scenario. To activate the Web Server Resource monitors, you must set up a list of resources to monitor before you run your scenario. For more information, see Chapter 24, “Web Server Resource Monitoring.”
Chapter 16 • Online Monitoring

The **Web Application Server Resource** monitors measure statistics at the Web application server(s) during the scenario. To activate the Web Application Server Resource monitors, you must set up a list of resources to monitor before you run your scenario. For more information, see Chapter 25, “Web Application Server Resource Monitoring.”

The **Database Server Resource** monitors measure statistics related to the SQL server, Oracle, Sybase, and DB2 databases. To activate the Database Server Resource monitors, you must set up a list of measurements to monitor before you run your scenario. For more information, see Chapter 26, “Database Resource Monitoring.”

The **Streaming Media** monitors measure statistics at the Windows Media Server and RealPlayer audio/video servers, as well as the RealPlayer client. To activate the Streaming Media monitors, you must set up a list of resources to monitor before you run your scenario. For more information, see Chapter 27, “Streaming Media Monitoring.”

The **ERP Server Resource** monitor measures statistics at the ERP servers during the scenario. To activate the ERP Server Resource monitor, you must set up a list of resources to monitor before you run your scenario. For more information, see Chapter 28, “ERP Server Resource Monitoring.”

The **Java Performance** monitors measure statistics of Enterprise Java Bean (EJB) objects and Java-based applications, using EJB, JProbe, Sitraka JMonitor, and TowerJ Java virtual machines. To activate the Java Performance monitors, you must set up lists of resources to monitor before you run your scenario. For more information, see Chapter 29, “Java Performance Monitoring.”
All of the monitors allow you to view a summary of the collected data at the conclusion of the scenario. Using LoadRunner Analysis, you can generate a graph for any of the monitors. For more information, see the *LoadRunner Analysis User’s Guide*.

---

**Note:** For a detailed list of LoadRunner’s monitors, see Mercury Interactive’s Web site (http://www-heva.mercuryinteractive.com/resources/library/technical/loadtesting_monitors/supported.html).

---

**Starting the Monitors**

You use the online monitors to monitor Vuser status, errors, transactions, system resources, Web resources, network delay, firewall server resources, Web server resources, Web application server resources, database server resources, streaming media resources, ERP server resources, and Java performance.

**To start the online monitors:**

1. Start the scenario. Select the Vuser groups you want to run and click the **Start Scenario** button, or choose **Scenario > Start**.
2 Click the Run tab. The default graphs are displayed below the Scenario Groups window.

3 Double-click a graph to maximize it. Repeat the operation to restore the tiled view.

4 If the graph tree is not displayed, select View > Show Available Graphs. Click the "+" in the left pane to expand the graph tree. To hide the graph tree view, select View > Hide Available Graphs, or click the X button in the right-hand corner of the Available Graphs list.

5 Select a graph from the tree and drag it into the right pane. You can also drag graphs between panes.
Note: The Transaction Monitor graphs will not contain any data unless transactions are being executed. In addition, the System Resource, Network, Firewall, Web Server, Web Application Server, Database, Streaming Media, ERP Resource, and Java Performance graphs will not contain any data unless you set up a list of resources to monitor before running your scenario.

Opening Online Monitor Graphs

By default, LoadRunner displays four graphs in the Run view: Running Vusers, Transaction Response Time, Hits per Second, and Windows Resources. You can display the other graphs by clicking and dragging them from the graph tree view to the graph view area. Alternatively, you can open a new graph using the Open a New Graph dialog box.
To open a new graph using the Open a New Graph dialog box:

1. Select Monitors > Online Graphs > Add New Graph, or right-click a graph and select Open a New Graph. The Open a New Graph dialog box opens.

2. Click the "+" in the left pane to expand the graph tree, and select a graph. You can view a description of the graph in the Graph Description box.

3. Click Open Graph. The graph appears in the graph view area.
Customizing the Graph Display View

LoadRunner lets you display up to 16 online monitor graphs simultaneously.

To customize your online graph display:
Click View > View Graphs and select the number of graphs you want to view. You can choose from Show One Graph, Show Two Graphs, Show Four Graphs, Show Eight Graphs, or Custom Number. If you select Custom Number, enter the number of graphs you want to view in the View Graphs dialog box, and click OK. The number of graphs selected open in the graph view area.

To display only one graph, double-click the graph pane. To return to the previous view, double-click the graph again.

Configuring Online Monitors

LoadRunner lets you configure the settings for your online monitors. You can set graph measurements and properties, such as the sampling time, the colors of the lines, and the scale of the graph.

Monitor options: global sampling rate, error handling, debugging, and the frequency settings. For more information, see “Setting Monitor Options” on page 217.

Graph properties: refresh rate, display type, graph time for the x-axis, and the y-axis scale. For more information, see “Configuring Online Graphs” on page 219.

Measurement settings: line color, scale of the y-axis, and whether to show or hide the line. For more information, see “Configuring Online Measurements” on page 225.

When you save a scenario, the online monitor configuration settings are saved as well.
Setting Monitor Options

Before running your scenario, you can set monitor options in the following areas:

➤ **Sampling Rate**: The sampling rate is the period of time (in seconds) between consecutive samples. By default, the online monitor samples the data at intervals of three seconds. If you increase the sampling rate, the data is monitored less frequently. This setting applies to all graphs. To set a sampling rate for a specific graph, see “Configuring Online Graphs” on page 219.

The sampling rate you set is applied to all server monitors that you subsequently activate. It is not applied to server monitors that have already been activated. To apply the new sampling rate to activated server monitors, save your scenario and reopen it.

---

**Note**: Each monitor has a different minimum sampling rate. If the default sampling rate, or the rate set in the Options Monitors tab is less than a monitor’s minimum sampling rate, the monitor will sample data at its minimum sampling rate. For example, the minimum sampling rate for the Oracle Monitor is 10 seconds. If the sampling rate in the Options Monitors tab is set at less than 10 seconds, the Oracle Monitor will continue to monitor data at 10 second intervals.

---

➤ **Error Handling**: You indicate how LoadRunner should behave when a monitor error occurs—issue a popup message box (default) or send error messages to the Output window.

➤ **Debug**: The online monitor provides debugging capabilities. You can display the debug messages in the output log. For the Network monitor, you can indicate the debug (detail) level of messages sent to the log, ranging from 1-9.

➤ **Frequency**: You set the frequency at which the monitor sends updates to the Controller for the Transaction, Data Point, and Web Resource graphs. The data is averaged for the frequency period defined, and only one value is sent to the Controller.
For information on enabling and disabling the Transaction monitor and Web page breakdown, see Chapter 19, “Run-Time and Transaction Monitoring.”

**To set monitor options:**

1. **Select Tools > Options and select the Monitors tab.**

2. Specify the frequency at which the monitor should send updates to the Controller for the Transaction, Data Point, and Web Resource graphs. The default value is 5 seconds. For a small scenario, it is recommended that you use a frequency of 1. For a large scenario, it is recommended that you use a frequency of 3-5. The higher the frequency, the less network traffic there will be.

   **Note:** You cannot modify these settings during scenario execution; you must stop the scenario before disabling the monitor or changing its frequency.

3. Enter a sampling rate.
Set the desired Error Handling option.

To display debug messages in the Output window, select the Display Debug Messages check box. For the Network monitor, specify a Debug level from 1-9.

Click OK to save your settings and close the Options dialog box.

You can configure an additional monitor setting while working in Expert mode. For information on working in Expert mode, see Appendix C, “Working in Expert Mode.”

Configuring Online Graphs

You can customize your graph in the following areas:

➤ Refresh Rate
➤ X-Axis Style
➤ Graph Time
➤ Display Type
➤ Y-Axis Style
➤ Network Delay View

Note that these settings can be set globally—to apply to all graphs—or per graph.

Refresh Rate

The refresh rate is the interval in which the graph is refreshed with new data. By default, the graph is refreshed every five seconds. If you increase the refresh rate, the data is refreshed less frequently.

Note: In a large load test, it is recommended to use a refresh rate of three to five seconds. This enables you to avoid problems with CPU resource usage.
**X-Axis Style**

You can specify how the graph displays the x-axis time: *Don’t Show*, *Clock Time*, or *Relative to Scenario Start*. The *Don’t Show* setting instructs LoadRunner not to display values for the x-axis. The *Clock Time* setting displays the absolute time, based on the system clock. The *Relative to Scenario Start* setting displays the time relative to the beginning of the scenario. In the following example, the graph is shown with the *Don’t Show* and *Clock Time* options:

**Graph Time**

The Graph Time settings indicate the scale for a graph’s x-axis when it is time-based. A graph can show 60 or 3600 seconds of activity. To see the graph in greater detail, decrease the graph time. To view the performance over a longer period of time, increase the graph time. The available graph times are: *Whole Scenario*, 60, 180, 600, and 3600 seconds.

**Display Type**

You can specify whether LoadRunner displays the Network Delay Time graph as a line, pie, or area graph. By default, the graph is displayed as a line graph. Note that all other graphs can only be displayed as line graphs.

**Y-Axis Style**

You can instruct LoadRunner to display graphs using the default y-axis scale, or you can specify a different y-axis scale. Click *Automatic* if you want
Chapter 16 • Online Monitoring

LoadRunner to use the default y-axis values. Specify a maximum or minimum value for the y-axis if you want to modify the y-axis scale.

**Network Delay View**

This option only appears when you configure the Network Delay Time graph. Click **SubPaths** to view the delay measurements from the source machine to each of the nodes along the network path. Click **DNS name** to view the DNS names of the measurements displayed in the legend.

**To customize your graphs:**

1. Select the online graph you want to configure (in either the right or left pane) and choose **Monitors > Online Graphs > Configure**. Alternatively, right-click a graph and select **Configure**. The Graph Configuration dialog box opens.

![Graph Configuration dialog box](image)

- **Refresh rate (sec):** Specify the refresh rate in seconds.
- **Time:** Choose the time relative to the scenario start or run time.
- **Graph Time (sec):** Select the graph time duration.
- **Display Type:** Choose between Line and Bar.
- **Bar Values Type:** Choose between Average, Maximum, and Minimum.

**Y Axis Scale**

- **Automatic** option to scale the y-axis automatically.
- **Maximum Y-Axis Value** and **Minimum Y-Axis Value** fields to set custom y-axis limits.

**Apply to selected graph** or **Apply to all graphs** option to apply the configuration to selected or all graphs.
2 To apply the dialog box settings to all graphs, select **Apply to all graphs**.

3 Enter the desired refresh rate—the time between graph updates—in the Refresh Rate box.

4 Select a style for the x-axis from the Time box.

5 Select a value from the Graph Time box. The graph time is the time in seconds displayed by the x-axis.

6 For the Network Delay Time graph, select a graph style-Line, Pie, or Area-from the Display Type box.

7 If the selected display type is Bar, choose a value from the Bar Values Type box. This determines the type of value that will be displayed in the bar graph. You can choose between **Average**, **Last Value**, **Minimum** and **Maximum**.

8 Select a maximum or minimum value for the y-axis, or choose **Automatic** to view graphs using the default y-axis scale.

9 Click **OK** to save your settings and close the Graph Configuration dialog box.
Merging Graphs

LoadRunner lets you merge the results of two graphs from the same scenario into a single graph. The merging allows you to compare several different measurements at once. For example, you can make a merged graph to display the Web Throughput and Hits per Second, as a function of the elapsed time. Note that in order to merge graphs, their x-axis must be the same measurement.

When you overlay the contents of two graphs that share a common x-axis, the left y-axis on the merged graph shows the current graph’s values. The right y-axis shows the values of the graph that was merged.

To overlay two graphs:

1 Right-click one of the graphs you want to overlay, and select Overlay Graphs. The Overlay Graphs dialog box opens.

2 Select a graph with which you want to overlay the current graph. The drop-down list only shows the active graphs that have a common x-axis with the current graph.

3 Enter a title for the overlaid graph.

4 Click OK. The merged graph appears in the graph view area.
Understanding Online Monitor Graphs

Online monitor graphs display information about the measurements listed below the graph. Each value is represented by a colored line. A legend beneath the graph indicates the color and measurement.

By default, the online monitor displays each measurement in a scenario in the legend below the graphs. The legend displays the measurements for the selected graph.
Chapter 16 • Online Monitoring

Note: In a goal-oriented scenario, the goal you defined is also displayed in the appropriate graph.

To get additional information about a measurement, right-click the measurement and choose Description.

To focus on a particular line, you can:

➤ **Highlight a measurement**: To highlight a specific measurement, select it in the legend. The corresponding line in the graph is displayed in blue.

➤ **Hide a measurement**: To hide a measurement, right-click the measurement and choose Hide.

To show a hidden measurement, right-click the measurement and choose Show.

➤ **Pause the monitor**: To pause a specific graph during scenario execution, select the graph and choose Monitors > Online Graph > Freeze, or right-click the graph and select Freeze. To resume, repeat one of the above actions. When you resume, the graph displays the data for the paused period.

**Configuring Online Measurements**

You can configure the following online measurement settings:

➤ Changing Line Colors

➤ Setting the Scale of the Measurement

➤ Showing and Hiding Transactions

**Changing Line Colors**

LoadRunner assigns a unique color to each measurement. You can modify the color using the configuration interface.
Setting the Scale of the Measurement

You can modify the scale of a measurement—the relationship between the y-axis and the graph’s actual value. For example, a scale set at 1 indicates that the measurement’s value is the value of the y-axis. If you choose a scale of 10, you must divide the y-axis value by 10 to obtain the true value of the measurement.

In the following example, the same graph is displayed with a scale of 1 and 10.

The actual graph values range from 0-1, as shown in the left graph. You can view the information more accurately using a larger scale for the display, as shown in the right graph. However, to obtain the actual values, you need to divide the displayed value by the scale. In the example above, the highest value shown in the graph is 5. Since the scale is 10, the actual value is 0.5.

The legend below the graph indicates the scale factor.

By default, LoadRunner uses the *autoscale* option, which automatically scales the measurements by calculating the best ratio for displaying the graph.
Chapter 16 • Online Monitoring

Showing and Hiding Transactions

By default, the Transaction Monitor displays a line for each item in the transaction list. You can hide the line for any of the monitored transactions in order to focus on a specific measurement.

In the following example, a line is shown for each measurement.

In this example, the second item in the legend is hidden.
To configure a measurement:

1. In the legend below the graphs, select the measurement you want to configure. Right-click and choose **Configure**. The Measurement Configuration dialog box opens.

![Measurement Configuration Dialog Box]

2. To change the color of the line, select a color from the Color list.

3. To change the scale, clear the **Autoscale** check box and select the desired ratio from the Scale list.

4. To hide a measurement, click **Hide**. To show a hidden resource, click **Show**.

   Note that you can also show and hide measurements without opening the Measurement Configuration dialog box, by right-clicking a measurement in the legend and selecting **Show/Hide**.

5. Click **OK** to accept the settings and close the dialog box.
The specified changes are reflected in the graph and in the legend beneath the graph. The color is displayed in the first column of the legend. Hidden transactions are displayed as unfilled boxes. The scale is displayed in the legend's second column.

### Exporting Online Monitor Graphs

LoadRunner allows you to export the online graph to HTML for viewing at a later stage. When you export to HTML, the legend is also displayed with the graph. You can export all graphs or only the selected one.

**To export online graphs to HTML:**

1. To export a specific graph, select the graph you want to export and choose Monitors > Online Graphs > Export to HTML. The Select Filename and Path dialog box opens.

2. To export all graphs in the Online Monitor view, choose Monitors > Export Online Graphs to HTML. The Select Filename and Path dialog box opens.

3. Specify a filename and path and click Save.

### Viewing Data Offline

After monitoring resources during a scenario run, you can view a graph of the data that was gathered using the LoadRunner Analysis. When you run the Analysis utility, it processes the data and generates a graph for each measurement that was monitored.

To view a graph, choose Graph > Add Graph in the Analysis window. For more information about working with the LoadRunner Analysis at the conclusion of the scenario, see the LoadRunner Analysis User's Guide.
Monitoring over a Firewall

To enable monitoring of your servers from outside the firewall, *Monitors over Firewall* is installed on designated machines inside the firewall. The installation sets up the Server Monitor mediator (referred to as the “mediator” in this chapter) as well as the Server Monitor configuration tool. You then configure the servers to monitor, and define the specific measurements that LoadRunner collects for each monitored server.

This chapter describes:

➤ Installing Monitors over Firewall
➤ Installing MI_Listener
➤ Preparing for Data Collection
➤ Configuring Server Monitor Properties
➤ Adding and Removing Measurements
➤ Configuring Measurement Frequency
➤ Configuring the Network Delay Monitor over a Firewall
About Monitoring over the Firewall

Once you set up your environment, as described in Chapter 15, “Working with Firewalls,” and install the Monitoring over Firewall component, as described in “Installing Monitors over Firewall,” on page 232, continue with the steps below:

1 Prepare for data collection.
   Check that you can obtain information for the monitors configured inside the firewall. Refer to “Preparing for Data Collection,” on page 237.

2 Configure server monitor properties.
   Refer to “Configuring Server Monitor Properties,” on page 238.

3 Add and remove measurements.
   Add measurements to monitor for each server. If LoadRunner added default measurements, you can edit them as required. Refer to “Adding and Removing Measurements,” on page 240.

4 Configure measurement frequencies.
   Set a measurement schedule for each measurement to be reported. Refer to “Configuring Measurement Frequency,” on page 241.

Installing Monitors over Firewall

Monitors over Firewall may have been installed during LoadRunner installation. To check whether it was installed, click Start > Programs > LoadRunner > Advanced Settings. If the Monitor Configuration option appears on the list of LoadRunner options, then Monitors over Firewall was already installed, and you can proceed to “Installing MI_Listener” on page 237.

If Monitors over Firewall was not yet installed, you need to install it using one of the following:

- Perform a custom installation of LoadRunner from the LoadRunner CD, choosing only the Monitors over Firewall option. For instructions on performing a custom installation of LoadRunner, refer to the Installing LoadRunner guide.
To install Monitors over Firewall from the Mercury Interactive Customer Support Web site:

1 Copy the self-extracting installer file to the mediator machine.

2 Double-click the installer file to begin installation. The software license agreement appears. Read the agreement, and click Yes to accept it. If you click No, Setup closes.
3 In the Choose Destination Location screen, specify the folder in which to install the add-in. To select a different location, click **Browse**, choose a folder, and click **OK**.

Click **Next**.
4 In the Select Program Folder screen, specify a program folder, or accept the default folder, *Server Monitor*.

Click **Next**.
In the Start Copying Files screen, review your settings. To make changes, click **Back**.

Click **Next**.

The installation process begins. To quit the installation, click **Cancel**.
Chapter 17 • Monitoring over a Firewall

7 Setup completes the installation process. The Setup Complete screen prompts you to restart your computer. You can delay restarting your computer until a later point, however, you must restart your computer before you use LoadRunner Server Monitors.

Click Finish to complete the setup process.

Installing MI_Listener

To enable monitoring over a firewall, you need to install MI Listener on one or more machines in the same LAN as the Controller machine. Note that the Controller installation automatically includes the MI Listener, so you can designate the Controller as the MI Listener machine. For instructions, refer to the Installing LoadRunner guide.

Preparing for Data Collection

In order to obtain information for the monitors configured inside the firewall, you must create a unique connection between the Controller and the mediator machine, via the Mercury Interactive listener machine, MI Listener. You establish this connection by defining the mediator machine as a load generator.

To configure the Controller for data collection:

1 You should already have configured the LoadRunner agent and the Controller to operate over the firewall, as described in Chapter 15, “Working with Firewalls.”

2 Remember that in the Firewall tab of the Load Generator Information dialog box, you should enter the IP address of the MI Listener machine, and check Enable Monitoring over Firewall.

3 Connect to the load generator. Make sure that you obtain information for the monitors configured inside the firewall.
Configuring Server Monitor Properties

The next step is to add the server monitors. You configure server monitor properties (select the server whose resources you want to monitor, and the type of monitors to run), add the measurements to monitor for each server, and specify the frequency with which you want the monitored measurements to be reported.

To enable monitoring over the firewall, you need to configure server monitor properties.

To configure server monitor properties:

1. Select Start > Programs > LoadRunner > Advanced Settings > Monitor Configuration. For machines without the complete LoadRunner installation, select Start > Programs > Server Monitor > Monitor Configuration. The Monitor Configuration dialog box opens.
2 Click the **Add Server** button. The New Monitored Server Properties dialog box opens.

3 In the Monitored Server box, type the name or IP address of the server whose resources you want to monitor.

   **Note:** To add several servers simultaneously, separate the server names or IP ranges with commas. For example: 255.255.255.0-255.255.255.5, server1, server2.

4 From the Available Monitors list, select the monitors appropriate for the server being monitored.

   **Note:** Data can only be viewed for the monitors that are enabled with your LoadRunner license key. To preview your license key information, in the LoadRunner Controller, select **Help > About LoadRunner**.
5 Click OK to close the New Monitored Server Properties dialog box to display the Monitored Servers list.

Note that, for certain monitors, LoadRunner displays default measurements in the right pane. For details on selecting measurements, see “Adding and Removing Measurements” on page 240.

6 To add additional monitored servers to the list, repeat steps 1-5.

7 Click Apply to save your settings.

**Adding and Removing Measurements**

After you configure one or more server machines to monitor, you add measurements to monitor for each server. If LoadRunner added default measurements, you can edit them as required.

**To add a measurement to monitor:**

1 Select a server from the Monitored Servers list.

2 Click the **Add Measurement** button. Select the appropriate monitor. A dialog box opens, enabling you to choose measurements for the monitor you selected.

3 Select the measurements that you want to monitor, and click OK.

4 Click Apply to save your settings.

For information on configuring measurements for each server monitor, see the relevant chapter.

**To remove a measurement from the measurements list:**

1 Select the measurement, and click the **Delete** button.

2 Click Apply to save your settings.
Configuring Measurement Frequency

Once you have configured monitor measurements, you configure measurement frequency.

In the Measurement Properties section, you set a measurement schedule for each measurement to be reported.

To set a measurement schedule for a measurement:

1. Select the configured server measurement you want to schedule.
2. Specify the frequency at which you want LoadRunner to report the measurement.
3. Click Apply to save your settings.

Configuring the Network Delay Monitor over a Firewall

To run the Network Delay Monitor when there are firewalls between the Controller machine and the source machine, you must configure the Network Delay Monitor (see “Configuring the Network Monitor,” on page 308), and add the following to step 3 (on page 309):

In the Monitor the network delay from machine section, enter the server name or IP address of the source machine according to the following format: <MI Listener machine>:<source machine local key>.

where source machine local key is the unique key that you chose when configuring the LoadRunner Agent on the source machine.

For example: 12.12.12.3:vds
Remote Performance Monitoring

Remote performance monitoring enables additional viewers to monitor a LoadRunner scenario from a remote location using a Web browser. This allows a licensed number of participants to simultaneously view the online test results without requiring access to the Controller machine. Each remote viewer is able to select the graphs that he chooses to monitor, and customize the graph settings to suit his needs.

This chapter describes:

➤ Installing the Remote Performance Monitor Server
➤ Connecting to the Remote Performance Monitor
➤ Monitoring Load Test Data
➤ Viewing Online Graphs
➤ Customizing Online Graph Settings

About Remote Performance Monitoring

You can monitor scenario execution and view online results from any browser using LoadRunner’s Remote Performance monitor. The Remote Performance Monitor enables multiple load tests to participate in a scenario run with customized resource monitoring.
During a load test run, the Remote Performance monitor enables you to view graphs that display information about the load the Vusers generate on your server. Online graphs display data about the run, including Vuser status, errors, transaction, Web resource, system resource, network delay, firewall server resource, Web server resource, Web application server resource, database server resource, streaming media resource, ERP server resource, and Java performance monitors.

For more information about the available graphs and monitor measurements, see Chapter 16, “Online Monitoring.”

**Installing the Remote Performance Monitor Server**

To monitor the performance of your servers from a remote location, you need to install the Remote Performance Monitor Server from the LoadRunner Controller 7.6 CD.

**Installation Requirements**

The Remote Performance Monitor Server configures an IIS Web server for the Remote Performance monitor. This requires a machine with the following components installed:

<table>
<thead>
<tr>
<th>IIS Server</th>
<th>4.0; 5.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating system</td>
<td>Windows 2000 Server; Windows 2000 Advanced Server; Windows NT Server</td>
</tr>
<tr>
<td>Client Browser</td>
<td>Internet Explorer 5.0 and later; Netscape 6.2 and later</td>
</tr>
</tbody>
</table>

The IIS Web server communicates with the Controller and the Remote Performance monitor to manage the user’s requests to produce online graphs and graph legends.

For instructions on installing the Remote Performance Monitor Server, refer to the *LoadRunner Controller Installation Guide.*
Connecting to the Remote Performance Monitor

To connect to the LoadRunner Remote Performance monitor, type the following path in your Web browser:
http://[name of IIS Web server machine]/remoteview

The Remote Performance Monitor log on page opens.

To log on to the LoadRunner Remote Performance Monitor:

1 In the **UserID** box, type Admin.
2 In the **Password** box, type Admin.
3 In the **Controller Machine** box, type the name or IP address of the Controller machine you want to access.
4 Click **Login**. The LoadRunner Remote Performance monitor page opens. By default, the left graph is selected, and its measurements are displayed in the measurements legend.

**Note:** If there is no browser activity for 20 minutes, the Remote Performance monitoring session times out. You need to log in again to continue your session.
Monitoring Load Test Data

You monitor load test data during the load test run to get a quick overview of the test’s status and the effects of load on your Web server.

At the top of the Remote Performance monitor page, you can view the status of the test that is currently running.

| Scenario name: Scenario1     | Elapsed Time: 1:01:41 | Controller machine: fiesta |

The Remote Performance monitor page displays the name of the running test, the length of time the test has been running, and the name of the Controller machine.

Viewing Online Graphs

The graphs are tiled to enable you to view five graphs simultaneously: two large graphs and three small graphs. In addition, you can view graph measurements in the legend.

To view graphs during the load test run:

1. To display a graph in the large graph pane, select a graph from the drop-down graph list located above the large graph pane. The page reloads with the selected graph.
Note: Available graphs appear in green in the drop-down graph list. If you select an unavailable graph (black), an empty pane will appear.

2 To display a graph in the small graph pane, or to change any of the graphs displayed on the screen, click the Select button located above the small graphs. The Select Graphs window opens.

3 Choose any of the listed graphs and the corresponding position in which they should be displayed. The diagram at the top shows the numbered positions.

4 Click OK to close the Select Graphs window. The selected graphs appear in the Remote Performance monitor page.
Graph Legend

You can view the measurements of any graph that is displayed in the large graph window. By default, when the remote viewer opens, the left graph is selected (denoted by a highlighted gray border), and its measurements are displayed in the measurements legend.

Note: The measurements of a small graph cannot be displayed in the legend. Therefore, open the resource you want to measure as a large graph.

To view a graph’s legend:

1. Click in the graph pane to select the graph. The graph is highlighted with a gray border, and its measurements are displayed in the legend.

   To view the measurements of two graphs, select both of the large graphs. The legend splits vertically, displaying the measurements of both graphs.

2. The legend displays details about the maximum, average, minimum, and last values for each measurement. To sort the measurements by one of these values, click the column heading (Max, Avg, Min, or Last). An icon is displayed beside the column heading, showing you whether the measurements are sorted in ascending or descending order.

3. To close a graph’s legend, click anywhere in the graph’s pane.
Customizing Online Graph Settings

You can modify the following online graph settings while a load test is running from the Remote Performance monitor:

➤ graph scale
➤ graph refresh rate
➤ graph configuration measurements

The changes to the default settings only apply to the current run and are not saved for future runs of the load test.

Scale Graphs

You can modify the scale of a measurement—the relationship between the y-axis and the graph's actual value. The x-axis represents Elapsed Time and cannot be adjusted. By default, LoadRunner uses the Auto option, which automatically sets the most suitable measurements for displaying the graph.

To scale the large graphs:

1 In the y-axis value section below the large graphs, select Set to, type a value in the box, and click Refresh Graphs. The graph is redrawn with the specified value as the upper limit of the y-axis.

2 To view the graph scaled normally, select Auto and click Refresh Graphs.
To scale the small graphs:

1. Click the Scale button located above the small graphs. The Scale Graphs window opens.

   ![Scale Graphs window]

   You can change the y-axis measurement of the small graphs in positions three, four, and five as shown in the Select Graphs window on page 248.

2. To use a different scale, select Set to, and type a value in the box.

3. To view the graph scaled normally, select Auto.

4. Click OK to close the Scale graphs window. The graph is redrawn with the specified value as the upper limit of the y-axis.

---

**Note:** For more information on graph scale, refer to “Setting the Scale of the Measurement” in Chapter 16, “Online Monitoring.”
**Refresh Rate**

By default, graphs on the Remote Performance monitor page are refreshed every five seconds. You can use the Auto-Refresh option to change the default refresh rate. If you increase the refresh rate, the graphs are refreshed less frequently.

---

**Note:** In a large load test, it is recommended to use a slower refresh rate for the small graphs. This enables you to avoid problems with CPU resource usage.

---

**To modify the default refresh rate:**

1 Click the **Refresh** button located above the small graphs. The Refresh Rate window opens.

![Refresh Rate Window]

By default, the refresh option is enabled to automatically refresh all graphs at 5 second intervals. To disable the auto-refresh option, select the **Do not refresh** check box.

2 Select a frequency for refreshing the large graphs and small graphs.

3 Click **OK** to modify the auto-refresh rates and return to the Load Test Run page.
Configure Graph Measurements

You can customize graphs to show, hide, or highlight selected graph measurements.

To configure graph measurements:

1. Click the icon at the top of the large graph pane to configure the graph’s measurements. The Configure graph’s measurements page opens.

2. Select the Show check box to show a measurement on the graph. By default, all graph measurements are shown on the graph. To remove a measurement...
from being displayed on the graph, clear the **Show** check box. To highlight a measurement in bold on the graph, select the **Bold** check box.

Check the **Select/Deselect All** check box in the **Show** column to display all measurements on the graph. Clear the **Select/Deselect All** check box to remove all measurements from the graph.

To highlight all measurements in **Bold** on the graph, check the **Select/Deselect All** check box in the **Bold** column. To remove the bold highlights, clear the **Select/Deselect All** check box.

3 Click **OK** to close the Configure graph measurements page. The new graph configuration settings appear on the refreshed graph.

**Log Out**

To log out of the LoadRunner Remote Performance monitor, click the **Log Out** button at the top of the page.
While running a scenario, you can use LoadRunner’s Run-Time and Transaction monitors to view graphs of run-time status and transaction performance.

This chapter describes:
- Run-Time Graphs
- User-Defined Data Points Graph
- Transaction Monitor Graphs
- Enabling the Transaction Monitor
- Adding Transactions to a Script
- Enabling Web Page Breakdown

**About Run-Time and Transaction Graphs**

The *Run-Time* monitor provides information about the status of the Vusers participating in the scenario, and the number and types of errors that the Vusers generate. In addition, the Run-Time monitor provides the User-Defined Data Points graph, which displays the real time values for user-defined points in a Vuser script.

The *Transaction* monitor displays the transaction rate and response time during scenario execution. For more information about transactions, see “Adding Transactions to a Script” on page 260.
Run-Time Graphs

The monitor’s Running Vusers graph provides information about the status of the Vusers running in the current scenario on all load generator machines. The graph shows the number of running Vusers, while the information in the legend indicates the number of Vusers in each state.

<table>
<thead>
<tr>
<th>Color</th>
<th>Scale</th>
<th>Status</th>
<th>Max</th>
<th>Min</th>
<th>Avg</th>
<th>Std</th>
<th>Last</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Running</td>
<td>14</td>
<td>2</td>
<td>7.633552...</td>
<td>3.783389...</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Error</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Finished</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

The Status field of each Vuser displays the current status of the Vuser. The following table describes each Vuser status.

<table>
<thead>
<tr>
<th>Status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RUNNING</td>
<td>The total number of Vusers currently running on all load generators.</td>
</tr>
<tr>
<td>READY</td>
<td>The number of Vusers that completed the initialization section of the script and are ready to run.</td>
</tr>
<tr>
<td>FINISHED</td>
<td>The number of Vusers that have finished running. This includes both Vusers that passed and failed.</td>
</tr>
<tr>
<td>ERROR</td>
<td>The number of Vusers whose execution generated an error. Check the Status field in the Vuser view or the Output window for a complete explanation of the error.</td>
</tr>
</tbody>
</table>

The monitor’s Error Statistics graph provides details about the number of errors that accrue during each second of the scenario run. The errors are grouped by error source—for example, the location in the script or the load generator name.

The Vusers with Error Statistics graph provides details about the number of Vusers that generate errors during scenario execution. The errors are grouped by error source.
**User-Defined Data Points Graph**

The User-Defined Data Points graph displays the real-time values of user-defined data points. You define a data point in your Vuser script by inserting an `lr_user_data_point` function at the appropriate place (`user_data_point` for GUI Vusers and `lr.user_data_point` for Java Vusers).

```c
Action1()
{
    lr_think_time(1);
    lr_user_data_point ("data_point_1",1);
    lr_user_data_point ("data_point_2",2);
    return 0;
}
```

For Vuser protocols that support the graphical script representations such as Web and Oracle NCA, you insert a data point as a User Defined step. Data point information is gathered each time the script executes the function or step. For more information about data points, see the LoadRunner Function Reference.

By default, LoadRunner displays all of the data points in a single graph. The legend provides information about each data point. If desired, you can hide specific data points using the legend below the graphs.

You can also view data points offline, after the completion of the scenario. For more information, see the LoadRunner Analysis User's Guide.
**Transaction Monitor Graphs**

The *Transaction* monitor provides the following graphs:

- Transaction Response Time
- Transactions per Second (Passed)
- Transactions per Second (Failed, Stopped)
- Total Transactions per Second (Passed)

The **Transaction Response Time** graph shows the average response time of transactions in seconds (y-axis) as a function of the elapsed time in the scenario (x-axis).

The **Transactions per Second (Passed)** graph shows the number of successful transactions performed per second (y-axis) as a function of the elapsed time in the scenario (x-axis).

The **Transactions per Second (Failed, Stopped)** graph shows the number of failed and stopped transactions per second (y-axis) as a function of the elapsed time in the scenario (x-axis).

The **Total Transactions per Second (Passed)** graph shows the total number of completed, successful transactions per second (y-axis) as a function of the elapsed time in the scenario (x-axis).
Enabling the Transaction Monitor

The Transaction monitor is enabled by default—it automatically begins monitoring Vuser transactions at the start of a scenario. You can disable the Transaction monitor in order to conserve resources.

To enable the Transaction monitor:

1. Choose **Tools > Options** and select the **Monitors** tab.

   ![Options Tab](image)

   **NOTE:** For these settings to take effect, you must reconnect to the load generator.

2. Enable transaction monitoring by selecting the **Enable Transaction Monitor** check box. To disable transaction monitoring, clear the **Enable Transaction Monitor** check box.
Adding Transactions to a Script

If there are no transactions defined in your Vuser script, no data will be displayed in the online graphs. To add transactions to an existing script, edit it using the appropriate tool. The following table shows the script generation tools for each script type:

<table>
<thead>
<tr>
<th>Script type</th>
<th>Editing tool</th>
</tr>
</thead>
<tbody>
<tr>
<td>GUI Windows</td>
<td>WinRunner</td>
</tr>
<tr>
<td>non-GUI Windows</td>
<td>VuGen (Vuser Generator)</td>
</tr>
<tr>
<td>SAP</td>
<td>QuickTest for SAP</td>
</tr>
</tbody>
</table>

To add a transaction to a script:

1. Click the **Design** tab to view the list of Vuser groups and scripts.

2. To edit a script for a Vuser group, select the group and click the **View Script** button to the right of the Scenario Groups window. The script generation tool opens.

To edit a script for an individual Vuser, click **Vusers**. Right-click the Vuser whose script you want to edit, and select **View Script** to open the script generation tool.

3. Insert Start and End Transaction functions or markers throughout your script.

For more information, see the appropriate user's guide as described in the Welcome chapter.
Enabling Web Page Breakdown

In order for the Analysis to generate Web Page Breakdown graphs, which provide you with performance information for each transaction and sub-transaction defined in your script, you must enable the Web page breakdown feature in the Controller before running your scenario.

To enable Web page breakdown:

1. Choose Tools > Options and select the Web Page Breakdown tab.

2. Select Enable Web Page Breakdown, and specify the percentage of Web Vusers for which you want Web page breakdown to be performed.

For more information about Web Page Breakdown graphs, see the LoadRunner Analysis User’s Guide.
You can obtain information about the performance of your Web server using LoadRunner’s Web Resource monitor.

This chapter describes:

➤ Hits per Second Graph
➤ Throughput Graph
➤ HTTP Responses per Second Graph
➤ Pages Downloaded per Second Graph
➤ Retries per Second Graph

About Web Resource Monitoring

The Web Resource monitor enables you to analyze the throughput on the Web server, the number of hits per second that occurred during the scenario, the number of HTTP responses per second, the HTTP status codes (which indicate the status of HTTP requests, for example, “the request was successful,” “the page was not found”) returned from the Web server, the number of downloaded pages per second, and the number of server retries per second.
Hits per Second Graph

The **Hits Per Second** graph shows the number of hits (HTTP requests) to the Web server (y-axis) as a function of the elapsed time in the scenario (x-axis). This graph can display the whole step, or the last 60, 180, 600, or 3600 seconds. You can compare this graph to the Transaction Response Time graph to see how the number of hits affects transaction performance.

Throughput Graph

The **Throughput** graph shows the amount of throughput on the Web server (y-axis) during each second of the scenario run (x-axis). Throughput is measured in bytes and represents the amount of data that the Vusers received from the server at any given second. You can compare this graph to the Transaction Response Time graph to see how the throughput affects transaction performance.

In the following example, the Transaction Response time graph is compared with the Throughput graph. It is apparent from the graph that as the throughput decreases, the transaction response time also decreases. The
peak throughput occurred at approximately 1 minute into the step. The highest response time also occurred at this time.

**HTTP Responses per Second Graph**

The **HTTP Responses per Second** graph shows the number of HTTP status codes—which indicate the status of HTTP requests, for example, “the request was successful,” “the page was not found”—(y-axis) returned from the Web server during each second of the scenario run (x-axis), grouped by status code. You can group the results shown in this graph by script (using the "Group By" function) to locate scripts which generated error codes.

The following table displays a list of HTTP status codes:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>OK</td>
</tr>
<tr>
<td>201</td>
<td>Created</td>
</tr>
<tr>
<td>202</td>
<td>Accepted</td>
</tr>
<tr>
<td>203</td>
<td>Non-Authoritative Information</td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
</tr>
<tr>
<td>------</td>
<td>------------------------------</td>
</tr>
<tr>
<td>204</td>
<td>No Content</td>
</tr>
<tr>
<td>205</td>
<td>Reset Content</td>
</tr>
<tr>
<td>206</td>
<td>Partial Content</td>
</tr>
<tr>
<td>300</td>
<td>Multiple Choices</td>
</tr>
<tr>
<td>301</td>
<td>Moved Permanently</td>
</tr>
<tr>
<td>302</td>
<td>Found</td>
</tr>
<tr>
<td>303</td>
<td>See Other</td>
</tr>
<tr>
<td>304</td>
<td>Not Modified</td>
</tr>
<tr>
<td>305</td>
<td>Use Proxy</td>
</tr>
<tr>
<td>307</td>
<td>Temporary Redirect</td>
</tr>
<tr>
<td>400</td>
<td>Bad Request</td>
</tr>
<tr>
<td>401</td>
<td>Unauthorized</td>
</tr>
<tr>
<td>402</td>
<td>Payment Required</td>
</tr>
<tr>
<td>403</td>
<td>Forbidden</td>
</tr>
<tr>
<td>404</td>
<td>Not Found</td>
</tr>
<tr>
<td>405</td>
<td>Method Not Allowed</td>
</tr>
<tr>
<td>406</td>
<td>Not Acceptable</td>
</tr>
<tr>
<td>407</td>
<td>Proxy Authentication Required</td>
</tr>
<tr>
<td>408</td>
<td>Request Timeout</td>
</tr>
<tr>
<td>409</td>
<td>Conflict</td>
</tr>
<tr>
<td>410</td>
<td>Gone</td>
</tr>
<tr>
<td>411</td>
<td>Length Required</td>
</tr>
<tr>
<td>412</td>
<td>Precondition Failed</td>
</tr>
<tr>
<td>413</td>
<td>Request Entity Too Large</td>
</tr>
</tbody>
</table>
Chapter 20 • Web Resource Monitoring

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>414</td>
<td>Request - URI Too Large</td>
</tr>
<tr>
<td>415</td>
<td>Unsupported Media Type</td>
</tr>
<tr>
<td>416</td>
<td>Requested range not satisfiable</td>
</tr>
<tr>
<td>417</td>
<td>Expectation Failed</td>
</tr>
<tr>
<td>500</td>
<td>Internal Server Error</td>
</tr>
<tr>
<td>501</td>
<td>Not Implemented</td>
</tr>
<tr>
<td>502</td>
<td>Bad Gateway</td>
</tr>
<tr>
<td>503</td>
<td>Service Unavailable</td>
</tr>
<tr>
<td>504</td>
<td>Gateway Timeout</td>
</tr>
<tr>
<td>505</td>
<td>HTTP Version not supported</td>
</tr>
</tbody>
</table>

For more information on the above status codes and their descriptions, see http://www.w3.org/Protocols/rfc2616/rfc2616-sec10.html#sec10.

**Pages Downloaded per Second Graph**

The **Pages Downloaded per Second** graph shows the number of Web pages (y-axis) downloaded from the server during each second of the scenario run (x-axis). This graph helps you evaluate the amount of load Vusers generate, in terms of the number of pages downloaded.

**Note:** In order to view the Pages Downloaded per Second graph, you must select **Pages per second (HTML Mode only)** from the run-time settings Preferences tab before running your scenario.

Like throughput, downloaded pages per second is a representation of the amount of data that the Vusers received from the server at any given second.
The Throughput graph takes into account each resource and its size (for example, the size of each .gif file, the size of each Web page).

The Pages Downloaded per Second graph takes into account simply the number of pages.

In the following example, the Throughput graph is compared with the Pages Downloaded per Second graph. It is apparent from the graph that throughput is not proportional to the number of pages downloaded per second. For example, between 15 and 16 seconds into the scenario run, the throughput decreased while the number of pages downloaded per second increased.

Retries per Second Graph

The Retries Per Second graph shows the number of attempted Web server connections (y-axis) as a function of the elapsed time in the scenario (x-axis). A server connection is retried when the initial connection was unauthorized, when proxy authentication is required, when the initial connection was closed by the server, when the initial connection to the server could not be made, or when the server was initially unable to resolve the load generator's IP address.
You can monitor a machine’s system resource usage during a scenario run using LoadRunner’s System Resource monitors.

This chapter describes:

➤ Configuring the Windows Resources Monitor
➤ Configuring the UNIX Resources Monitor
➤ Configuring an rstatd Daemon on UNIX
➤ Configuring the SNMP Resources Monitor
➤ Configuring the TUXEDO Monitor
➤ Configuring the Antara FlameThrower Monitor

About System Resource Monitoring

A primary factor in a transaction’s response time is its system resource usage. Using the LoadRunner resource monitors, you can monitor the Windows, TUXEDO, UNIX, SNMP, and Antara FlameThrower resources on a machine during a scenario run, and determine why a bottleneck occurred on a particular machine.

The Windows measurements correspond to the built-in counters available from the Windows Performance Monitor.

The UNIX measurements include those available by the rstatd daemon: average load, collision rate, context switch rate, CPU utilization, incoming packets error rate, incoming packets rate, interrupt rate, outgoing packets error rate, outgoing packets rate, page-in rate, page-out rate, paging rate,
swap-in rate, swap-out rate, system mode CPU utilization, and user mode CPU utilization.

**Note:** You must configure an `rstatd` daemon on all UNIX machines being monitored. For information on how to configure an `rstatd` daemon, refer to the UNIX *man* pages, or see "Configuring an rstatd Daemon on UNIX," on page 281.

The TUXEDO monitor can monitor the server, load generator machine, workstation handler, and queue in a TUXEDO system. Note that in order to run the TUXEDO monitor, you must install the TUXEDO client libraries on the machine you want to monitor. For information on configuring the TUXEDO monitor, see “Configuring the TUXEDO Monitor,” on page 285.

The SNMP monitor is available for monitoring machines using the Simple Network Management Protocol (SNMP). SNMP monitoring is platform independent.

The Antara FlameThrower monitor can measure the following performance counters: Layer, TCP, HTTP, SSL/HTTPS, Sticky SLB, FTP, SMPT, POP3, DNS, and Attacks.

The resource monitors are automatically enabled when you execute a scenario. However, you must specify the machine you want to monitor and which resources to monitor for each machine. You can also add or remove machines and resources during the scenario run.
Configuring the Windows Resources Monitor


---

**Note:** To monitor a Windows NT or 2000 machine through a firewall, use TCP, port 139.

---

To configure the Windows Resources monitor:

1. Click the Windows Resources graph in the graph tree, and drag it into the right pane of the Run view.

2. Right-click the graph and choose *Add Measurement(s)*, or choose *Monitors > Add Online Measurement*.

3. In the Monitored Server Machines section of the Windows Resources dialog box, click *Add* to enter the server name or IP address of the machine you want to monitor. Select the platform on which the machine runs, and click *OK*.

4. In the Resource Measurements section of the Windows Resources dialog box, select the measurements that you want to monitor.
The following default measurements are available for Windows machines:

<table>
<thead>
<tr>
<th>Object</th>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>System</td>
<td>% Total Processor Time</td>
<td>The average percentage of time that all the processors on the system are busy executing non-idle threads. On a multiprocessor system, if all processors are always busy, this is 100%, if all processors are 50% busy this is 50% and if 1/4th of the processors are 100% busy this is 25%. It can be viewed as the fraction of the time spent doing useful work. Each processor is assigned an Idle thread in the Idle process which consumes those unproductive processor cycles not used by any other threads.</td>
</tr>
<tr>
<td>System</td>
<td>File Data Operations/sec</td>
<td>The rate at which the computer issues read and write operations to file system devices. This does not include File Control Operations.</td>
</tr>
<tr>
<td>Processor</td>
<td>% Processor Time (Windows 2000)</td>
<td>The percentage of time that the processor is executing a non-idle thread. This counter was designed as a primary indicator of processor activity. It is calculated by measuring the time that the processor spends executing the thread of the idle process in each sample interval, and subtracting that value from 100%. (Each processor has an idle thread which consumes cycles when no other threads are ready to run). It can be viewed as the percentage of the sample interval spent doing useful work. This counter displays the average percentage of busy time observed during the sample interval. It is calculated by monitoring the time the service was inactive, and then subtracting that value from 100%.</td>
</tr>
<tr>
<td>Object</td>
<td>Measurement</td>
<td>Description</td>
</tr>
<tr>
<td>------------</td>
<td>---------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>System</td>
<td>Processor Queue</td>
<td>The instantaneous length of the processor queue in units of threads. This counter is always 0 unless you are also monitoring a thread counter. All processors use a single queue in which threads wait for processor cycles. This length does not include the threads that are currently executing. A sustained processor queue length greater than two generally indicates processor congestion. This is an instantaneous count, not an average over the time interval.</td>
</tr>
<tr>
<td></td>
<td>Length</td>
<td></td>
</tr>
<tr>
<td>Memory</td>
<td>Page Faults/sec</td>
<td>This is a count of the page faults in the processor. A page fault occurs when a process refers to a virtual memory page that is not in its Working Set in the main memory. A page fault will not cause the page to be fetched from disk if that page is on the standby list (and hence already in main memory), or if it is in use by another process with which the page is shared.</td>
</tr>
<tr>
<td>PhysicalDisk</td>
<td>% Disk Time</td>
<td>The percentage of elapsed time that the selected disk drive is busy servicing read or write requests.</td>
</tr>
<tr>
<td>Memory</td>
<td>Pool Nonpaged Bytes</td>
<td>The number of bytes in the nonpaged pool, a system memory area where space is acquired by operating system components as they accomplish their appointed tasks. Nonpaged pool pages cannot be paged out to the paging file. They remain in main memory as long as they are allocated.</td>
</tr>
</tbody>
</table>
## Monitoring a Scenario

<table>
<thead>
<tr>
<th>Object</th>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory</td>
<td>Pages/sec</td>
<td>The number of pages read from the disk or written to the disk to resolve memory references to pages that were not in memory at the time of the reference. This is the sum of Pages Input/sec and Pages Output/sec. This counter includes paging traffic on behalf of the system cache to access file data for applications. This value also includes the pages to/from non-cached mapped memory files. This is the primary counter to observe if you are concerned about excessive memory pressure (that is, thrashing), and the excessive paging that may result.</td>
</tr>
<tr>
<td>System</td>
<td>Total Interrupts/sec</td>
<td>The rate at which the computer is receiving and servicing hardware interrupts. The devices that can generate interrupts are the system timer, the mouse, data communication lines, network interface cards, and other peripheral devices. This counter provides an indication of how busy these devices are on a computer-wide basis. See also Processor:Interrupts/sec.</td>
</tr>
<tr>
<td>Objects</td>
<td>Threads</td>
<td>The number of threads in the computer at the time of data collection. Notice that this is an instantaneous count, not an average over the time interval. A thread is the basic executable entity that can execute instructions in a processor.</td>
</tr>
<tr>
<td>Process</td>
<td>Private Bytes</td>
<td>The current number of bytes that the process has allocated that cannot be shared with other processes.</td>
</tr>
</tbody>
</table>
Note: To change the default counters for the Windows machine monitor, see “Changing a Monitor’s Default Counters,” on page 553.

If you are monitoring a Win2000 machine, some of the NT machine default counters may not be available (such as % Total CPU usage and Interrupts/sec). Proceed to step 5 in order to select counters appropriate for Win2000.

5 To select additional measurements, click Add. A dialog box displaying the available measurements and server properties opens.

6 Select an object, a counter, and an instance. You can select multiple counters using the Ctrl key. The instance is relevant only if multiple instances of the highlighted counter are running. For a description of each counter, click Explain>> to expand the dialog box.

7 Click Add to place the selected counter on the resource list. Add all the desired resources to the list, and click Close.

8 Click OK in the Windows Resources dialog box to activate the monitor.
Note: If you want to monitor a remote Windows machine that does not use Windows domain security, you must authenticate the Controller machine on the remote Windows machine. To authenticate the Controller machine, create an account, or change the password of the account used to log on to the Controller so that it matches the password and user name used to log on to the remote monitored Windows machine. When the remote Windows machine requests another machine’s resources, it sends the logged-in user name and password of the machine requesting the resources.

Configuring the UNIX Resources Monitor

The UNIX kernel statistics measurements include those available by the rstatd daemon: average load, collision rate, context switch rate, CPU utilization, incoming packets error rate, incoming packets rate, interrupt rate, outgoing packets error rate, outgoing packets rate, page-in rate, page-out rate, paging rate, swap-in rate, swap-out rate, system mode CPU utilization, and user mode CPU utilization.

To configure the UNIX Resources monitor:

1. Click the UNIX Resources graph in the graph tree, and drag it into the right pane of the Run view.
2. Right-click the graph and choose Add Measurement(s), or choose Monitors > Add Online Measurement.
3. In the Monitored Server Machines section of the UNIX Resources dialog box, click Add to enter the server name or IP address of the machine you want to monitor. Select UNIX from the list of platforms, and click OK.
4. In the Resource Measurements section of the UNIX Resources dialog box, select the default measurements you want to monitor.
The following default measurements are available for the UNIX machine:

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average load</td>
<td>Average number of processes simultaneously in READY state during the last minute</td>
</tr>
<tr>
<td>Collision rate</td>
<td>Collisions per second detected on the Ethernet</td>
</tr>
<tr>
<td>Context switches rate</td>
<td>Number of switches between processes or threads, per second</td>
</tr>
<tr>
<td>CPU utilization</td>
<td>Percent of time that the CPU is utilized</td>
</tr>
<tr>
<td>Disk rate</td>
<td>Rate of disk transfers</td>
</tr>
<tr>
<td>Incoming packets error rate</td>
<td>Errors per second while receiving Ethernet packets</td>
</tr>
<tr>
<td>Incoming packets rate</td>
<td>Incoming Ethernet packets per second</td>
</tr>
<tr>
<td>Interrupt rate</td>
<td>Number of device interrupts per second</td>
</tr>
<tr>
<td>Outgoing packets errors rate</td>
<td>Errors per second while sending Ethernet packets</td>
</tr>
<tr>
<td>Outgoing packets rate</td>
<td>Outgoing Ethernet packets per second</td>
</tr>
<tr>
<td>Page-in rate</td>
<td>Number of pages read to physical memory, per second</td>
</tr>
<tr>
<td>Page-out rate</td>
<td>Number of pages written to pagefile(s) and removed from physical memory, per second</td>
</tr>
<tr>
<td>Paging rate</td>
<td>Number of pages read to physical memory or written to pagefile(s), per second</td>
</tr>
<tr>
<td>Swap-in rate</td>
<td>Number of processes being swapped</td>
</tr>
<tr>
<td>Swap-out rate</td>
<td>Number of processes being swapped</td>
</tr>
<tr>
<td>System mode CPU utilization</td>
<td>Percent of time that the CPU is utilized in system mode</td>
</tr>
<tr>
<td>User mode CPU utilization</td>
<td>Percent of time that the CPU is utilized in user mode</td>
</tr>
</tbody>
</table>
Note: To change the default counters for the UNIX monitor, see “Changing a Monitor’s Default Counters,” on page 553.

5 To select additional measurements, click Add. The UNIX Kernel Statistics dialog box opens, displaying the available measurements and server properties.

6 To add UNIX measurements to the monitor list, select the desired measurements, and click OK.

7 Click OK in the UNIX Resources dialog box to activate the UNIX monitor.

Note: Ensure that the rstatd daemon is correctly configured and running on the monitored UNIX machine. For more information, see "Configuring an rstatd Daemon on UNIX," on page 281.
Configuring an rstatd Daemon on UNIX

To monitor UNIX resources, you must configure the rstatd daemon. Note that the rstatd daemon might already be configured, because when a machine receives an rstat request, the inetd on that machine activates the rstatd automatically.

To verify whether the rstatd daemon is already configured:

The rup command reports various machine statistics, including rstatd configuration. Run the following command to view the machine statistics:

```bash
>rup host
```

You can also use lr_host_monitor and see if it returns any relevant statistics.

If the command returns meaningful statistics, the rstatd daemon is already configured and activated. If not, or if you receive an error message, the rstatd daemon is not configured.

To configure the rstatd daemon:

1. Run the command: `su root`
2. Go to `/etc/inetd.conf` and look for the rstatd row (it begins with the word rstatd). If it is commented out (with a #), remove the comment directive, and save the file.
3. From the command line, run:
   ```bash
   kill -1 inet_pid
   ```
   where `inet_pid` is the pid of the inetd process. This instructs the inetd to rescan the `/etc/inetd.conf` file and register all daemons which are uncommented, including the rstatd daemon.
4. Run `rup` again.

If the command still does not indicate that the rstatd daemon is configured, contact your system administrator.
Note: To monitor a UNIX machine through a firewall, you must run a UNIX utility called rpcinfo and identify the rstatd's port number. By running `rpcinfo -p <hostname>`, you will receive a list of all RPC servers registered in the host's portmapper, along with the port number. This list will not change until rstatd is stopped and rerun.

Some firewalls allow you to open an RPC program number instead of a port. In such cases, open program 100001. If are prompted to include a version number, specify versions 3 and 4.

### Configuring the SNMP Resources Monitor

The SNMP Resources monitor is available for monitoring any machine that runs an SNMP agent, using the Simple Network Management Protocol (SNMP).

**Note:** You can specify a port number in the `snmp.cfg` file. If you do not specify a port, LoadRunner connects to default SNMP port 161. You can also specify a machine name in the following format:

```
<server name>:<port number>
```

To monitor SNMP resources through a firewall, use ports 161 or 162.

**To configure the SNMP Resources monitor:**

1. Click the SNMP Resources graph in the graph tree, and drag it into the right pane of the Run view.
2. Right-click the graph and choose **Add Measurement(s)**, or choose **Monitors > Add Online Measurement**.
3. In the Monitored Server Machines section of the SNMP dialog box, click **Add** to enter the server name or IP address of the machine you want to monitor. Select the platform on which the machine runs, and click **OK**.
4 In the Resource Measurements section of the SNMP dialog box, click Add to select the measurements that you want to monitor.

The SNMP Resources dialog box opens.

5 Browse the SNMP Object tree.

6 To measure an object, select it, and click Add. For a description of each resource, click Explain>> to expand the dialog box. Add all the desired resources to the list, and click Close.

Note: The SNMP monitor can only monitor up to 25 measurements.

7 Click OK in the SNMP dialog box to activate the monitor.

You can modify the list of resources that you want to monitor at any point during the scenario. Note that a scenario does not have to be active in order for you to monitor the resources on a remote machine.
Note: You can improve the level of measurement information for the SNMP monitor by enabling measurements with string values to be listed (in addition to measurements with numeric values), and by enabling the name modifier (which displays the string value as an identifying part of the measurement name).

In the following example of a measurement using the name modifier, the string value of ProcessName (sched) is displayed in addition to its instance ID (0):

```
{psProcessName]
  [0 sched]
  [1 init]
  [2 pageout]
```

To enable this feature, add the following line to the `<LoadRunner root folder>\dat\monitors\snmp.cfg` file:

```
SNMP_show_string_nodes=1
```

Usage Notes: You can select more than one name modifier, but the first in the hierarchy will be used. Each time the SNMP Add Measurements dialog box opens, the information is reread from the `snmp.cfg` file. You cannot add the same measurement twice (once with a name modifier and once without it). If you do so, an error message is issued.
Configuring the TUXEDO Monitor

The TUXEDO monitor allows you to measure and view your TUXEDO client’s performance.

Note: If TUXEDO 7.1 or higher is installed on the Controller machine, more than one TUXEDO application server can be monitored at a time. However, if TUXEDO 6.5 or below is installed on the Controller machine, only one TUXEDO application server can be monitored at a time. Use a TUXEDO 6.x client if a TUXEDO 6.x server is used, and TUXEDO 7.1 or above if a TUXEDO 7.1 or above server is used.

Before you set up the monitor:

1 Ensure that a TUXEDO workstation client (not a native client) is installed on the Controller machine.

Note: A TUXEDO workstation client communicates with the application server over the network, and is not required to run the TUXEDO application server on the same machine. A native client can only communicate with the TUXEDO application server if it is part of the relevant TUXEDO domain.

2 Define the TUXEDO environment variables on the Controller machine—set the TUXDIR variable to the TUXEDO installation directory, and add the TUXEDO bin directory to the PATH variable.

3 Configure the TUXEDO application server so that the workstation listener (WSL) process is running. This enables the application server to accept requests from workstation clients. Note that the address and port number used to connect to the application server must match those dedicated to the WSL process.
To configure the TUXEDO monitor:

1. Click the TUXEDO graph in the graph tree, and drag it into the right pane of the Run view.

2. Right-click the graph and choose Add Measurement(s), or choose Monitors > Add Online Measurement.

3. In the Monitored Server Machines section of the TUXEDO dialog box, click Add to enter the server name or IP address of the machine you want to monitor. Select the platform on which the machine runs, and click OK.

4. Click Add in the Resource Measurements section of the TUXEDO dialog box to select the measurements that you want to monitor. You will be prompted to enter information about the TUXEDO server: Login Name, Password, Server Name, Client Name.

---

**Note:** This information is located in the Logon section of the tpinit.ini file in the recorded script's directory. Click the Browse button and navigate to the tpinit.ini file of that LoadRunner script. You can also determine the client name from the lrt_tpinitialize statement in the recorded script.

---

If you already know the required values, you can manually type them into the dialog box. The format of the server name is //<machine name>:<port number>. Alternatively, you can specify the IP address instead of the machine name. The hexadecimal format used by old versions of TUXEDO is also supported. Note that quotation marks should not be used.

In the following example of a tpinit.ini file, the TUXEDO monitor was configured for a server named URANUS using port 65535, and a client
named bankapp. The logon user name was Smith and the password was mypasswd.

```
[Logon]
LogonServername=//URANUS:65535
LogonUsrName=Smith
LogonCltName=bankapp
LogonGrpName=
LogonPasswd=mypassword
LogonData=
```

The TUXEDO monitor can only connect to one application server during a Controller session. Once it connects to an application server, that server is the only one used by the monitor until the Controller is closed. This applies even when all of the counters are deleted from the monitor.

5 Click OK. The Add TUXEDO Measurements dialog box opens.
Select a TUXEDO object from the Object list. Select the measurements and instances you want to monitor. The following table lists the available TUXEDO monitor measurements:

<table>
<thead>
<tr>
<th>Monitor</th>
<th>Measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Server</td>
<td><strong>Requests per second</strong> - How many server requests were handled per second</td>
</tr>
<tr>
<td></td>
<td><strong>Workload per second</strong> - The workload is a weighted measure of the server requests. Some requests could have a different weight than others. By default, the workload is always 50 times the number of requests.</td>
</tr>
<tr>
<td>Machine</td>
<td><strong>Workload completed per second</strong> - The total workload on all the servers for the machine that was completed, per unit time</td>
</tr>
<tr>
<td></td>
<td><strong>Workload initiated per second</strong> - The total workload on all the servers for the machine that was initiated, per unit time</td>
</tr>
<tr>
<td></td>
<td><strong>Current Accessers</strong> - Number of clients and servers currently accessing the application either directly on this machine or through a workstation handler on this machine.</td>
</tr>
<tr>
<td></td>
<td><strong>Current Clients</strong> - Number of clients, both native and workstation, currently logged in to this machine.</td>
</tr>
<tr>
<td></td>
<td><strong>Current Transactions</strong> - Number of in use transaction table entries on this machine.</td>
</tr>
<tr>
<td>Queue</td>
<td><strong>Bytes on queue</strong> - The total number of bytes for all the messages waiting in the queue</td>
</tr>
<tr>
<td></td>
<td><strong>Messages on queue</strong> - The total number of requests that are waiting on queue. By default this is 0.</td>
</tr>
</tbody>
</table>
### Configuring the Antara FlameThrower Monitor

You select measurements to monitor the Antara FlameThrower server using the Antara FlameThrower Monitor Configuration dialog box.

**To configure the Antara FlameThrower monitor:**

1. Click the Antara FlameThrower graph in the graph tree, and drag it into the right pane of the Run view.

2. Right-click the graph and choose **Add Measurement(s)**, or choose **Monitors > Add Online Measurement**.

3. In the Monitored Server Machines section of the Antara FlameThrower dialog box, click **Add** to enter the server name or IP address of the machine.
you want to monitor. Enter the server name or IP address according to the following format: `<server name>:<port number>`.

For example: merc1:12135

Select the platform on which the machine runs, and click OK.

4 Click Add in the Resource Measurements section of the Antara FlameThrower dialog box to select the measurements that you want to monitor. The Antara FlameThrower Monitor Configuration dialog box opens.

5 Browse the Measured Components tree.

6 Check the required performance counters in the Antara FlameThrower Monitor Configuration window’s right pane.

The following tables describe the counters that can be monitored:

**Layer Performance Counters**

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TxBytes</td>
<td>The total number of Layer 2 data bytes transmitted.</td>
</tr>
<tr>
<td>TxByteRate/sec</td>
<td>The number of Layer 2 data bytes transmitted per second.</td>
</tr>
<tr>
<td>TxFrames</td>
<td>The total number of packets transmitted.</td>
</tr>
<tr>
<td>TxFrameRate/sec</td>
<td>The number of packets transmitted per second.</td>
</tr>
<tr>
<td>RxBytes</td>
<td>The total number of Layer 2 data bytes received.</td>
</tr>
<tr>
<td>RxByteRate/sec</td>
<td>The number of Layer 2 data bytes received per second.</td>
</tr>
<tr>
<td>RxFrames</td>
<td>The total number of packets received.</td>
</tr>
<tr>
<td>RxFrameRate/sec</td>
<td>The number of packets received per second.</td>
</tr>
</tbody>
</table>

**TCP Performance Counters**

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ActiveTCPConns</td>
<td>Total number of currently active TCP connections.</td>
</tr>
<tr>
<td>SuccTCPConns</td>
<td>Total number of SYN ACK packets received.</td>
</tr>
</tbody>
</table>
### System Resource Monitoring

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SuccTCPConn Rate(/sec)</td>
<td>Number of SYN ACK packets received per second.</td>
</tr>
<tr>
<td>TCPConnLatency(milisec)</td>
<td>Interval between transmitting a SYN packet and receiving a SYN ACK reply packet in msec.</td>
</tr>
<tr>
<td>MinTCPConn Latency(milisec)</td>
<td>Minimum TCPConnectionLatency in msec.</td>
</tr>
<tr>
<td>MaxTCPConn Latency(milisec)</td>
<td>Maximum TCPConnectionLatency in msec.</td>
</tr>
<tr>
<td>TCPSndConnClose</td>
<td>Total number of FIN or FIN ACK packets transmitted (Client).</td>
</tr>
<tr>
<td>TCPRcvConnClose</td>
<td>Total number of FIN or FIN ACK packets received (Client).</td>
</tr>
<tr>
<td>TCPSndResets</td>
<td>Total number of RST packets transmitted.</td>
</tr>
<tr>
<td>TCPRcvResets</td>
<td>Total number of RST packets received.</td>
</tr>
<tr>
<td>SYNSent</td>
<td>Total number of SYN packets transmitted.</td>
</tr>
<tr>
<td>SYNSentRate(/sec)</td>
<td>Number of SYN packets transmitted per second.</td>
</tr>
<tr>
<td>SYNAckSent</td>
<td>Total number of SYN ACK packets transmitted.</td>
</tr>
<tr>
<td>SYNAckRate(/sec)</td>
<td>Number of SYN ACK packets transmitted per second.</td>
</tr>
</tbody>
</table>

### HTTP Performance Counters

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTTPRequests</td>
<td>Total number of HTTP Request command packets transmitted.</td>
</tr>
<tr>
<td>HTTPRequestRate (/sec)</td>
<td>Number of HTTP Request packets transmitted per second.</td>
</tr>
<tr>
<td>AvgHTTPData Latency(milisecs)</td>
<td>The average HTTP Data Latency over the past second in msec.</td>
</tr>
<tr>
<td>HTTPData Latency(milisecs)</td>
<td>Interval between transmitting a Request packet and receiving a response in msec.</td>
</tr>
</tbody>
</table>
## Monitoring a Scenario

**DataThroughput (bytes/sec)**
- The number of data bytes received from the HTTP server per second.

**MinHTTPDataLatency (miliseconds)**
- Minimum HTTPDataLatency in msec.

**MaxHTTPDataLatency (miliseconds)**
- Maximum HTTPDataLatency in msec.

**MinDataThroughput (bytes/sec)**
- Minimum HTTPDataThroughput in seconds.

**MaxDataThroughput (bytes/sec)**
- Maximum HTTPDataThroughput in seconds.

**SuccHTTPRequests**
- Total number of successful HTTP Request Replies (200 OK) received.

**SuccHTTPRequestRate (sec)**
- Number of successful HTTP Request Replies (200 OK) received per second.

**UnSuccHTTPRequests**
- Number of unsuccessful HTTP Requests.

### SSL/HTTPS Performance Counters

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SSLConnections</strong></td>
<td>Number of ClientHello messages sent by the Client.</td>
</tr>
<tr>
<td><strong>SSLConnectionRate/sec</strong></td>
<td>Number of ClientHello messages sent per second.</td>
</tr>
<tr>
<td><strong>SuccSSLConnections</strong></td>
<td>Number of successful SSL Connections. A successful connection is one in which the Client receives the Server's finished handshake message without any errors.</td>
</tr>
<tr>
<td><strong>SuccSSLConnectionRate/sec</strong></td>
<td>Number of successful SSL connections established per second.</td>
</tr>
</tbody>
</table>
### Chapter 21 • System Resource Monitoring

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSLAlertErrors</td>
<td>Number of SSL alert messages received by the client (e.g. bad_record_mac, decryption_failed, handshake_failure, etc..)</td>
</tr>
<tr>
<td>SuccSSLResumed Sessions</td>
<td>Number of SSL Sessions that were successfully resumed.</td>
</tr>
<tr>
<td>FailedSSLResumed Sessions</td>
<td>Number of SSL Sessions that were unable to be resumed.</td>
</tr>
</tbody>
</table>

### Sticky SLB Performance Counters

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cookie AuthenticationFail</td>
<td>The number of Cookie's that were not authenticated by the Server.</td>
</tr>
<tr>
<td>SuccCookie Authentication</td>
<td>The number of Cookie's authenticated by the server.</td>
</tr>
<tr>
<td>SSLClientHellos</td>
<td>The number of Client Hello packets sent to the server.</td>
</tr>
<tr>
<td>SSLServerHellos</td>
<td>The number of Server Hello packets sent to back to the client.</td>
</tr>
<tr>
<td>SSLSessionsFailed</td>
<td>The number of Session ID's that were not authenticated by the server.</td>
</tr>
<tr>
<td>SSLSessions Resumed</td>
<td>The number of Session ID's authenticated by the server.</td>
</tr>
<tr>
<td>succSSLClientHellos</td>
<td>The number of Client Hello replies received by the client or packets received by the server.</td>
</tr>
<tr>
<td>succSSLServerHellos</td>
<td>The number of Server Hello's received by the client.</td>
</tr>
</tbody>
</table>
## FTP Performance Counters

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPUsers</td>
<td>Total number of Ftp User command packets transmitted.</td>
</tr>
<tr>
<td>FTPUserRate(/sec)</td>
<td>Number of Ftp User command packets transmitted per second.</td>
</tr>
<tr>
<td>FTPUserLatency (milisecs)</td>
<td>Interval between transmitting a Ftp User command packet and receiving a response in msec.</td>
</tr>
<tr>
<td>MinFTPUserLatency (milisecs)</td>
<td>Minimum FTPUsersLatency in msec.</td>
</tr>
<tr>
<td>MaxFTPUserLatency (milisecs)</td>
<td>Maximum FTPUsersLatency in msec.</td>
</tr>
<tr>
<td>SuccFTPUsers</td>
<td>Total number of successful Ftp User command replies received.</td>
</tr>
<tr>
<td>SuccFTPUserRate (/sec)</td>
<td>Number of successful Ftp User command replies received per second.</td>
</tr>
<tr>
<td>FTPPasses</td>
<td>Total number of FTP PASS packets transmitted.</td>
</tr>
<tr>
<td>FTPPassRate(/sec)</td>
<td>Number of FTP PASS packets transmitted per second.</td>
</tr>
<tr>
<td>FTPPassLatency (milisecs)</td>
<td>Interval between transmitting a Ftp PASS packet and receiving a response in msec.</td>
</tr>
<tr>
<td>MinFTPPassLatency (milisecs)</td>
<td>Minimum FTPPassLatency in msec.</td>
</tr>
<tr>
<td>MaxFTPPassLatency (milisecs)</td>
<td>Maximum FTPPassLatency in msec.</td>
</tr>
<tr>
<td>SuccFTPPasses</td>
<td>Total number of successful FTP PASS replies received.</td>
</tr>
<tr>
<td>SuccFTPPassRate (/sec)</td>
<td>Number of successful FTP PASS replies received per second.</td>
</tr>
<tr>
<td>FTPControl Connections</td>
<td>Total number of SYN packets transmitted by the FTP client.</td>
</tr>
<tr>
<td>FTPControl ConnectionRate (/sec)</td>
<td>Number of SYN packets transmitted by the FTP client per second.</td>
</tr>
</tbody>
</table>
### System Resource Monitoring

#### Chapter 21

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SuccFTPControl Connections</td>
<td>Total number of SYN ACK packets received by the FTP client.</td>
</tr>
<tr>
<td>SuccFTPControl ConnectionRate (/sec)</td>
<td>Number of SYN ACK packets received by the FTP Client per second.</td>
</tr>
<tr>
<td>FTPData Connections</td>
<td>Number of SYN ACK packets received by the FTP client.</td>
</tr>
<tr>
<td>FTPDataConnectionRate (/sec)</td>
<td>Number of SYN ACK packets transmitted by the FTP Client or received by the FTP Server per second.</td>
</tr>
<tr>
<td>SuccFTPData Connections</td>
<td>Total number of SYN ACK packets transmitted by the FTP Client or received by the FTP Server.</td>
</tr>
<tr>
<td>SuccFTPData ConnectionRate (/sec)</td>
<td>Number of SYN ACK packets received by the FTP server per second.</td>
</tr>
<tr>
<td>FtpAuthFailed</td>
<td>Total number of error replies received by the FTP client.</td>
</tr>
<tr>
<td>FTPGets</td>
<td>Total number of client Get requests.</td>
</tr>
<tr>
<td>FTPPuts</td>
<td>Total number of client Put requests.</td>
</tr>
<tr>
<td>SuccFTPGets</td>
<td>Total number of successful Get requests (data has been successfully transferred from server to client).</td>
</tr>
<tr>
<td>SuccFTPPuts</td>
<td>Total number of successful Put requests (data has been successfully transferred from client to server).</td>
</tr>
</tbody>
</table>

### SMTP Performance Counters

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMTPHelos</td>
<td>Total number of HELO packets transmitted.</td>
</tr>
<tr>
<td>SMTPHeloRate(/sec)</td>
<td>Number of HELO packets transmitted per second.</td>
</tr>
<tr>
<td>SMTPHeloLatency (miliseconds)</td>
<td>Interval between transmitting a HELO packet and receiving a response in msec.</td>
</tr>
<tr>
<td>MinSMTPHeloLatency (miliseconds)</td>
<td>Minimum SMTPHeloLatency in msec.</td>
</tr>
<tr>
<td>Measurement</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------------</td>
<td>------------------------------------------------------------------</td>
</tr>
<tr>
<td>MaxSMTPHelo Latency(milisecs)</td>
<td>Maximum SMTPHeloLatency in msec.</td>
</tr>
<tr>
<td>SuccSMTPHelos</td>
<td>Total number of successful HELO replies received.</td>
</tr>
<tr>
<td>SuccSMTPHelo Rate(/sec)</td>
<td>Number of successful HELO replies received per second.</td>
</tr>
<tr>
<td>SMTPMailFroms</td>
<td>Total number of Mail From packets transmitted.</td>
</tr>
<tr>
<td>SMTPMailFromRate (/sec)</td>
<td>Number of Mail From packets transmitted per second.</td>
</tr>
<tr>
<td>SMTPMailFrom Latency(milisecs)</td>
<td>Interval between transmitting a Mail From packet and</td>
</tr>
<tr>
<td></td>
<td>receiving a response in msec.</td>
</tr>
<tr>
<td>MinSMTPMailFrom Latency(milisecs)</td>
<td>Minimum SMTPMailFromLatency in msec.</td>
</tr>
<tr>
<td>MaxSMTPMailFrom Latency(milisecs)</td>
<td>Maximum SMTPMailFromLatency in msec.</td>
</tr>
<tr>
<td>SuccSMTPMailFroms</td>
<td>Total number of successful Mail From replies received.</td>
</tr>
<tr>
<td>SuccSMTPMailFromRate(/sec)</td>
<td>Number of successful Mail From replies received per second.</td>
</tr>
<tr>
<td>SMTPRcptTos</td>
<td>Total number of RcptTo packets transmitted.</td>
</tr>
<tr>
<td>SMTPRcptToRate (/sec)</td>
<td>Number of RcptTo packets transmitted per second.</td>
</tr>
<tr>
<td>SMTPRcptTo Latency(milisecs)</td>
<td>Interval between transmitting a RcptTo packet and</td>
</tr>
<tr>
<td></td>
<td>receiving a response in msec.</td>
</tr>
<tr>
<td>MinSMTPRcptTo Latency(milisecs)</td>
<td>Minimum SMTPRcptToLatency in msec.</td>
</tr>
<tr>
<td>MaxSMTPRcptTo Latency(milisecs)</td>
<td>Maximum SMTPRcptToLatency in msec.</td>
</tr>
<tr>
<td>SuccSMTPRcptTos</td>
<td>Total number of successful RcptTo replies received.</td>
</tr>
<tr>
<td>SuccSMTPRcptToRate(/sec)</td>
<td>Number of successful RcptTo replies received per second.</td>
</tr>
</tbody>
</table>
### Chapter 21 • System Resource Monitoring

#### SMTP Performance Counters

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMTPDatas</td>
<td>Total number of Data packets transmitted.</td>
</tr>
<tr>
<td>SMTPDataRate(/sec)</td>
<td>Number of Data packets transmitted per second.</td>
</tr>
<tr>
<td>SMTPDataLatency (milisecs)</td>
<td>Interval between transmitting a Data packet and receiving a response in msec.</td>
</tr>
<tr>
<td>MinSMTPDataLatency (milisecs)</td>
<td>Minimum SMTPDataLatency in msec.</td>
</tr>
<tr>
<td>MaxSMTPDataLatency (milisecs)</td>
<td>Maximum SMTPDataLatency in msec.</td>
</tr>
<tr>
<td>SuccSMTPDatas</td>
<td>Total number of successful Data replies received.</td>
</tr>
<tr>
<td>SuccSMTPDataRate (/sec)</td>
<td>Number of successful Data replies received per second.</td>
</tr>
</tbody>
</table>

#### POP3 Performance Counters

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>POP3Users</td>
<td>Total number of Pop3 User command packets transmitted.</td>
</tr>
<tr>
<td>POP3UserRate(/sec)</td>
<td>Number of Pop3 User command packets transmitted per second.</td>
</tr>
<tr>
<td>POP3UserLatency (milisecs)</td>
<td>Interval between transmitting a Pop3 User command packet and receiving a response in msec.</td>
</tr>
<tr>
<td>MinPOP3UserLatency (milisecs)</td>
<td>Minimum POP3UserLatency in msec.</td>
</tr>
<tr>
<td>MaxPOP3UserLatency (milisecs)</td>
<td>Maximum POP3UserLatency in msec.</td>
</tr>
<tr>
<td>SuccPOP3Users</td>
<td>Total number of successful Pop3 User replies received.</td>
</tr>
<tr>
<td>SuccPOP3UserRate (/sec)</td>
<td>Number of successful Pop3 User replies received per second.</td>
</tr>
<tr>
<td>POP3Passes</td>
<td>Total number of Pop3 Pass command packets transmitted.</td>
</tr>
</tbody>
</table>
### LoadRunner Controller User's Guide • Monitoring a Scenario

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>POP3PassRate(/sec)</td>
<td>Number of Pop3 Pass command packets transmitted per second.</td>
</tr>
<tr>
<td>POP3PassLatency(milisecs)</td>
<td>Interval between transmitting a Pop3 Pass packet and receiving a response in msec.</td>
</tr>
<tr>
<td>MaxPOP3PassLatency(milisecs)</td>
<td>Maximum POP3PassLatency in msec.</td>
</tr>
<tr>
<td>SuccPOP3Passes</td>
<td>Total number of successful Pop3 Pass replies received.</td>
</tr>
<tr>
<td>SuccPOP3PassRate(/sec)</td>
<td>Number of successful Pop3 Pass replies received per second.</td>
</tr>
<tr>
<td>POP3Stats</td>
<td>Total number of Pop3 Stat command packets sent.</td>
</tr>
<tr>
<td>POP3StatRate(/sec)</td>
<td>Number of Pop3 Stat command packets transmitted per second.</td>
</tr>
<tr>
<td>POP3StatLatency(milisecs)</td>
<td>Interval between transmitting a Pop3 Stat packet and receiving a response in msec.</td>
</tr>
<tr>
<td>MaxPOP3StatLatency(milisecs)</td>
<td>Maximum POP3StatLatency in msec.</td>
</tr>
<tr>
<td>SuccPOP3Stats</td>
<td>Total number of successful Pop3 Stat replies received.</td>
</tr>
<tr>
<td>SuccPOP3StatRate(/sec)</td>
<td>Number of successful Pop3 Stat replies received per second.</td>
</tr>
<tr>
<td>POP3Lists</td>
<td>Total number of Pop3 List command packets transmitted.</td>
</tr>
<tr>
<td>POP3ListRate(/sec)</td>
<td>Number of Pop3 List command packets transmitted per second.</td>
</tr>
<tr>
<td>POP3ListLatency(milisecs)</td>
<td>Interval between transmitting a Pop3 List packet and receiving a response in msec.</td>
</tr>
</tbody>
</table>
## System Resource Monitoring

### POP3 Performance Counters

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MinPOP3ListLatency(milisecs)</td>
<td>Minimum POP3ListLatency in msec.</td>
</tr>
<tr>
<td>MaxPOP3ListLatency(milisecs)</td>
<td>Maximum POP3ListLatency in msec.</td>
</tr>
<tr>
<td>SuccPOP3Lists</td>
<td>Total number of successful Pop3Lists received.</td>
</tr>
<tr>
<td>SuccPOP3ListRate (/sec)</td>
<td>Number of successful Pop3Lists received per second.</td>
</tr>
<tr>
<td>POP3Retrs</td>
<td>Total number of Pop3 Retr packets transmitted.</td>
</tr>
<tr>
<td>POP3RetrRate(/sec)</td>
<td>Number of Pop3 Retr packets transmitted per second.</td>
</tr>
<tr>
<td>POP3RetrLatency(milisecs)</td>
<td>Interval between transmitting a Pop3 Retr packet and receiving a response in msec.</td>
</tr>
<tr>
<td>MinPOP3RetrLatency(milisecs)</td>
<td>Minimum POP3RetrLatency in msec.</td>
</tr>
<tr>
<td>MaxPOP3RetrLatency(milisecs)</td>
<td>Maximum POP3RetrLatency in msec.</td>
</tr>
<tr>
<td>SuccPOP3Retrs</td>
<td>Total number of successful Pop3Retrs received.</td>
</tr>
<tr>
<td>SuccPOP3RetrRate (/sec)</td>
<td>Number of successful Pop3Retrs received per second.</td>
</tr>
</tbody>
</table>

### DNS Performance Counters

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SuccPrimaryDNSRequest</td>
<td>Total number of Successful DNS requests made to the Primary DNS server.</td>
</tr>
<tr>
<td>SuccSecondaryDNSRequest</td>
<td>Total number of Successful DNS requests made to the Secondary DNS server.</td>
</tr>
<tr>
<td>SuccDNSDataRequestRate(/sec)</td>
<td>Number of Successful DNS Request packets transmitted per second.</td>
</tr>
<tr>
<td>PrimaryDNSFailure</td>
<td>Total number of DNS requests failures received from the Primary DNS server.</td>
</tr>
</tbody>
</table>

299
### Measurement | Description
--- | ---
PrimaryDNSRequest | Total number of DNS requests made to the Primary DNS server.
SecondaryDNS Failure | Total number of DNS requests failures received from the Secondary DNS server.
SecondaryDNS Request | Total number of DNS requests made to the Secondary DNS server.
MinDNSData Latency | Minimum DNS Data Latency in msec.
MaxDNSData Latency | Maximum DNS Data Latency in msec.
CurDNSData Latency | Interval between sending a DNS request packet and receiving a response in msec.
DNSDataRequest Rate(/sec) | Number of DNS Request packets transmitted per second.
NoOf ReTransmission | Total number of DNS Request packets re
NoOfAnswers | Total number of Answers to the DNS Request packets.

### Attacks Performance Counters

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attacks</td>
<td>Total number of attack packets transmitted (All Attacks)</td>
</tr>
<tr>
<td>AttackRate(/sec)</td>
<td>Number of attack packets transmitted per second (ARP, Land, Ping, SYN, and Smurf)</td>
</tr>
<tr>
<td>Havoc Flood</td>
<td>Number of Havoc packets generated (Stacheldraht only)</td>
</tr>
<tr>
<td>Icmp Flood</td>
<td>Number of ICMP attack packets generated (TFN, TFN2K, &amp; Stacheldraht)</td>
</tr>
<tr>
<td>Mix Flood</td>
<td>Number of Mix packets generated (TFN2K only)</td>
</tr>
<tr>
<td>Mstream Flood</td>
<td>Number of Mstream packets generated (Stacheldraht only)</td>
</tr>
</tbody>
</table>
### Measurement | Description
--- | ---
Null Flood | Number of Null packets generated  (Stacheldraht only)
Smurf Flood | Number of Smurf packets generated  (TFN, TFN2K, & Stacheldraht)
Syn Flood | Number of SYN packets generated  (TFN, TFN2K, & Stacheldraht)
Targa Flood | Number of Targa packets generated  (TFN2K only)
Udp Flood | Number of UDP packets generated  (All DDoS Attacks only)

7 Click **OK** in the Antara FlameThrower Monitor Configuration dialog box, and in the Antara FlameThrower dialog box, to activate the Antara FlameThrower monitor.

.
Network Monitoring

You can use Network monitoring to determine whether your network is causing a delay in the scenario. You can also determine the problematic network segment.

Note: You must have administrator privileges on the Windows source machine in order to run the Network monitor (unless you are using the ICMP protocol).

This chapter describes:

- Network Monitoring from a UNIX Source Machine
- Configuring the Network Monitor
- Viewing the Network Delay Time Graph

About Network Monitoring

Network configuration is a primary factor in the performance of applications. A poorly designed network can slow client activity to unacceptable levels.

In a true Web or client/server system, there are many network segments. A single network segment with poor performance can affect the entire system.
The following diagram shows a typical network. In order to go from the server machine to the Vuser machine, data must travel over several segments.

To measure network performance, the Network monitor sends packets of data across the network. When a packet returns, the monitor calculates the time it takes for the packet to go to the requested node and return. This time is the delay which appears in the Network Delay Time graph.

Using the online Network Delay Time graph, you can locate the network-related problem so that it can be fixed.

**Note:** The delays from the source machine to each of the nodes are measured concurrently, yet independently. It is therefore possible that the delay from the source machine to one of the nodes could be greater than the delay for the complete path between the source and destination machines.
Network Monitoring from a UNIX Source Machine

You can run the Network monitor on UNIX machines, using UDP or ICMP. Before running the Network monitor from a UNIX source machine:

➤ configure the source machine by assigning root permissions to the merc_webtrace process.
➤ make the necessary adjustments to either connect to the source machine through rsh, or through the agent.

Configuring the Source Machine

To configure the source machine, where LoadRunner is installed locally:

To assign root permissions to the merc_webtrace process, add an s-bit to merc_webtrace's permissions, as follows:

1 Log in to the source machine as root.
2 Type: cd LR_installation/bin to change to the bin directory.
3 Type: chown root merc_webtrace to make the root user the owner of the merc_webtrace file.
4 Type: chmod +s merc_webtrace to add the s-bit to the file permissions.
5 To verify, type ls -l merc_webtrace. The permissions should look like: -rwsrwsr-x.

To configure the source machine, where LoadRunner is installed on the network:

In a LoadRunner network installation, the merc_webtrace process is on the network, not on the source machine disk. The following procedure copies the merc_webtrace file to the local disk, configures mdrv.dat to recognize the process, and assigns root permissions to merc_webtrace:

1 Copy merc_webtrace from LR_installation/bin to anywhere on the local disk of the source machine. For example, to copy the file to the /local/LR directory, type: cp /net/tools/LR_installation/bin/merc_webtrace /local/LR
**LoadRunner Controller User’s Guide • Monitoring a Scenario**

**Note:** All of the source machines that use the same network installation must copy `merc_webtrace` to the identical directory path on their local disk (for example, `/local/LR`), since all of them use the same `mdrv.dat`.

2 Add the following line to the `LR_installation/dat/mdrv.dat` file, in the `[monitors_server]` section:

```
ExtCmdLine=-merc_webtrace_path /local/xxx
```

3 Log in to the source machine as root.

4 Type: `cd LR_installation/bin` to change to the `bin` directory.

5 Type: `chown root merc_webtrace` to make the root user the owner of the `merc_webtrace` file.

6 Type: `chmod +s merc_webtrace` to add the s-bit to the file permissions.

7 To verify, type: `ls -l merc_webtrace`. The permissions should look like: `-rwsrwsr-x`.

**Connecting to the Source Machine Through RSH**

If the Controller is connected to the source machine through rsh (default connection mode), then you don’t need to activate the agent daemon. Before running the Network monitor the first time, you enter an encrypted user name and password in the Network monitor configuration file.

**To create an encrypted user name and password:**

1 On the Controller machine, type: `cd LR_installation/bin` to change to the `bin` directory.

2 Run `CryptonApp.exe`.

3 Type your RSH user name and password, separated by a vertical bar symbol. For example, `myname|mypw`.

4 Copy the encrypted string to the clipboard (highlight the string and click `ctrl+c`).
5 Add the following line to the LR_installation/dat/monitors/ndm.cfg file, in the [hosts] section:

Host = <encrypted string copied from clipboard>

6 Close and open the current scenario. LoadRunner will read the updated configuration file and recognize the source machine for monitoring.

**Connecting to the Source Machine Through the Agent**

If the Controller is not connected to the source machine through RSH, then make sure that the agent daemon is active on the source machine before running the Network monitor. For more information about working without RSH, refer to the section titled “UNIX Shell” in Appendix D, “Troubleshooting the Controller.”

**To activate the agent daemon:**

If you are not working in RSH, invoke the agent daemon on the source machine.

1 Type m_daemon_setup -install from the LR_installation/bin directory.

2 Make sure that the agent daemon is running whenever you activate the Network monitor.
Configuring the Network Monitor

You configure the Network monitor from the Run view of the Controller before you begin running a scenario. Using the Network Delay Time and Add Destination Machines for Network Delay Monitoring dialog boxes, you select the network path you want to monitor.

Note: To enable network monitoring, you must install the LoadRunner agent on the source machine. You do not have to install the LoadRunner agent on the destination machine.

To configure the Network monitor:

1 In the graph tree view, select the Network Delay Time graph and drag it into the right pane.

2 Right-click the graph and choose Add Measurement(s), or choose Monitors > Add Online Measurement. The Network Delay Time dialog box opens.
3 In the **Monitor the network delay from machine** section, click **Add** to enter the server name or IP address of the source machine, from which you want the network path monitoring to begin. Select the platform on which the machine runs, and click **OK**.

4 In the **To machine(s)** section of the Network Delay Time dialog box, click **Add** to enter the name of the machine at the final destination of the path you want to monitor. The Add Destination Machines for Network Delay Monitoring dialog box opens.

5 Click **Add**, enter the name of the destination machine, and click **OK**. The name of the machine appears in the Add Destination Machines for Network Delay Monitoring dialog box. Repeat this procedure for each path you want to monitor.

---

**Note:** If the destination machine is *localhost*, enter the local machine’s name and not *localhost*.

To rename a machine, click **Rename**, and enter a new name for the machine.

To delete a machine, select it and click **Delete**.
6 Click **Properties** to configure additional network monitor settings. The Network Monitor Settings for Defined Path dialog box opens.

7 In the Monitor Settings box, select the protocol and enter the port number being used by the network path. The Network monitor supports three protocols: TCP, UDP, and ICMP. It is recommended that you use the default protocol. In Windows, the default is TCP, and in UNIX, the default is UDP.

8 Select **Enable display of network nodes by DNS names** if you want to view the DNS name of each node along the network path, in addition to its IP address. Note that selecting this option will decrease the speed of the Network monitor.

9 In the Monitoring Frequency box, select the number of milliseconds the monitor should wait between receiving a packet and sending out the next packet. The default value is 3000 milliseconds. If you have a long, steady scenario, you can increase the interval by several seconds.
10 In the Monitoring Packet Retries box, select the maximum number of seconds that the monitor should wait for a packet to return before it retries to send the packet. The default value is 3 seconds. If your network is very large and loaded (an internet connection with a low capacity), you should increase the value by several seconds. If you have a small network (such as a LAN), you can decrease the value.

In addition, select the number of times the Network monitor should try resending a packet to a node if the packet is not initially returned. The default value is 0.

**Network Monitoring over a Firewall**

If you are monitoring a network in which there are firewalls between the source and the destination machines, you must configure the firewalls to allow the network data packets to reach their destinations.

➤ If you are using the TCP protocol, the firewall that protects the destination machine should not block outgoing ICMP_TIMEEXCEEDED packets (packets that are sent outside the firewall from the machine). In addition, the firewall protecting the source machine should allow ICMP_TIMEEXCEEDED packets to enter, as well as TCP packets to exit.

➤ If you are using the ICMP protocol, the destination machine’s firewall should not block incoming ICMP_ECHO_REQUEST packets, or outgoing ICMP_ECHO_REPLY and ICMP_ECHO_TIMEEXCEEDED packets. In addition, the firewall protecting the source machine should allow ICMP_ECHO_REPLY and ICMP_ECHO_TIMEEXCEEDED packets to enter, and ICMP_ECHO_REQUEST packets to exit.

➤ If you are using the UDP protocol, ensure that the UDP protocol can access the destination machine from the source machine. The destination machine’s firewall should not block outgoing ICMP_DEST_UNREACHABLE and ICMP_ECHO_TIMEEXCEEDED packets. In addition, the firewall protecting the source machine should allow ICMP_DEST_UNREACHABLE and ICMP_ECHO_TIMEEXCEEDED packets to enter.
Note: To run the Network Delay Monitor when there are firewalls between the Controller machine and the source machine, you must configure the LoadRunner agent, MI Listener, and Network monitor for monitoring over a firewall. For more information see “Configuring the LoadRunner Agents in LAN1,” on page 194, “Installing and Configuring the MI_Listener in LAN2,” on page 203, and “Configuring the Network Delay Monitor over a Firewall,” on page 241.

Viewing the Network Delay Time Graph

The Network Delay Time graph shows the delay for the complete path between the source and destination machines (y-axis) as a function of the elapsed scenario time (x-axis).

Each path defined in the Add Destination Machines for Network Delay Monitoring dialog box is represented by a separate line with a different color in the graph.

To view the DNS names of the measurements displayed in the legend, right-click the graph and select View as DNS Name.

To view the delay time from the source machine to each of the nodes along the network path, right-click the graph and select Configure. In the Graph Configuration dialog box, click SubPaths.

In addition, you can view the delay time for each segment of the path.
To view the delay time for the network segments:

1. Right-click the Network Delay Time graph, and select **View Segments**. The Network Breakdown dialog box opens.

   ![Network Breakdown Dialog Box]

2. Select the path that you want to break down.

3. Choose whether you want to view the network segments of the graph you chose as an area graph or a pie graph.

4. Click **OK** to close the Network Breakdown dialog box. The delay time for the network segments of the path you chose is displayed in the graph view area.

---

**Note:** The segment delays are measured approximately, and do not add up to the network path delay which is measured exactly. The delay for each segment of the path is estimated by calculating the delay from the source machine to one node and subtracting the delay from the source machine to another node. For example, the delay for segment B to C is calculated by measuring the delay from the source machine to point C, and subtracting the delay from the source machine to point B.

---

To return to the complete path delay time view, select **Hide Segments** from the right-click menu.
Firewall Server Performance Monitoring

During a scenario run, you can monitor the firewall server in order to isolate server performance bottlenecks.

This chapter describes:

➤ Configuring the Check Point FireWall-1 Server Monitor

About the Firewall Server Monitor

The Firewall server online monitor measures the performance of a Firewall server during scenario execution. In order to obtain performance data, you need to activate the Firewall server monitor before executing the scenario, and indicate which statistics and measurements you want to monitor.

Configuring the Check Point FireWall-1 Server Monitor

To monitor the Check Point FireWall-1 server, you must select the counters you want the Check Point FireWall-1 server monitor to measure. You select these counters using the Check Point FireWall-1 SNMP Resources dialog box.

To configure the Check Point FireWall-1 server monitor:

1. Click the Check Point FireWall-1 graph in the graph tree, and drag it into the right pane of the Run view.

2. Right-click the graph and choose Add Measurement(s), or choose Monitors > Add Online Measurement.
3 In the Monitored Server Machines section of the Check Point FireWall-1 dialog box, click **Add** to enter the server name or IP address of the machine you want to monitor. Select the platform on which the machine runs, and click **OK**.

**Note:** You can specify a port number in the `snmp.cfg` file. If you do not specify a port number, LoadRunner connects to port 260, the default port for the Check Point FireWall-1 SNMP agent. You can also specify a machine name and port number in the Add Machine dialog box using the following format:

```
<machine name>:<port number>
```

4 Click **Add** in the Resource Measurements section of the Check Point FireWall-1 dialog box. The Check Point FireWall-1 SNMP Resources dialog box opens.
5 Select the measurements you want to monitor. The following default counters can be monitored:

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>fwRejected</td>
<td>The number of rejected packets.</td>
</tr>
<tr>
<td>fwDropped</td>
<td>The number of dropped packets.</td>
</tr>
<tr>
<td>fwLogged</td>
<td>The number of logged packets.</td>
</tr>
</tbody>
</table>

6 Click Add to place the selected counter on the resource list. Add all the desired resources to the list, and click Close.

Note: The Check Point FireWall-1 monitor can only monitor up to 25 measurements.

7 Click OK in the Check Point FireWall-1 dialog box to activate the monitor.
**Note:** You can improve the level of measurement information for the Check Point FireWall-1 monitor by enabling measurements with string values to be listed (in addition to measurements with numeric values), and by enabling the name modifier (which displays the string value as an identifying part of the measurement name).

In the following example of a measurement using the name modifier, the string value of `ProcessName` (sched) is displayed in addition to its instance ID (0):

```
[psProcessName]
[0 sched]
[1 init]
[2 pagerout]
```

To enable this feature, add the following line to the `<LoadRunner root folder>\dat\monitors\snmp.cfg` file:

```
SNMP_show_string_nodes=1
```

**Usage Notes:** You can select more than one name modifier, but the first in the hierarchy will be used. Each time the Check Point FireWall-1 Add Measurements dialog box opens, the information is reread from the `snmp.cfg` file. You cannot add the same measurement twice (once with a name modifier and once without it). If you do so, an error message is issued.
Using LoadRunner’s Web Server Resource monitors, you can monitor the Apache, Microsoft IIS, iPlanet (SNMP), and iPlanet/Netscape servers during a scenario run and isolate server performance bottlenecks.

This chapter describes:

➤ Configuring the Apache Monitor
➤ Configuring the Microsoft IIS Monitor
➤ Configuring the iPlanet/Netscape Monitor
➤ Configuring the iPlanet (SNMP) Monitor
➤ Monitoring Using a Proxy Server

About Web Server Resource Monitors

Web Server Resource monitors provide you with information about the resource usage of the Apache, Microsoft IIS, iPlanet (SNMP), and iPlanet/Netscape Web servers during scenario execution. In order to obtain this data, you need to activate the online monitor for the server and specify which resources you want to measure before executing the scenario.

The procedures for selecting monitor measurements and configuring the monitors vary according to server type. The following sections contain specific configuration instructions for each server type.
**LoadRunner Controller User’s Guide • Monitoring a Scenario**

**Note:** Certain measurements or counters are especially useful for determining server performance and isolating the cause of a bottleneck during an initial stress test on a Web server. For more information about these counters, see “Useful Counters for Stress Testing” on page 554.

---

**Configuring the Apache Monitor**

To monitor an Apache server you need to know the server statistics information URL. A simple way to verify the statistics information URL is to try to view it through the browser.

The URL should be in the following format:

http://<server name/IP address>:<port number>/server-status?auto

For example:

http://stimpy:80/server-status?auto

**To configure the Apache monitor:**

1. Click the Apache graph in the graph tree, and drag it into the right pane of the Run view.

2. Right-click the graph and choose **Add Measurement(s)**, or choose **Monitors > Add Online Measurement**.

3. In the Monitored Server Machines section of the Apache dialog box, click **Add** to enter the server name or IP address of the machine you want to monitor. Select the platform on which the machine runs, and click **OK**.

4. In the Resource Measurements section of the Apache dialog box, click **Add** to select the measurements that you want to monitor.
The Apache - Add Measurements dialog box opens, displaying the available measurements and server properties.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td># Busy Servers</td>
<td>The number of servers in the Busy state</td>
</tr>
<tr>
<td># Idle Servers</td>
<td>The number of servers in the Idle state</td>
</tr>
<tr>
<td>Apache CPU Usage</td>
<td>The percentage of time the CPU is utilized by the Apache server</td>
</tr>
<tr>
<td>Hits/sec</td>
<td>The HTTP request rate</td>
</tr>
<tr>
<td>KBytes Sent/sec</td>
<td>The rate at which data bytes are sent from the Web server</td>
</tr>
</tbody>
</table>
5 In the Server Properties section, enter the Port number and URL (without the server name), and click OK. The default URL is /server-status?auto.

6 Click OK in the Apache dialog box to activate the monitor.

---

**Note:** The default port number and URL can vary from one server to another. Please consult your Web server administrator.

---

**To change the default server properties:**

1 Open the apache.cfg file in the `<LR root folder>\dat\monitors\` directory.

2 Edit the following parameters after the `Delimiter`: statement:

   - **InfoURL**: server statistics information URL
   - **ServerPort**: server port number
   - **SamplingRate**: rate (milliseconds) at which the LoadRunner monitor will poll the server for the statistics information. If this value is greater than 1000, LoadRunner will use it as its sampling rate. Otherwise, it will use the sampling rate defined in the Monitors tab of the Options dialog box.

---

**Note:** To monitor an Apache server through a firewall, use the Web server port (by default, port 80).
Configuring the Microsoft IIS Monitor

You select measurements for the Microsoft IIS Server monitor using the MS IIS dialog box.

Note: To monitor an IIS server through a firewall, use TCP, port 139.

To configure the IIS server monitor:

1. Click the MS IIS graph in the graph tree, and drag it into the right pane of the Run view.

2. Right-click the graph and choose Add Measurement(s), or choose Monitors > Add Online Measurement.

3. In the Monitored Server Machines section of the MS IIS dialog box, click Add to enter the server name or IP address of the machine you want to monitor. Select the platform on which the machine runs, and click OK.

4. In the Resource Measurements section of the MS IIS dialog box, select the measurements you want to monitor. The following table describes the default measurements that can be monitored:

<table>
<thead>
<tr>
<th>Object</th>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web Service</td>
<td>Bytes Sent/sec</td>
<td>The rate at which the data bytes are sent by the Web service</td>
</tr>
<tr>
<td>Web Service</td>
<td>Bytes Received/sec</td>
<td>The rate at which the data bytes are received by the Web service</td>
</tr>
<tr>
<td>Web Service</td>
<td>Get Requests/sec</td>
<td>The rate at which HTTP requests using the GET method are made. Get requests are generally used for basic file retrievals or image maps, though they can be used with forms.</td>
</tr>
<tr>
<td>Web Service</td>
<td>Post Requests/sec</td>
<td>The rate at which HTTP requests using the POST method are made. Post requests are generally used for forms or gateway requests.</td>
</tr>
<tr>
<td>Object</td>
<td>Measurement</td>
<td>Description</td>
</tr>
<tr>
<td>-------------</td>
<td>---------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Web Service</td>
<td>Maximum Connections</td>
<td>The maximum number of simultaneous connections established with the Web service</td>
</tr>
<tr>
<td>Web Service</td>
<td>Current Connections</td>
<td>The current number of connections established with the Web service</td>
</tr>
<tr>
<td>Web Service</td>
<td>Current NonAnonymous Users</td>
<td>The number of users that currently have a non-anonymous connection using the Web service</td>
</tr>
<tr>
<td>Web Service</td>
<td>Not Found Errors/sec</td>
<td>The rate of errors due to requests that could not be satisfied by the server because the requested document could not be found. These are generally reported to the client as an HTTP 404 error code.</td>
</tr>
<tr>
<td>Process</td>
<td>Private Bytes</td>
<td>The current number of bytes that the process has allocated that cannot be shared with other processes.</td>
</tr>
</tbody>
</table>

Note: To change the default counters for the Microsoft IIS Server monitor, see “Changing a Monitor’s Default Counters” on page 553.
To select additional measurements, click **Add**. A dialog box displaying the Web Service object, its counters, and instances opens.

Select a counter and an instance. You can select multiple counters using the **Ctrl** key. The instance is relevant only if multiple instances of the highlighted counter are running. For a description of each counter, click **Explain>>** to expand the dialog box.

Click **Add** to place the selected counter on the resource list. Add all the desired resources to the list, and click **Close**.

Click **OK** in the MS IIS dialog box to activate the monitor.

### Configuring the iPlanet/Netscape Monitor

To monitor an iPlanet/Netscape server, you need to know the administration server URL. A simple way to verify the administration server URL, is to try to view it through the browser.

The URL should be in the following format:

http://<admin_srv_name/IP address>:<port number>/https:<admin_srv_name/IP address>/bin/sitemon?doit

for example:

http://lazarus:12000/https-lazarus.mercury.co.il/bin/sitemon?doit
Note: In some server configurations, the URL must contain the administration server name and not the IP address.

In addition, the administration server name may differ from the iPlanet/Netscape server name.

To activate the iPlanet/Netscape monitor from the Controller:

1. Click the iPlanet/Netscape graph in the graph tree, and drag it into the right pane of the Run view.

2. Right-click the graph and choose Add Measurement(s), or choose Monitors > Add Online Measurement.

3. In the Monitored Server Machines section of the iPlanet/Netscape dialog box, click Add to enter the server name or IP address of the machine you want to monitor. Select the platform on which the machine runs, and click OK.

4. In the Resource Measurements section of the iPlanet/Netscape dialog box, click Add to select the measurements that you want to monitor.
Another iPlanet/Netscape - Add Measurements dialog box opens, displaying the available measurements and server properties:

Select the required measurements. You can select multiple measurements using the Ctrl key.

The following table describes the measurements and server properties that can be monitored:

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>200/sec</td>
<td>The rate of successful transactions being processed by the server</td>
</tr>
<tr>
<td>2xx/sec</td>
<td>The rate at which the server handles status codes in the 200 to 299 range</td>
</tr>
<tr>
<td>302/sec</td>
<td>The rate of relocated URLs being processed by the server</td>
</tr>
</tbody>
</table>
### Table: Measurement and Description

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>304/sec</td>
<td>The rate of requests for which the server tells the user to use a local copy of a URL instead of retrieving a newer version from the server</td>
</tr>
<tr>
<td>3xx/sec</td>
<td>The rate at which the server handles status codes in the 300 to 399 range</td>
</tr>
<tr>
<td>401/sec</td>
<td>The rate of unauthorized requests handled by the server</td>
</tr>
<tr>
<td>403/sec</td>
<td>The rate of forbidden URL status codes handled by the server</td>
</tr>
<tr>
<td>4xx/sec</td>
<td>The rate at which the server handles status codes in the 400 to 499 range</td>
</tr>
<tr>
<td>5xx/sec</td>
<td>The rate at which the server handles status codes 500 and higher</td>
</tr>
<tr>
<td>Bad requests/sec</td>
<td>The rate at which the server handles bad requests</td>
</tr>
<tr>
<td>Bytes sent/sec</td>
<td>The rate at which bytes of data are sent from the Web server</td>
</tr>
<tr>
<td>Hits/sec</td>
<td>The HTTP request rate</td>
</tr>
<tr>
<td>xxx/sec</td>
<td>The rate of all status codes (2xx-5xx) handled by the server, excluding timeouts and other errors that did return an HTTP status code</td>
</tr>
</tbody>
</table>

5 Fill in the Server Properties:

➤➤Enter the user login name and password. The user must have administrator permissions on the server.

➤➤Enter the port number and URL (without the server name), and click OK. The default URL is /https-<admin_server>/bin/sitemon?doit.

6 Click OK in the iPlanet/Netscape dialog box to activate the monitor.

---

Note: The default port number and URL can vary from one server to another. Please consult the Web server administrator. In some server configurations, the URL must contain the administration server name and not the IP address.
To change the default server properties:

1. Open the *Netscape.cfg* file in the `<LR root folder>\dat\monitors\` directory.

2. Edit the following parameters in the [Netscape] section:

   - **Counters**: number of counters that the LoadRunner iPlanet/Netscape monitor will show you. This value should match the number of counters defined in the file.
   - **InfoURL**: server statistics information URL
   - **ServerPort**: server port number
   - **ServerLogin**: login name to the server
   - **ServerPassword**: login password for the login name
   - **SamplingRate**: rate (milliseconds) at which the LoadRunner monitor will poll the server for the statistics information. If this value is greater than 1000, LoadRunner will use it as its sampling rate. Otherwise, it will use the sampling rate defined in the Monitors tab of the Options dialog box.

---

**Note:** To monitor an iPlanet/Netscape server through a firewall, use the iPlanet/Netscape Administration server port. Configure this port during the server installation process.
Configuring the iPlanet (SNMP) Monitor

The iPlanet (SNMP) monitor uses the Simple Network Management Protocol (SNMP) to retrieve iPlanet (SNMP) server statistics. You define the measurements for the iPlanet (SNMP) monitor using the iPlanet (SNMP) dialog box.

Note: To monitor a iPlanet (SNMP) server, use port 161 or 162, depending on the configuration of the agent.

To configure the iPlanet (SNMP) Resources monitor:

1. Click the iPlanet (SNMP) graph in the graph tree, and drag it into the right pane of the Run view.

2. Right-click the graph and choose Add Measurement(s), or choose Monitors > Add Online Measurement.

3. In the Monitored Server Machines section of the iPlanet (SNMP) dialog box, click Add to enter the server name or IP address of the machine you want to monitor. Select the platform on which the machine runs, and click OK.

Note: You need to define the port number if the iPlanet SNMP agent is running on a different port than the default SNMP port. Enter the following information in the Add Machine dialog box:

<server name:port number>

For example: digi:8888

In addition, you can define the default port for your iPlanet server in the configuration file, snmp.cfg, located in <LoadRunner root folder>\dat\monitors. For example, if the port used by the SNMP agent on your WebLogic server is 8888, you should edit the snmp.cfg file as follows:

; iPlanet (WebServer)
[cm_snmp_mon_iws60]
port=8888
4 In the Resource Measurements section of the iPlanet (SNMP) dialog box, click Add to select the measurements that you want to monitor. The iPlanet (SNMP) dialog box opens.

5 Browse the iPlanet (SNMP) Object tree.

6 To measure an object, select it, and click Add. For a description of each resource, click Explain>> to expand the dialog box. Add all the desired resources to the list, and click Close.

Note: The iPlanet (SNMP) monitor can only monitor up to 25 measurements.

7 Click OK in the iPlanet (SNMP) dialog box to activate the monitor.
Note: You can improve the level of measurement information for the iPlanet (SNMP) monitor by enabling measurements with string values to be listed (in addition to measurements with numeric values), and by enabling the name modifier (which displays the string value as an identifying part of the measurement name).

In the following example of a measurement using the name modifier, the string value of ProcessName (sched) is displayed in addition to its instance ID (0):

```
[pid=ProcessName]
[0 sched]
[1 init]
[2 pageout]
```

To enable this feature, add the following line to the `<LoadRunner root folder>/dat/monitors/snmp.cfg` file:

```
SNMP_show_string_nodes=1
```

Usage Notes: You can select more than one name modifier, but the first in the hierarchy will be used. Each time the iPlanet SNMP Add Measurements dialog box opens, the information is reread from the `snmp.cfg` file. You cannot add the same measurement twice (once with a name modifier and once without it). If you do so, an error message is issued.
Monitoring Using a Proxy Server

LoadRunner allows you to monitor using the Apache and Netscape monitors when there is a proxy server between the Controller and the monitored server. To enable this, you must define settings in your configuration file: in `<LR root folder>\dat\monitors\apache.cfg` for the Apache monitor, or in `<LR root folder>\dat\monitors\Netscape.cfg` for the Netscape monitor.

Before defining settings, you need to determine whether you want LoadRunner to obtain proxy settings from your Internet Explorer connection configuration, or from the proxy settings in the configuration file.

To have LoadRunner read proxy settings from your Internet Explorer connection:

1. In the Proxy Settings section of the configuration file, assign `useProxy` a value of 1.
2. If the proxy requires a username, password, or domain, enter these parameters on the lines `proxyUsername`, `proxyPassword`, and `proxyDomain`.

To have LoadRunner read proxy settings from the configuration file:

1. In the Proxy Settings section of the configuration file, enter the proxy information on the `httpProxy` line. Use the format:
   
   
   For example:
   
2. If the proxy requires a username, password, or domain, enter these parameters on the lines `proxyUsername`, `proxyPassword`, and `proxyDomain`.

To have LoadRunner connect directly to the server (any proxy settings are ignored):

In the Proxy Settings section of the configuration file, assign `useProxy` a value of 0.
You can monitor a Web application server during a scenario run and isolate application server performance bottlenecks using LoadRunner's Web Application Server Resource monitors.

This chapter describes:

➤ Configuring the Ariba Monitor
➤ Configuring the ATG Dynamo Monitor
➤ Configuring the BroadVision Monitor
➤ Configuring the ColdFusion Monitor
➤ Configuring the Fujitsu INTERSTAGE Monitor
➤ Configuring the Microsoft Active Server Pages Monitor
➤ Configuring the Oracle9iAS HTTP Monitor
➤ Configuring the SilverStream Monitor
➤ Configuring the WebLogic (SNMP) Monitor
➤ Configuring the WebLogic (JMX) Monitor
➤ Configuring the WebSphere Monitor
➤ Configuring the WebSphere (EPM) Monitor
About Web Application Server Resource Monitors

Web Application Server Resource monitors provide you with information about the resource usage of the Ariba, ATG Dynamo, BroadVision, ColdFusion, Fujitsu INTERSTAGE, Microsoft ASP, Oracle9iAS HTTP, SilverStream, WebLogic (SNMP), WebLogic (JMX), and WebSphere application servers during scenario execution. In order to obtain performance data, you need to activate the online monitor for the server and specify which resources you want to measure before executing the scenario.

The procedures for selecting monitor measurements and configuring the monitors vary according to server type. The following sections contain specific configuration instructions for each server type.

Configuring the Ariba Monitor

You select measurements to monitor the Ariba server using the Ariba Monitor Configuration dialog box.

---

Note: The port you use to monitor an Ariba server through a firewall depends on the configuration of your server.

---

To configure the Ariba monitor:

1. Click the Ariba graph in the graph tree, and drag it into the right pane of the Run view.

2. Right-click the graph and choose Add Measurement(s), or choose Monitors > Add Online Measurement.

3. In the Monitored Server Machines section of the Ariba dialog box, click Add to enter the server name or IP address of the machine you want to monitor. Enter the server name or IP address according to the following format: `<server name>:`<port number>.

   For example: merc1:12130
Select the platform on which the machine runs, and click OK.

4 Click **Add** in the Resource Measurements section of the Ariba dialog box to select the measurements that you want to monitor. The Ariba Monitor Configuration dialog box opens.

5 Browse the Measured Components tree.

6 Check the required performance counters in the Ariba Monitor Configuration window’s right pane.
The following tables describe the counters that can be monitored:

**Core Server Performance Counters**

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requisitions Finished</td>
<td>The instantaneous reading of the length of the worker queue at the moment this metric is obtained. The longer the worker queue, the more user requests are delayed for processing.</td>
</tr>
<tr>
<td>Worker Queue Length</td>
<td>The instantaneous reading of the length of the worker queue at the moment this metric is obtained. The longer the worker queue, the more user requests are delayed for processing.</td>
</tr>
<tr>
<td>Concurrent Connections</td>
<td>The instantaneous reading of the number of concurrent user connections at the moment this metric is obtained</td>
</tr>
<tr>
<td>Total Connections</td>
<td>The cumulative number of concurrent user connections since Ariba Buyer was started.</td>
</tr>
<tr>
<td>Total Memory</td>
<td>The instantaneous reading of the memory (in KB) being used by Ariba Buyer at the moment this metric is obtained</td>
</tr>
<tr>
<td>Free Memory</td>
<td>The instantaneous reading of the reserved memory (in KB) that is not currently in use at the moment this metric is obtained</td>
</tr>
<tr>
<td>Up Time</td>
<td>The amount of time (in hours and minutes) that Ariba Buyer has been running since the previous time it was started</td>
</tr>
<tr>
<td>Number of Threads</td>
<td>The instantaneous reading of the number of server threads in existence at the moment this metric is obtained</td>
</tr>
<tr>
<td>Number of Cached Objects</td>
<td>The instantaneous reading of the number of Ariba Buyer objects being held in memory at the moment this metric is obtained</td>
</tr>
<tr>
<td>Average Session Length</td>
<td>The average length of the user sessions (in seconds) of all users who logged out since previous sampling time. This value indicates on average how long a user stays connected to server.</td>
</tr>
</tbody>
</table>
## Web Application Server Resource Monitoring

### Chapter 25

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average Idle Time</strong></td>
<td>The average idle time (in seconds) for all the users who are active since previous sampling time. The idle time is the period of time between two consecutive user requests from the same user.</td>
</tr>
<tr>
<td><strong>Approves</strong></td>
<td>The cumulative count of the number of approves that happened during the sampling period. An Approve consists of a user approving one Approvable.</td>
</tr>
<tr>
<td><strong>Submits</strong></td>
<td>The cumulative count of the number of Approvables submitted since previous sampling time.</td>
</tr>
<tr>
<td><strong>Denies</strong></td>
<td>The cumulative count of the number of submitted Approvables denied since previous sampling time.</td>
</tr>
<tr>
<td><strong>Object Cache Accesses</strong></td>
<td>The cumulative count of accesses (both reads and writes) to the object cache since previous sampling time.</td>
</tr>
<tr>
<td><strong>Object Cache Hits</strong></td>
<td>The cumulative count of accesses to the object cache that are successful (cache hits) since previous sampling time.</td>
</tr>
</tbody>
</table>

### System Related Performance Counters

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Database Response Time</strong></td>
<td>The average response time (in seconds) to the database requests since the previous sampling time</td>
</tr>
<tr>
<td><strong>Buyer to DB server Traffic</strong></td>
<td>The cumulative number of bytes that Ariba Buyer sent to DB server since the previous sampling time.</td>
</tr>
<tr>
<td><strong>DB to Buyer server Traffic</strong></td>
<td>The cumulative number of bytes that DB server sent to Ariba Buyer since the previous sampling time.</td>
</tr>
<tr>
<td><strong>Database Query Packets</strong></td>
<td>The average number of packets that Ariba Buyer sent to DB server since the previous sampling time.</td>
</tr>
<tr>
<td><strong>Database Response Packets</strong></td>
<td>The average number of packets that DB server sent to Ariba Buyer since the previous sampling time.</td>
</tr>
</tbody>
</table>

7 Click OK in the Ariba Monitor Configuration dialog box, and in the Ariba dialog box, to activate the Ariba monitor.
XML Accessibility Verification

Only browsers that are XML-compatible will allow you to view the performance XML file.

To verify whether the XML file is accessible:

Display the XML file through the browser. The URL should be in the following format: http://<server name:port number>/metrics?query=getStats

For example: http://merc1:12130/metrics?query=getStats

Note: In some cases, although the browser is XML-compatible, it may still return the error: The XML page cannot be displayed. In these cases, the XML file can be accessed by the Ariba performance monitor, although it cannot be viewed by the browser.

Configuring the ATG Dynamo Monitor

The ATG Dynamo monitor uses SNMP to retrieve ATG Dynamo server statistics. You define the measurements for the ATG Dynamo monitor using the ATG Dynamo Resources dialog box.

To configure the ATG Dynamo server monitor:

1 Click the ATG Dynamo graph in the graph tree, and drag it into the right pane of the Run view.

2 Right-click the graph and choose Add Measurement(s), or choose Monitors > Add Online Measurement.

3 In the Monitored Server Machines section of the ATG Dynamo dialog box, click Add to enter the server name or IP address of the machine you want to monitor. Select the platform on which the machine runs, and click OK.
Chapter 25 • Web Application Server Resource Monitoring

---

**Note:** You need to define the port number if the ATG SNMP agent is running on a different port than the default ATG SNMP port 8870. You can define the default port for your ATG server in the configuration file, `snmp.cfg`, located in `<LoadRunner root folder>/dat/monitors`. For example, if the port used by the SNMP agent on your ATG system is 8888, you should edit the `snmp.cfg` file as follows:

```ini
; ATG Dynamo
[cm_snmp_mon_atg]
port=8888
```

You can also specify a machine name and port number in the Add Machine dialog box using the following format:

```text
<server name:port number>
```

For example: `digi:8888`

---

4 Click **Add** in the Resource Measurements section of the ATG Dynamo dialog box. The ATG Dynamo Resources dialog box opens.
Browse the ATG Dynamo Object tree, and select the measurements you want to monitor.

The following tables describe the measurements that can be monitored:

**d3System**

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>sysTotalMem</td>
<td>The total amount of memory currently available for allocating objects, measured in bytes</td>
</tr>
<tr>
<td>sysFreeMem</td>
<td>An approximation of the total amount of memory currently available for future allocated objects, measured in bytes</td>
</tr>
<tr>
<td>sysNumInfoMsgs</td>
<td>The number of system global info messages written</td>
</tr>
</tbody>
</table>
# Web Application Server Resource Monitoring

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>sysNumWarningMsgs</td>
<td>The number of system global warning messages written</td>
</tr>
<tr>
<td>sysNumErrorMsgs</td>
<td>The number of system global error messages written</td>
</tr>
</tbody>
</table>

## d3LoadManagement

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>lmIsManager</td>
<td>True if the Dynamo is running a load manager</td>
</tr>
<tr>
<td>lmManagerIndex</td>
<td>Returns the Dynamo's offset into the list of load managing entities</td>
</tr>
<tr>
<td>lmIsPrimaryManager</td>
<td>True if the load manager is an acting primary manager</td>
</tr>
<tr>
<td>lmServicingCMs</td>
<td>True if the load manager has serviced any connection module requests in the amount of time set as the connection module polling interval</td>
</tr>
<tr>
<td>lmCMLDRPPort</td>
<td>The port of the connection module agent</td>
</tr>
<tr>
<td>lmIndex</td>
<td>A unique value for each managed entity</td>
</tr>
<tr>
<td>lmSNMPPort</td>
<td>The port for the entry's SNMP agent</td>
</tr>
<tr>
<td>lmProbability</td>
<td>The probability that the entry will be given a new session</td>
</tr>
<tr>
<td>lmNewSessions</td>
<td>Indicates whether or not the entry is accepting new sessions, or if the load manager is allowing new sessions to be sent to the entry. This value is inclusive of any override indicated by lmNewSessionOverride.</td>
</tr>
<tr>
<td>lmNewSessionOverride</td>
<td>The override set for whether or not a server is accepting new sessions</td>
</tr>
</tbody>
</table>

## d3SessionTracking

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>stCreatedSessionCnt</td>
<td>The number of created sessions</td>
</tr>
<tr>
<td>stValidSessionCnt</td>
<td>The number of valid sessions</td>
</tr>
</tbody>
</table>
### d3DRPServer

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>drpPort</td>
<td>The port of the DRP server</td>
</tr>
<tr>
<td>drpTotalReqsServed</td>
<td>Total number of DRP requests serviced</td>
</tr>
<tr>
<td>drpTotalReqTime</td>
<td>Total service time in msecs for all DRP requests</td>
</tr>
<tr>
<td>drpAvgReqTime</td>
<td>Average service time in msecs for each DRP request</td>
</tr>
<tr>
<td>drpNewsessions</td>
<td>True if the Dynamo is accepting new sessions</td>
</tr>
</tbody>
</table>

### d3DBConnPooling

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dbPoolsEntry</td>
<td>A pooling service entry containing information about the pool configuration and current status</td>
</tr>
<tr>
<td>dbIndex</td>
<td>A unique value for each pooling service</td>
</tr>
<tr>
<td>dbPoolID</td>
<td>The name of the DB connection pool service</td>
</tr>
<tr>
<td>dbMinConn</td>
<td>The minimum number of connections pooled</td>
</tr>
<tr>
<td>dbMaxConn</td>
<td>The maximum number of connections pooled</td>
</tr>
<tr>
<td>dbMaxFreeConn</td>
<td>The maximum number of free pooled connections at a time</td>
</tr>
<tr>
<td>dbBlocking</td>
<td>Indicates whether or not the pool is to block out check outs</td>
</tr>
<tr>
<td>dbConnOut</td>
<td>Returns the number of connections checked out</td>
</tr>
</tbody>
</table>
Chapter 25 • Web Application Server Resource Monitoring

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dbFreeResources</td>
<td>Returns the number of free connections in the pool. This number refers to connections actually created that are not currently checked out. It does not include how many more connections are allowed to be created as set by the maximum number of connections allowed in the pool.</td>
</tr>
<tr>
<td>dbTotalResources</td>
<td>Returns the number of total connections in the pool. This number refers to connections actually created and is not an indication of how many more connections may be created and used in the pool.</td>
</tr>
</tbody>
</table>

6 Click **Add** to place the selected counter on the resource list. Add all the desired resources to the list, and click **Close**.

---

**Note:** The ATG Dynamo monitor can only monitor up to 25 measurements.

---

7 Click **OK** in the ATG Dynamo dialog box to activate the monitor.
**Note:** You can improve the level of measurement information for the ATG Dynamo monitor by enabling measurements with string values to be listed (in addition to measurements with numeric values), and by enabling the name modifier (which displays the string value as an identifying part of the measurement name).

In the following example of a measurement using the name modifier, the string value of `ProcessName` *(sched)* is displayed in addition to its instance ID *(0)*:

![Example Measurement]

To enable this feature, add the following line to the `<LoadRunner root folder>`\`dat\`\`monitors\`\`snmp.cfg` file:

```
SNMP_show_string_nodes=1
```

Usage Notes: You can select more than one name modifier, but the first in the hierarchy will be used. Each time the ATG Dynamo Add Measurements dialog box opens, the information is reread from the `snmp.cfg` file. You cannot add the same measurement twice (once with a name modifier and once without it). If you do so, an error message is issued.

---

**Configuring the BroadVision Monitor**

To monitor a BroadVision server, you must grant the client permission to invoke or launch services on the server.

**Note:** The port you use to monitor a BroadVision server through a firewall depends on the configuration of your server.
To grant permission for a BroadVision server:

➤ Use the Iona Technologies (Orbix) command for setting user and access permission on a load generator machine:

```bash
chmodit [-h <host>] [-v] { <server> | -a <dir> }
{i|+,-}{user,group} | {l|+,-}{user,group}
```

➤ If you experience problems connecting to the BroadVision monitor, you may need to redefine the permissions to "all."

To invoke permission for all, enter the following command at the BroadVision server command prompt:

```bash
# chmodit <server> i+all
```

To launch permission for all, enter the following command at the BroadVision server command prompt:

```bash
# chmodit <server> l+all
```

➤ Alternatively, set ORBIX_ACL. Setting ORBIX_ACL=i+all l+all in the BroadVision/Orbix configuration file gives permission to all.

In addition, to monitor a BroadVision server, you need to have JDK 1.2 or higher installed on the Controller machine.

You can install JDK 1.2 by following the download and installation instructions at the following Web site: http://java.sun.com/products/jdk/1.2/

Before activating the monitor, make sure that your Java environment is configured properly.

To configure your Java environment:

1. Open the Windows Registry.

2. The registry should contain the correct path to the Java executable (java.exe) under the JDK 1.2 installation directory. Verify the following registry key:

   ```bash
   HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion\App Paths\java.exe
   ```
3 The registry should contain the correct path to the Java run-time environment (JRE) under the JRE 1.2 installation directory. Verify the following registry key:

HKEY_LOCAL_MACHINE\SOFTWARE\JavaSoft\Java Runtime Environment\1.2\JavaHome

To configure the BroadVision online monitor:

1 Right-click the graph in the graph view area and choose Add Measurement(s), or choose Monitors > Add Online Measurement.

2 In the Monitored Server Machines section of the BroadVision dialog box, click Add to enter the BroadVision server name or IP address with the port number according to the following format: <server name>:<port number>. For example: dnsqa:1221. Select the machine platform, and click OK.

3 Click Add in the Resource Measurements section of the BroadVision dialog box.

The BroadVision Monitor Configuration dialog box opens, displaying the available measurements:
4 Browse the Services tree and check the required performance counters in the BroadVision Monitor Configuration window’s right pane. For a description of the performance counters, see the information below.

5 Click **OK** in the BroadVision Monitor Configuration dialog box, and in the BroadVision dialog box, to activate the BroadVision monitor.

The following table describes the servers/services that can be monitored:

<table>
<thead>
<tr>
<th>Server</th>
<th>Multiple Instances</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>adm_srv</td>
<td>No</td>
<td>One-To-One user administration server. There must be one.</td>
</tr>
<tr>
<td>alert_srv</td>
<td>No</td>
<td>Alert server handles direct IDL function calls to the Alert system.</td>
</tr>
<tr>
<td>bvconf_srv</td>
<td>No</td>
<td>One-To-One configuration management server. There must be one.</td>
</tr>
<tr>
<td>cmsdb</td>
<td>Yes</td>
<td>Visitor management database server.</td>
</tr>
<tr>
<td>cntdb</td>
<td>Yes</td>
<td>Content database server.</td>
</tr>
<tr>
<td>deliv_smtp_d</td>
<td>Yes</td>
<td>Notification delivery server for e-mail type messages. Each instance of this server must have its own ID, numbered sequentially starting with &quot;1&quot;.</td>
</tr>
<tr>
<td>deliv_comp_d</td>
<td>No</td>
<td>Notification delivery completion processor.</td>
</tr>
<tr>
<td>extdbacc</td>
<td>Yes</td>
<td>External database accessor. You need at least one for each external data source.</td>
</tr>
<tr>
<td>genericdb</td>
<td>No</td>
<td>Generic database accessor handles content query requests from applications, when specifically called from the application. This is also used by the One-To-One Command Center.</td>
</tr>
<tr>
<td>hostmgr</td>
<td>Yes</td>
<td>Defines a host manager process for each machine that participates in One-To-One, but doesn’t run any One-To-One servers. For example, you need a hostmgr on a machine that runs only servers. You don’t need a separate hostmgr on a machine that already has one of the servers in this list.</td>
</tr>
</tbody>
</table>
### Monitoring a Scenario

<table>
<thead>
<tr>
<th>Server</th>
<th>Multiple Instances</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>g1_ofbe_srv</td>
<td>No</td>
<td>Order fulfillment back-end server.</td>
</tr>
<tr>
<td>g1_ofdb</td>
<td>Yes</td>
<td>Order fulfillment database server.</td>
</tr>
<tr>
<td>g1_om_srv</td>
<td>No</td>
<td>Order management server.</td>
</tr>
<tr>
<td>pmtassign_d</td>
<td>No</td>
<td>The payment archiving daemon routes payment records to the archives by periodically checking the invoices table, looking for records with completed payment transactions, and then moving those records into an archive table.</td>
</tr>
<tr>
<td>pmthdlr_d</td>
<td>Yes</td>
<td>For each payment processing method, you need one or more authorization daemons to periodically acquire the authorization when a request is made.</td>
</tr>
<tr>
<td>pmtsettle_d</td>
<td>Yes</td>
<td>Payment settlement daemon periodically checks the database for orders of the associated payment processing method that need to be settled, and then authorizes the transactions.</td>
</tr>
<tr>
<td>sched_poll_d</td>
<td>No</td>
<td>Notification schedule poller scans the database tables to determine when a notification must be run.</td>
</tr>
<tr>
<td>sched_srv</td>
<td>Yes</td>
<td>Notification schedule server runs the scripts that generate the visitor notification messages.</td>
</tr>
</tbody>
</table>

### Performance Counters

Performance counters for each server/service are divided into logical groups according to the service type.

The following section describes all the available counters under each group. Note that the same group can have a different number of counters, depending on the service.
Counter groups:

- BV_DB_STAT
- BV_SRV_CTRL
- BV_SRV_STAT
- NS_STAT
- BV_CACHE_STAT
- JS_SCRIPT_CTRL
- JS_SCRIPT_STAT

**BV_DB_STAT**

The database accessor processes have additional statistics available from the BV_DB_STAT memory block. These statistics provide information about database accesses, including the count of selects, updates, inserts, deletes, and stored procedure executions.

- DELETE - Count of deletes executions
- INSERT - Count of inserts executions
- SELECT - Count of selects executions
- SPROC - Count of stored procedure executions.
- UPDATE - Count of updates executions

**BV_SRV_CTRL**

- SHUTDOWN
NS_STAT

The NS process displays the namespace for the current One-To-One environment, and optionally can update objects in a name space.

➤ Bind
➤ List
➤ New
➤ Rebind
➤ Rsolv
➤ Unbind

BV_SRV_STAT

The display for Interaction Manager processes includes information about the current count of sessions, connections, idle sessions, threads in use, and count of CGI requests processed.

➤ HOST - Host machine running the process.
➤ ID - Instance of the process (of which multiple can be configured in the bv1to1.conf file), or engine ID of the Interaction Manager.
➤ CGI - Current count of CGI requests processed.
➤ CONN - Current count of connections.
➤ CPU - CPU percentage consumed by this process. If a process is using most of the CPU time, consider moving it to another host, or creating an additional process, possibly running on another machine. Both of these specifications are done in the bv1to1.conf file. The CPU % reported is against a single processor. If a server is taking up a whole CPU on a 4 processor machine, this statistic will report 100%, while the Windows Task Manager will report 25%. The value reported by this statistic is consistent with "% Processor Time" on the Windows Performance Monitor.
➤ GROUP - Process group (which is defined in the bv1to1.conf file), or Interaction Manager application name.
Chapter 25 • Web Application Server Resource Monitoring

- **STIME** - Start time of server. The start times should be relatively close. Later times might be an indication that a server crashed and was automatically restarted.
- **IDL** - Total count of IDL requests received, not including those to the monitor.
- **IdlQ**
- **JOB**
- **LWP** - Number of light-weight processes (threads).
- **RSS** - Resident memory size of server process (in kilobytes).
- **STIME** - System start time.
- **SESS** - Current count of sessions.
- **SYS** - Accumulated system mode CPU time (seconds).
- **THR** - Current count of threads.
- **USR** - Accumulated user mode CPU time (seconds).
- **VSZ** - Virtual memory size of server process (in kilobytes). If a process is growing in size, it probably has a memory leak. If it is an Interaction Manager process, the culprit is most likely a component or dynamic object (though Interaction Manager servers do grow and shrink from garbage collection during normal use).

**BV_CACHE_STAT**

Monitors the request cache status.

The available counters for each request are:

- **CNT- Request_Name-HIT** - Count of requests found in the cache.
- **CNT- Request_Name-MAX** - Maximum size of the cache in bytes
- **CNT- Request_Name-SWAP** - Count of items that got swapped out of the cache.
- **CNT- Request_Name-MISS** - Count of requests that were not in the cache.
- **CNT- Request_Name-SIZE** - Count of items currently in the cache.
Cache Metrics

Cache metrics are available for the following items:

➤ AD

➤ ALERTSCHED - Notification schedules are defined in the BV_ALERTSCHED and BV_MSGSCHED tables. They are defined by the One-To-One Command Center user or by an application.

➤ CATEGORY_CONTENT

➤ DISCUSSION - The One-To-One discussion groups provide moderated system of messages and threads of messages aligned to a particular topic. Use the Discussion group interfaces for creating, retrieving and deleting individual messages in a discussion group. To create, delete, or retrieve discussion groups, use the generic content management API. The BV_DiscussionDB object provides access to the threads and messages in the discussion group database.

➤ EXT_FIN_PRODUCT

➤ EDITORIAL - Using the Editorials content module, you can point cast and community cast personalized editorial content, and sell published text on your One-To-One site. You can solicit editorial content, such as investment reports and weekly columns, from outside authors and publishers, and create your own articles, reviews, reports, and other informative media. In addition to text, you can use images, sounds, music, and video presentations as editorial content.

➤ INCENTIVE - Contains sales incentives

➤ MSGSCHED - Contains the specifications of visitor-message jobs. Notification schedules are defined in the BV_ALERTSCHED and BV_MSGSCHED tables. They are defined by the One-To-One Command Center user or by an application.

➤ MSGSCRIPT - Contains the descriptions of the JavaScripts that generate visitor messages and alert messages. Contains the descriptions of the JavaScripts that generate targeted messages and alert messages. Use the Command Center to add message script information to this table by selecting the Visitor Messages module in the Notifications group. For more information, see the Command Center User’s Guide.
PRODUCT - BV_PRODUCT contains information about the products that a visitor can purchase.

QUERY - BV_QUERY contains queries.

SCRIPT - BV_SCRIPT contains page scripts.

SECURITIES

TEMPLATE - The Templates content module enables you to store in the content database any BroadVision page templates used on your One-To-One site. Combining BroadVision page templates with BroadVision dynamic objects in the One-To-One Design Center application is one way for site developers to create One-To-One Web sites. If your developers use these page templates, you can use the Command Center to enter and manage them in your content database. If your site doesn’t use BroadVision page template, you will not use this content module.

JS_SCRIPT_CTRL

CACHE

DUMP

FLUSH

METER

TRACE

JS_SCRIPT_STAT

ALLOC

ERROR

FAIL

JSPPERR

RELEASE

STOP

SUCC

SYNTAX
Configuring the ColdFusion Monitor

You select measurements to monitor the ColdFusion server using the ColdFusion dialog box.

**Note:** The ColdFusion monitor works via HTTP and supports UNIX platforms. If you want to monitor the ColdFusion server on a Windows platform, you can also use the Windows Resource monitor.

**To set up the ColdFusion monitor environment:**

Copy the `<LR installation>\dat\monitors\perfmon.cfm` file into the `<ColdFusion Home>\cfide\administrator` directory. By default, the ColdFusion monitor checks for the `<ColdFusion Home>\cfide\administrator\perfmon.cfm` file.

**Note:** The port you use to monitor a ColdFusion server through a firewall depends on the configuration of your server.

**To configure the ColdFusion monitor:**

1. Click the ColdFusion graph in the graph tree, and drag it into the right pane of the Run view.

2. Right-click the graph and choose **Add Measurement(s)**, or choose **Monitors > Add Online Measurement**.

3. In the Monitored Server Machines section of the ColdFusion dialog box, click **Add** to enter the server name or IP address of the machine you want to monitor. Select the platform on which the machine runs, and click **OK**.

4. In the Resource Measurements section of the ColdFusion dialog box, click **Add** to select the measurements that you want to monitor. The ColdFusion Monitor Configuration dialog box displays the available measurements.
Browse the Measured Components tree.

Check the required performance counters in the ColdFusion Monitor Configuration window's right pane.
The following table describes the default counters that can be measured:

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg. Database Time (msec)</td>
<td>The running average of the amount of time, in milliseconds, that it takes ColdFusion to process database requests.</td>
</tr>
<tr>
<td>Avg. Queue Time (msec)</td>
<td>The running average of the amount of time, in milliseconds, that requests spent waiting in the ColdFusion input queue before ColdFusion began to process the request.</td>
</tr>
<tr>
<td>Avg Req Time (msec)</td>
<td>The running average of the total amount of time, in milliseconds, that it takes ColdFusion to process a request. In addition to general page processing time, this value includes both queue time and database processing time.</td>
</tr>
<tr>
<td>Bytes In/sec</td>
<td>The number of bytes per second sent to the ColdFusion server.</td>
</tr>
<tr>
<td>Bytes Out/sec</td>
<td>The number of bytes per second returned by the ColdFusion server.</td>
</tr>
<tr>
<td>Cache Pops</td>
<td>Cache pops.</td>
</tr>
<tr>
<td>Database Hits/sec</td>
<td>This is the number of database hits generated per second by the ColdFusion server.</td>
</tr>
<tr>
<td>Page Hits/sec</td>
<td>This is the number of Web pages processed per second by the ColdFusion server.</td>
</tr>
<tr>
<td>Queued Requests</td>
<td>The number of requests currently waiting to be processed by the ColdFusion server.</td>
</tr>
<tr>
<td>Running Requests</td>
<td>The number of requests currently being actively processed by the ColdFusion server.</td>
</tr>
<tr>
<td>Timed Out Requests</td>
<td>The number of requests that timed out due to inactivity timeouts.</td>
</tr>
</tbody>
</table>

7 Click OK in the ColdFusion Monitor Configuration dialog box, and in the ColdFusion dialog box, to activate the ColdFusion monitor.
Chapter 25 • Web Application Server Resource Monitoring

Configuring the Fujitsu INTERSTAGE Monitor

The Fujitsu INTERSTAGE monitor uses SNMP to retrieve Fujitsu INTERSTAGE server statistics. You define the measurements for the Fujitsu INTERSTAGE monitor using the Fujitsu INTERSTAGE SNMP Resources dialog box.

To configure the Fujitsu INTERSTAGE server monitor:

1. Click the Fujitsu INTERSTAGE graph in the graph tree, and drag it into the right pane of the Run view.

2. Right-click the graph and choose Add Measurement(s), or choose Monitors > Add Online Measurement.

3. In the Monitored Server Machines section of the Fujitsu INTERSTAGE dialog box, click Add to enter the server name or IP address of the machine you want to monitor. Select the platform on which the machine runs, and click OK.

Note: You need to define the port number if the Fujitsu INTERSTAGE SNMP agent is running on a different port than the default SNMP port 161. Enter the following information in the Add Machine dialog box:

<server name:port number>

For example: digi:8888

In addition, you can define the default port for your Fujitsu INTERSTAGE server in the configuration file, snmp.cfg, located in <LoadRunner root folder>\dat\monitors. For example, if the port used by the SNMP agent on your Fujitsu INTERSTAGE system is 8888, you should edit the snmp.cfg file as follows:

; Fujitsu INTERSTAGE
[cm_snmp_mon_isp]
port=8888

4. Click Add in the Resource Measurements section of the Fujitsu INTERSTAGE dialog box. The Fujitsu INTERSTAGE SNMP Resources dialog box opens.
Browse the Fujitsu INTERSTAGE SNMP Object tree, and select the measurements you want to monitor.

The following tables describe the measurements that can be monitored:

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IspSumObjectName</td>
<td>The object name of the application for which performance information is measured</td>
</tr>
<tr>
<td>IspSumExecTimeMax</td>
<td>The maximum processing time of the application within a certain period of time</td>
</tr>
<tr>
<td>IspSumExecTimeMin</td>
<td>The minimum processing time of the application within a certain period of time</td>
</tr>
<tr>
<td>IspSumExecTimeAve</td>
<td>The average processing time of the application within a certain period of time</td>
</tr>
<tr>
<td>IspSumWaitTimeMax</td>
<td>The maximum time required for INTERSTAGE to start an application after a start request is issued</td>
</tr>
<tr>
<td>IspSumWaitTimeMin</td>
<td>The minimum time required for INTERSTAGE to start an application after a start request is issued</td>
</tr>
<tr>
<td>IspSumWaitTimeAve</td>
<td>The average time required for INTERSTAGE to start an application after a start request is issued</td>
</tr>
</tbody>
</table>
Chapter 25 • Web Application Server Resource Monitoring

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IspSumRequestNum</td>
<td>The number of requests to start an application</td>
</tr>
<tr>
<td>IspSumWaitReqNum</td>
<td>The number of requests awaiting application activation</td>
</tr>
</tbody>
</table>

6 Click Add to place the selected counter on the resource list. Add all the desired resources to the list, and click Close.

Note: The Fujitsu INTERSTAGE monitor can only monitor up to 25 measurements.

7 Click OK in the Fujitsu INTERSTAGE dialog box to activate the monitor.

Configuring the Microsoft Active Server Pages Monitor

You select measurements to monitor the Microsoft ASP application server using the MS Active Server Pages dialog box.

Note: To monitor an ASP server through a firewall, use TCP, port 139.

To configure the ASP monitor:

1 Click the MS Active Server Pages graph in the graph tree, and drag it into the right pane of the Run view.

2 Right-click the graph and choose Add Measurement(s), or choose Monitors > Add Online Measurement.

3 In the Monitored Server Machines section of the MS Active Server Pages dialog box, click Add to enter the server name or IP address of the machine you want to monitor. Select the platform on which the machine runs, and click OK.
In the Resource Measurements section of the MS Active Server Pages dialog box, select the measurements you want to monitor. The following table describes the default counters that can be monitored:

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Errors per Second</td>
<td>The number of errors per second.</td>
</tr>
<tr>
<td>Requests Wait Time</td>
<td>The number of milliseconds the most recent request was waiting in the queue.</td>
</tr>
<tr>
<td>Requests Executing</td>
<td>The number of requests currently executing.</td>
</tr>
<tr>
<td>Requests Queued</td>
<td>The number of requests waiting in the queue for service.</td>
</tr>
<tr>
<td>Requests Rejected</td>
<td>The total number of requests not executed because there were insufficient resources to process them.</td>
</tr>
<tr>
<td>Requests Not Found</td>
<td>The number of requests for files that were not found.</td>
</tr>
<tr>
<td>Requests/sec</td>
<td>The number of requests executed per second.</td>
</tr>
<tr>
<td>Memory Allocated</td>
<td>The total amount of memory, in bytes, currently allocated by Active Server Pages.</td>
</tr>
<tr>
<td>Errors During Script Run-Time</td>
<td>The number of failed requests due to run-time errors.</td>
</tr>
<tr>
<td>Sessions Current</td>
<td>The current number of sessions being serviced.</td>
</tr>
<tr>
<td>Transactions/sec</td>
<td>The number of transactions started per second.</td>
</tr>
</tbody>
</table>

**Note:** To change the default counters for the Microsoft ASP monitor, see “Changing a Monitor’s Default Counters” on page 553.
To select additional measurements, click Add. A dialog box displaying the Active Server Pages object, its counters, and instances opens.

Select a counter and instance. You can select multiple counters using the Ctrl key. The instance is relevant only if multiple instances of the highlighted counter are running. For a description of each counter, click Explain>> to expand the dialog box.

Click Add to place the selected counter on the resource list. Add all the desired resources to the list, and click Close.

Click OK in the MS Active Server Pages dialog box to activate the monitor.

Configuring the Oracle9iAS HTTP Monitor

You select measurements to monitor the Oracle9iAS HTTP server using the Oracle HTTP Server Monitor Configuration dialog box. Note that you must start running the Oracle9iAS HTTP server before you begin selecting the measurements you want to monitor.

Note: The port you use to monitor an Oracle9iAS HTTP server through a firewall depends on the configuration of your server.
To configure the Oracle9iAS HTTP monitor:

1. Click the Oracle9iAS HTTP graph in the graph tree, and drag it into the right pane of the Run view.

2. Right-click the graph and choose **Add Measurement(s)**, or choose **Monitors > Add Online Measurement**.

3. In the Monitored Server Machines section of the Oracle9iAS HTTP Server dialog box, click **Add** to enter the server name or IP address of the machine you want to monitor. Select any platform, and click **OK**.

4. Click **Add** in the Resource Measurements section of the Oracle9iAS HTTP Server dialog box to select the measurements that you want to monitor. The Oracle HTTP Server Monitor Configuration dialog box opens, displaying the counters that can be monitored.

5. Browse the Measured Components tree.
Check the required machine processing counters, or application server performance counters and modules, in the Oracle HTTP Server Monitor Configuration window's right pane.

The following table describes some of the modules that can be monitored:

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>mod_mime.c</td>
<td>Determines document types using file extensions</td>
</tr>
<tr>
<td>mod_mime_magic.c</td>
<td>Determines document types using &quot;magic numbers&quot;</td>
</tr>
<tr>
<td>mod_auth_anon.c</td>
<td>Provides anonymous user access to authenticated areas</td>
</tr>
<tr>
<td>mod_auth_dbm.c</td>
<td>Provides user authentication using DBM files</td>
</tr>
<tr>
<td>mod_auth_digest.c</td>
<td>Provides MD5 authentication</td>
</tr>
<tr>
<td>mod_cern_meta.c</td>
<td>Supports HTTP header metafiles</td>
</tr>
<tr>
<td>mod_digest.c</td>
<td>Provides MD5 authentication (deprecated by mod_auth_digest)</td>
</tr>
<tr>
<td>mod_expires.c</td>
<td>Applies Expires: headers to resources</td>
</tr>
<tr>
<td>mod_headers.c</td>
<td>Adds arbitrary HTTP headers to resources</td>
</tr>
<tr>
<td>mod_proxy.c</td>
<td>Provides caching proxy abilities</td>
</tr>
<tr>
<td>mod_rewrite.c</td>
<td>Provides powerful URI-to-filename mapping using regular expressions</td>
</tr>
<tr>
<td>mod_speling.c</td>
<td>Automatically corrects minor typos in URLs</td>
</tr>
<tr>
<td>mod_info.c</td>
<td>Provides server configuration information</td>
</tr>
<tr>
<td>mod_status.c</td>
<td>Displays server status</td>
</tr>
<tr>
<td>mod_usertrack.c</td>
<td>Provides user tracking using cookies</td>
</tr>
<tr>
<td>mod_dms.c</td>
<td>Provides access to DMS Apache statistics</td>
</tr>
<tr>
<td>mod_perl.c</td>
<td>Allows execution of perl scripts</td>
</tr>
<tr>
<td>mod_fastcgi.c</td>
<td>Supports CGI access to long-lived programs</td>
</tr>
<tr>
<td>mod_ssl.c</td>
<td>Provides SSL support</td>
</tr>
<tr>
<td>mod_plsql.c</td>
<td>Handles requests for Oracle stored procedures</td>
</tr>
<tr>
<td>Measurement</td>
<td>Description</td>
</tr>
<tr>
<td>---------------</td>
<td>------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>mod_isapi.c</td>
<td>Provides Windows ISAPI extension support</td>
</tr>
<tr>
<td>mod_setenvif.c</td>
<td>Sets environment variables based on client information</td>
</tr>
<tr>
<td>mod_actions.c</td>
<td>Executes CGI scripts based on media type or request method</td>
</tr>
<tr>
<td>mod_imap.c</td>
<td>Handles imagemap files</td>
</tr>
<tr>
<td>mod_asis.c</td>
<td>Sends files that contain their own HTTP headers</td>
</tr>
<tr>
<td>mod_log_config.c</td>
<td>Provides user-configurable logging replacement for mod_log_common</td>
</tr>
<tr>
<td>mod_env.c</td>
<td>Passes environments to CGI scripts</td>
</tr>
<tr>
<td>mod_alias.c</td>
<td>Maps different parts of the host file system in the document tree, and redirects URLs</td>
</tr>
<tr>
<td>mod_userdir.c</td>
<td>Handles user home directories</td>
</tr>
<tr>
<td>mod_cgi.c</td>
<td>Invokes CGI scripts</td>
</tr>
<tr>
<td>mod_dir.c</td>
<td>Handles the basic directory</td>
</tr>
<tr>
<td>mod_autoindex.c</td>
<td>Provides automatic directory listings</td>
</tr>
<tr>
<td>mod_include.c</td>
<td>Provides server-parsed documents</td>
</tr>
<tr>
<td>mod_negotiation.c</td>
<td>Handles content negotiation</td>
</tr>
<tr>
<td>mod_auth.c</td>
<td>Provides user authentication using text files</td>
</tr>
<tr>
<td>mod_access.c</td>
<td>Provides access control based on the client hostname or IP address</td>
</tr>
<tr>
<td>mod_so.c</td>
<td>Supports loading modules (.so on UNIX, .dll on Win32) at run-time</td>
</tr>
<tr>
<td>mod_oprocmgr.c</td>
<td>Monitors JServ processes and restarts them if they fail</td>
</tr>
<tr>
<td>mod_jserv.c</td>
<td>Routes HTTP requests to JServ server processes. Balances load across multiple JServs by distributing new requests in round-robin order</td>
</tr>
</tbody>
</table>
The following table describes the counters that can be monitored:

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>mod_ose.c</code></td>
<td>Routes requests to the JVM embedded in Oracle's database server</td>
</tr>
<tr>
<td><code>http_core.c</code></td>
<td>Handles requests for static Web pages</td>
</tr>
<tr>
<td><code>handle.minTime</code></td>
<td>The minimum time spent in the module handler</td>
</tr>
<tr>
<td><code>handle.avg</code></td>
<td>The average time spent in the module handler</td>
</tr>
<tr>
<td><code>handle.active</code></td>
<td>The number of threads currently in the handle processing phase</td>
</tr>
<tr>
<td><code>handle.time</code></td>
<td>The total amount of time spent in the module handler</td>
</tr>
<tr>
<td><code>handle.completed</code></td>
<td>The number of times the handle processing phase was completed</td>
</tr>
<tr>
<td><code>request.maxTime</code></td>
<td>The maximum amount of time required to service an HTTP request</td>
</tr>
<tr>
<td><code>request.minTime</code></td>
<td>The minimum amount of time required to service an HTTP request</td>
</tr>
<tr>
<td><code>request.avg</code></td>
<td>The average amount of time required to service an HTTP request</td>
</tr>
<tr>
<td><code>request.active</code></td>
<td>The number of threads currently in the request processing phase</td>
</tr>
<tr>
<td><code>request.time</code></td>
<td>The total amount of time required to service an HTTP request</td>
</tr>
<tr>
<td><code>request.completed</code></td>
<td>The number of times the request processing phase was completed</td>
</tr>
<tr>
<td><code>connection.maxTime</code></td>
<td>The maximum amount of time spent servicing any HTTP connection</td>
</tr>
<tr>
<td><code>connection.minTime</code></td>
<td>The minimum amount of time spent servicing any HTTP connection</td>
</tr>
</tbody>
</table>
### LoadRunner Controller User's Guide • Monitoring a Scenario

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>connection.avg</td>
<td>The average amount of time spent servicing HTTP connections</td>
</tr>
<tr>
<td>connection.active</td>
<td>The number of connections with currently open threads</td>
</tr>
<tr>
<td>connection.time</td>
<td>The total amount of time spent servicing HTTP connections</td>
</tr>
<tr>
<td>connection.completed</td>
<td>The number of times the connection processing phase was completed</td>
</tr>
<tr>
<td>numMods.value</td>
<td>The number of loaded modules</td>
</tr>
<tr>
<td>childFinish.count</td>
<td>The number of times the Apache parent server started a child server, for any reason</td>
</tr>
<tr>
<td>childStart.count</td>
<td>The number of times “children” finished “gracefully.” There are some ungraceful error/crash cases that are not counted in childFinish.count</td>
</tr>
<tr>
<td>Decline.count</td>
<td>The number of times each module declined HTTP requests</td>
</tr>
<tr>
<td>internalRedirect.count</td>
<td>The number of times that any module passed control to another module using an “internal redirect”</td>
</tr>
<tr>
<td>cpuTime.value</td>
<td>The total CPU time utilized by all processes on the Apache server (measured in CPU milliseconds)</td>
</tr>
<tr>
<td>heapSize.value</td>
<td>The total heap memory utilized by all processes on the Apache server (measured in kilobytes)</td>
</tr>
<tr>
<td>pid.value</td>
<td>The process identifier of the parent Apache process</td>
</tr>
<tr>
<td>upTime.value</td>
<td>The amount of time the server been running (measured in milliseconds)</td>
</tr>
</tbody>
</table>

7 Click **OK** in the Oracle HTTP Server Monitor Configuration dialog box, and in the Oracle9iAS HTTP Server dialog box, to activate the Oracle9iAS HTTP monitor.
Configuring the SilverStream Monitor

To monitor a SilverStream server you need to know the server statistics information URL. A simple way to verify the statistics URL is to access it from a browser.

The URL should be in the following format:

http://<server_name/IP_address>:<port_number>/SilverStream/Statistics

for example:

http://199.203.78.57:80/SilverStream/Statistics

To configure the SilverStream monitor:

1. Click the SilverStream graph in the graph tree, and drag it into the right pane of the Run view.

2. Right-click the graph and choose Add Measurement(s), or choose Monitors > Add Online Measurement.

3. In the Monitored Server Machines section of the SilverStream dialog box, click Add to enter the server name or IP address of the machine you want to monitor. Select the platform on which the machine runs, and click OK.

4. In the Resource Measurements section of the SilverStream dialog box, click Add to select the measurements that you want to monitor.
A dialog box displaying the available measurements and server properties opens.

Select the required measurements. You can select multiple measurements using the Ctrl key.

The following table describes the measurements and server properties that can be monitored:

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>#Idle Sessions</td>
<td>The number of sessions in the Idle state.</td>
</tr>
<tr>
<td>Avg. Request processing time</td>
<td>The average request processing time.</td>
</tr>
<tr>
<td>Bytes Sent/sec</td>
<td>The rate at which data bytes are sent from the Web server.</td>
</tr>
<tr>
<td>Current load on Web Server</td>
<td>The percentage of load utilized by the SilverStream server, scaled at a factor of 25.</td>
</tr>
<tr>
<td>Hits/sec</td>
<td>The HTTP request rate.</td>
</tr>
<tr>
<td>Total sessions</td>
<td>The total number of sessions.</td>
</tr>
</tbody>
</table>
### Measurement Description

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free memory</td>
<td>The total amount of memory in the Java Virtual Machine currently available for future allocated objects.</td>
</tr>
<tr>
<td>Total memory</td>
<td>The total amount of memory in the Java Virtual Machine.</td>
</tr>
<tr>
<td>Memory Garbage Collection Count</td>
<td>The total number of times the JAVA Garbage Collector has run since the server was started.</td>
</tr>
<tr>
<td>Free threads</td>
<td>The current number of threads not associated with a client connection and available for immediate use.</td>
</tr>
<tr>
<td>Idle threads</td>
<td>The number of threads associated with a client connection, but not currently handling a user request.</td>
</tr>
<tr>
<td>Total threads</td>
<td>The total number of client threads allocated.</td>
</tr>
</tbody>
</table>

5 In the Server Properties section, enter the Port number and URL (without the server name), and click **OK**. The default URL is `/SilverStream/Statistics`.

6 Click **OK** in the SilverStream dialog box to activate the monitor.

---

*Note:* The default port number and URL can vary from one server to another. Please consult the Web server administrator.
To change the default server properties:

1. Open the SilverStream.cfg file in the `<LR root folder>\dat\monitors\` directory.
2. Edit the following parameters at the end of the file:
   - **InfoURL**: server statistics information URL
   - **ServerPort**: server port number
   - **SamplingRate**: rate (milliseconds) at which the LoadRunner monitor will poll the server for the statistics information. If this value is greater than 1000, LoadRunner will use it as its sampling rate. Otherwise, it will use the sampling rate defined in the Monitors tab of the Options dialog box.

---

**Note:** To monitor a SilverStream server through a firewall, use the Web server port (by default, port 80).

---

**Configuring the WebLogic (SNMP) Monitor**

The WebLogic (SNMP) monitor uses SNMP to retrieve server statistics. To use this monitor, you must make sure that a version prior to WebLogic 6.0 is installed on your server, and that the SNMP agent is installed and activated on the server. For instructions on installing the SNMP agent, see [http://www.weblogic.com/docs51/admindocs/snmpagent.html](http://www.weblogic.com/docs51/admindocs/snmpagent.html).

---

**Note:** To monitor a WebLogic (SNMP) server, use port 161 or 162, depending on the configuration of the agent.

---

To configure the WebLogic (SNMP) monitor:

1. Click the WebLogic (SNMP) graph in the graph tree, and drag it into the right pane of the Run view.
Chapter 25 • Web Application Server Resource Monitoring

2 Right-click the graph and choose **Add Measurement(s)**, or choose **Monitors > Add Online Measurement**.

3 In the Monitored Server Machines section of the WebLogic (SNMP) dialog box, click **Add** to enter the server name or IP address of the machine you want to monitor. Select the platform on which the machine runs, and click **OK**.

---

**Note:** You need to define the port number if the WebLogic SNMP agent is running on a different port than the default SNMP port. Enter the following information in the Add Machine dialog box:

```
<server name:port number>
```

For example: `digi:8888`

In addition, you can define the default port for your WebLogic server in the configuration file, `snmp.cfg`, located in `<LoadRunner root folder>\dat\monitors`. For example, if the port used by the SNMP agent on your WebLogic server is 8888, you should edit the `snmp.cfg` file as follows:

```
; WebLogic
[cm_snmp_mon_isp]
port=8888
```

---

4 In the Resource Measurements section of the WebLogic (SNMP) dialog box, click **Add** to select the measurements that you want to monitor. The WebLogic SNMP Resources dialog box displays the available measurements.

---

**Note:** The WebLogic (SNMP) monitor can only monitor up to 25 measurements.
5 Browse the WebLogic SNMP Objects tree.

6 To measure an object, select it, and click Add. The following tables describe the measurements and server properties that can be monitored:

**Server Table**

The Server Table lists all WebLogic (SNMP) servers that are being monitored by the agent. A server must be contacted or be reported as a member of a cluster at least once before it will appear in this table. Servers are only reported as a member of a cluster when they are actively participating in the cluster, or shortly thereafter.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ServerState</td>
<td>The state of the WebLogic server, as inferred by the SNMP agent. Up implies</td>
</tr>
<tr>
<td></td>
<td>that the agent can contact the server. Down implies that the agent cannot</td>
</tr>
<tr>
<td></td>
<td>contact the server.</td>
</tr>
<tr>
<td>ServerLoginEnable</td>
<td>This value is true if client logins are enabled on the server.</td>
</tr>
<tr>
<td>ServerMaxHeapSpace</td>
<td>The maximum heap size for this server, in KB</td>
</tr>
<tr>
<td>ServerHeapUsedPct</td>
<td>The percentage of heap space currently in use on the server</td>
</tr>
</tbody>
</table>
### Chapter 25 • Web Application Server Resource Monitoring

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ServerQueueLength</td>
<td>The current length of the server execute queue</td>
</tr>
<tr>
<td>ServerQueueThroughput</td>
<td>The current throughput of execute queue, expressed as the number of requests processed per second</td>
</tr>
<tr>
<td>ServerNumEJBDeployment</td>
<td>The total number of EJB deployment units known to the server</td>
</tr>
<tr>
<td>ServerNumEJBBeansDeployed</td>
<td>The total number of EJB beans actively deployed on the server</td>
</tr>
</tbody>
</table>

#### Listen Table

The Listen Table is the set of protocol, IP address, and port combinations on which servers are listening. There will be multiple entries for each server: one for each protocol, ipAddr, port combination. If clustering is used, the clustering-related MIB objects will assume a higher priority.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ListenPort</td>
<td>Port number.</td>
</tr>
<tr>
<td>ListenAdminOK</td>
<td>True if admin requests are allowed on this (protocol, ipAddr, port); otherwise false</td>
</tr>
<tr>
<td>ListenState</td>
<td>Listening if the (protocol, ipAddr, port) is enabled on the server; not Listening if it is not. The server may be listening but not accepting new clients if its server Login Enable state is false. In this case, existing clients will continue to function, but new ones will not.</td>
</tr>
</tbody>
</table>
ClassPath Table

The ClassPath Table is the table of classpath elements for Java, WebLogic (SNMP) server, and servlets. There are multiple entries in this table for each server. There may also be multiple entries for each path on a server. If clustering is used, the clustering-related MIB objects will assume a higher priority.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPType</td>
<td>The type of CP element: Java, WebLogic, servlet. A Java CPType means the cpElement is one of the elements in the normal Java classpath. A WebLogic CPType means the cpElement is one of the elements in weblogic.class.path. A servlet CPType means the cpElement is one of the elements in the dynamic servlet classpath.</td>
</tr>
<tr>
<td>CPIndex</td>
<td>The position of an element within its path. The index starts at 1.</td>
</tr>
</tbody>
</table>

7 After selecting and adding the required objects, click Close.

8 Click OK in the WebLogic (SNMP) dialog box to activate the monitor.

Configuring the WebLogic (JMX) Monitor

The BEA WebLogic (JMX) monitor uses the Java JMX interface to access runtime MBeans on the server. An MBean is a container that holds the performance data.

Before using the WebLogic (JMX) monitor, you must install Java 1.3 or later on the Controller machine. If Java 1.3 or later is already installed, but is not the default Java version being used, specify the full path to the updated version. You specify the path in the `<LR root folder>\dat\monitors\WebLogicMon.ini` file. Edit the JVM entry in the `[WebLogicMon]` section. For example:

```
JVM="E:\Program Files\JavaSoft\JRE\1.3.1\bin\javaw.exe"
```
Note: To use the WebLogic (JMX) monitor, you must make sure that WebLogic 6.0 or above is installed on your server.

Setting Permissions for Monitoring
You must set certain permissions for a user to be able to monitor MBeans.

To set permissions:
1 Open the WebLogic console (http://<host:port>/console).
2 In the tree on the left, select Security > ACLs.
   If you are working with the WebLogic 6.1 console, click Create a new ACL...
   in the screen on the right.
3 In the New ACL Name box, type weblogic.admin.mbean, and click Create.
   If you are working with the WebLogic 6.1 console, click Add a new Permission...
   in the screen on the right.
4 In the New Permission box (or Permission box, in the WebLogic 6.1 console), type access. In the WebLogic 6.0 console, click Create.
5 In the Users box and Groups box, enter the name of any user or group you want to use for monitoring.
6 Click Grant Permission in the WebLogic 6.0 console. In the WebLogic 6.1 console, click Apply.

Loading Classes from the Server
The WebLogic (JMX) monitor utilizes a built-in server called the ClasspathServlet to load classes directly and automatically from the server. The advantages of this are easy installation and version independence. The disadvantages are a slight decrease in performance when loading classes for the first time (due to the size of the servlet), and the possibility of the servlet becoming disabled.

If the servlet is disabled, or if you do not want to use the servlet, you can load classes directly from the file system.
To load classes directly from the file system:

1. Copy the weblogic.jar file from the application server install folder (under the lib folder) to <LR root folder>\classes.

2. If the classes file is not located in the default <LR root folder> folder, you need to specify the full path to it in the <LR root folder>\dat\monitors\WebLogicMon.ini file. In this file, change the line Weblogic=weblogic.jar to Weblogic=full path to weblogic.jar.

**Configuring the WebLogic (JMX) Monitor**

You select measurements to monitor the WebLogic (JMX) application server using the BEA WebLogic Monitor Configuration dialog box.

**To configure the WebLogic (JMX) Monitor:**

1. Click the WebLogic (JMX) graph in the graph tree, and drag it into the right pane of the Run view.

2. Right-click the graph and choose **Add Measurement(s)**, or choose **Monitors > Add Online Measurement**.

3. In the Monitored Server Machines section of the WebLogic (JMX) dialog box, click **Add** to enter the server name or IP address of the machine you want to monitor. Enter the server name or IP address according to the following format: <server name>:<port number>.

   For example: mercury:8111

   Select the platform on which the machine runs, and click **OK**.

4. Click **Add** in the Resource Measurements section of the WebLogic (JMX) dialog box. In the Enter Login Information dialog box, enter the username and password of a user with administrative privileges to the WebLogic server. The BEA WebLogic Monitor Configuration dialog box opens. For details on creating user permissions, see “Setting Permissions for Monitoring” on page 377.
5. Browse the Measured Components tree.

6. Check the required performance counters in the BEA WebLogic Monitor Configuration window's right pane.

7. Click **OK** in the BEA WebLogic Monitor Configuration dialog box, and in the WebLogic (JMX) dialog box, to activate the WebLogic (JMX) monitor. The following measurements are available for the WebLogic (JMX) server:
LogBroadcasterRuntime

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MessagesLogged</td>
<td>The number of total log messages generated by this instance of the WebLogic server.</td>
</tr>
<tr>
<td>Registered</td>
<td>Returns “false” if the MBean represented by this object has been unregistered.</td>
</tr>
<tr>
<td>CachingDisabled</td>
<td>Private property that disables caching in proxies.</td>
</tr>
</tbody>
</table>

ServerRuntime

For more information on the measurements contained in each of the following measurement categories, see Mercury Interactive’s Load Testing Monitors Web site (http://www-svca.mercuryinteractive.com/resources/library/technical/loadtesting_monitors/supported.html).

➤ ServletRuntime
➤ WebAppComponentRuntime
➤ EJBStatefulHomeRuntime
➤ JTARuntime
➤ JVMRuntime
➤ EJBEntityHomeRuntime.
➤ DomainRuntime
➤ EJBComponentRuntime
➤ DomainLogHandlerRuntime
➤ JDBCConnectionPoolRuntime
➤ ExecuteQueueRuntime
➤ ClusterRuntime
➤ JMSRuntime
➤ TimeServiceRuntime
Chapter 25 • Web Application Server Resource Monitoring

➤ EJBStatelessHomeRuntime
➤ WLECConnectionServiceRuntime

ServerSecurityRuntime

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>UnlockedUsersTotalCount</td>
<td>Returns the number of times a user has been unlocked on the server</td>
</tr>
<tr>
<td>InvalidLoginUsersHighCount</td>
<td>Returns the high-water number of users with outstanding invalid login attempts for the server</td>
</tr>
<tr>
<td>LoginAttemptsWhileLockedTotalCount</td>
<td>Returns the cumulative number of invalid logins attempted on the server while the user was locked</td>
</tr>
<tr>
<td>Registered</td>
<td>Returns “false” if the MBean represented by this object has been unregistered.</td>
</tr>
<tr>
<td>LockedUsersCurrentCount</td>
<td>Returns the number of currently locked users on the server</td>
</tr>
<tr>
<td>CachingDisabled</td>
<td>Private property that disables caching in proxies.</td>
</tr>
<tr>
<td>InvalidLoginAttemptsTotalCount</td>
<td>Returns the cumulative number of invalid logins attempted on the server</td>
</tr>
<tr>
<td>UserLockoutTotalCount</td>
<td>Returns the cumulative number of user lockouts done on the server</td>
</tr>
</tbody>
</table>
Configuring the WebSphere Monitor

The WebSphere 3.x application server and the WebSphere 4.x application server have different monitor installation requirements.

To monitor versions 3.02, 3.5, and 3.5.x of the IBM WebSphere application server, you must first install the appropriate IBM WebSphere servlet patch on the WebSphere machine.

Note: WebSphere version 4.x contains the performance servlet within its default installation and therefore there is no need to install a patch.

To install the IBM WebSphere servlet patch for the WebSphere 3.x server:

1. Open Mercury Interactive’s Customer Support site, and select Downloads > Patches from the tree on the left.
   
   Please make sure to install the appropriate patch according to your WebSphere version:

   - **WebSphere version 3.02**: IBM_WebSphere3.02_Servlet.zip
   - **WebSphere version 3.5**: IBM_WebSphere3.5_Servlet.zip
   - **WebSphere version 3.5.x**: IBM_WebSphere3.5.x_Servlet.zip

2. Unzip the `IBM_WebSphere<version#>_Servlet.zip` file in the LoadRunner Performance Monitors section.

3. Copy `xml4j.jar`, `performance.dtd` and `perf.jar` (version 3.02), or `perf35.jar` (version 3.5) or `perf35x.jar` (version 3.5.2 and 3.5.3) into the `default_host\default_app servlets` directory on the monitored machine.

   To find the `default_app servlets` directory of the Web application, check the Web application’s classpath. From the admin console, select the Web application in the tree and click on the Advanced tab. You should see the classpath for the Web application.
For example:

➤ **Microsoft Windows Platforms:** if the IBM WebSphere directory is installed under drive E, then the files should be copied to:
   
   E:\WebSphere\AppServer\hosts\default_host\default_app\servlets

➤ **IBM iSeries Platforms:** files should be copied to:
   
   /QIBM/UserData/WebASAdv/<instance>/hosts/default_host/default_app/servlets

➤ **UNIX/Linux Platforms:** files should be copied to:
   
   /opt/IBMWebAS/hosts/default_host/default_app/servlets

---

**Note:** If you want to monitor additional Web applications that are not on the same machine, copy the above files to the Servlets folder of the application you want to monitor.

Add the com.ibm.ivb.epm.servlet.PerformanceServlet to the classpath configuration in the WebSphere console for each Web application.

---

**4** After copying the files, verify that the servlet is running properly and that the performance data is being generated. A simple way to verify that the performance data is accessible is to display it in a Web browser. The URL must be in the following format:


For example:


---

**Note:** Only browsers that are XML-compatible will allow you to view the performance XML file.

---

**5** Open the `<LR root folder>\dat\monitors\xmlmonitorshared.ini` file and add the following line to the [WebSphereMonitor] section:

QueryLoginInfo=1
To configure the WebSphere 3.x and 4.x monitor:

1. Click the WebSphere graph in the graph tree, and drag it into the right pane of the Run view.
2. Right-click the graph and choose Add Measurement(s), or choose Monitors > Add Online Measurement.
3. In the Monitored Server Machines section of the WebSphere dialog box, click Add to enter the server name or IP address of the machine you want to monitor. Select the platform on which the machine runs, and click OK.
4. In the Resource Measurements section of the WebSphere dialog box, click Add to select the measurements that you want to monitor. The WebSphere Monitor Configuration dialog box displays the available measurements.
5. Browse the Measured Components tree.
Chapter 25 • Web Application Server Resource Monitoring

6 Check the required performance counters in the WebSphere Monitor Configuration window’s right pane. For a list of the available performance counters, see page 386.

7 Click OK in the WebSphere Monitor Configuration dialog box, and in the WebSphere dialog box, to activate the WebSphere monitor.

Note: The port you use to monitor a WebSphere server through a firewall depends on the configuration of your server.

To specify another Web alias for the servlet directory:

By default, LoadRunner uses the alias servlet as the servlet directory Web alias. For example, if the WebSphere Server machine is named mercury and the path for the servlets directory is: E:\AppServer\hosts\default_host\default_app\servlets, LoadRunner will request the XML file in the following URL: http://mercury/servlet/com.ibm.ivb.epm.servlet.PerformanceServlet, where servlet is the default web alias for the servlet directory.

If the Web alias for the servlet directory is not servlet, you must specify the servlet directory Web alias in the Add Machine dialog box according to the following format:

http://<server name:port number>/<servlet_dir_alias>

For example: http://mercury/servlet2

Using this method, you can monitor as many application servers as you want—whether they are installed on the same machine, or on different machines.

To monitor other applications, in addition to the default application:

You can monitor as many applications as you want, regardless of whether they are installed on the same machine or different machines.

1 Copy the same files that you copied to the Servlets directory for the Default application to the Servlets directories for any other Web applications that you want to monitor.
2 Add the com.ibm.ivb.epm.servlet.PerformanceServlet to the configuration in the WebSphere Console for each Web application.

3 Add the Web application to be monitored to the WebSphere Performance Monitor using the following format:
   
   http://<server:port_number>/<servlet_dir_alias>/servlet
   
   For example: http://mercury/servlet3/servlet

   To work with WebSphere version 3.5.x

1 The EPM counters in 3.5.x are by default set to "none". To enable the counters, choose the application server you are monitoring in the WebSphere Administrator’s Console browser.

2 Right-click the application server and select Performance. Select Performance Modules from the pop-up window.

3 Right-click Performance Modules to choose a performance level. Selecting various levels of counters enables the application server to manage varying levels of performance data.

4 Click the Set button.

5 In versions 3.5.2 and 3.5.3 the Servlet counters have been disabled. To enable the Servlet counters, you need to modify the contents of the com/ibm/servlet/appserver.properties file located in 
   
   "<WAS_HOME>/lib/ibmwebas.jar".

   Extract the jar file and modify the appserver.properties as follows:

   #listeners.application=com.ibm.servlet.engine.EPMAplicationListener
   com.ibm.servlet.debug.OLTServletManager
   listeners.application=

   Should be:

   listeners.application=com.ibm.servlet.engine.EPMAplicationListener
   com.ibm.servlet.debug.OLTServletManager
   #listeners.application=

6 Repackage the jar file.

WebSphere Counters

The following tables describe the counters that can be monitored:
Run-Time Resources

Contains resources related to the Java Virtual Machine run-time, as well as the ORB.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MemoryFree</td>
<td>The amount of free memory remaining in the Java Virtual Machine</td>
</tr>
<tr>
<td>MemoryTotal</td>
<td>The total memory allocated for the Java Virtual Machine</td>
</tr>
<tr>
<td>MemoryUse</td>
<td>The total memory in use within the Java Virtual Machine</td>
</tr>
</tbody>
</table>

BeanData

Every home on the server provides performance data, depending upon the type of bean deployed in the home. The top level bean data holds an aggregate of all the containers.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BeanCreates</td>
<td>The number of beans created. Applies to an individual bean that is either ‘stateful’ or ‘entity’</td>
</tr>
<tr>
<td>EntityBeanCreates</td>
<td>The number of entity beans created</td>
</tr>
<tr>
<td>BeanRemoves</td>
<td>The number of entity beans pertaining to a specific bean that have been removed. Applies to an individual bean that is either ‘stateful’ or ‘entity’</td>
</tr>
<tr>
<td>EntityBeanRemoves</td>
<td>The number of entity beans removed</td>
</tr>
<tr>
<td>StatefulBeanCreates</td>
<td>The number of stateful beans created</td>
</tr>
<tr>
<td>StatefulBeanRemoves</td>
<td>The number of stateful bean removed</td>
</tr>
<tr>
<td>BeanPassivates</td>
<td>The number of bean passivates pertaining to a specific bean. Applies to an individual bean that is either ‘stateful’ or ‘entity’</td>
</tr>
<tr>
<td>EntityBeanPassivates</td>
<td>The number of entity bean passivates</td>
</tr>
</tbody>
</table>
### Measurement | Description
--- | ---
StatefulBeanPassivates | The number of stateful bean passivates
BeanActivates | The number of bean activates pertaining to a specific bean. Applies to an individual bean that is either ‘stateful’ or ‘entity’
EntityBeanActivates | The number of entity bean activates
StatefulBeanActivates | The number of stateful bean activates
BeanLoads | The number of times the bean data was loaded. Applies to entity
BeanStores | The number of times the bean data was stored in the database. Applies to entity
BeanInstantiates | The number of times a bean object was created. This applies to an individual bean, regardless of its type.
StatelessBeanInstantiates | The number of times a stateless session bean object was created
StatefulBeanInstantiates | The number of times a stateful session bean object was created
EntityBeanInstantiates | The number of times an entity bean object was created
BeanDestroys | The number of times an individual bean object was destroyed. This applies to any bean, regardless of its type
StatelessBeanDestroys | The number of times a stateless session bean object was destroyed
StatefulBeanDestroys | The number of times a stateful session bean object was destroyed
EntityBeanDestroys | The number of times an entity bean object was destroyed
BeansActive | The average number of instances of active beans pertaining to a specific bean. Applies to an individual bean that is either ‘stateful’ or ‘entity’
Chapter 25 • Web Application Server Resource Monitoring

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EntityBeansActive</td>
<td>The average number of active entity beans</td>
</tr>
<tr>
<td>StatefulBeansActive</td>
<td>The average number of active session beans</td>
</tr>
<tr>
<td>BeansLive</td>
<td>The average number of bean objects of this specific type that are instantiated but not yet destroyed. This applies to an individual bean, regardless of its type.</td>
</tr>
<tr>
<td>StatelessBeansLive</td>
<td>The average number of stateless session bean objects that are instantiated but not yet destroyed</td>
</tr>
<tr>
<td>StatefulBeansLive</td>
<td>The average number of stateful session bean objects that are instantiated but not yet destroyed</td>
</tr>
<tr>
<td>EntityBeansLive</td>
<td>The average number of entity bean objects that are instantiated but not yet destroyed</td>
</tr>
<tr>
<td>BeanMethodRT</td>
<td>The average method response time for all methods defined in the remote interface to this bean. Applies to all beans</td>
</tr>
<tr>
<td>BeanMethodActive</td>
<td>The average number of methods being processed concurrently. Applies to all beans</td>
</tr>
<tr>
<td>BeanMethodCalls</td>
<td>The total number of method calls against this bean</td>
</tr>
</tbody>
</table>

➤ BeanObjectPool

The server holds a cache of bean objects. Each home has a cache and there is therefore one BeanObjectPoolContainer per container. The top level BeanObjectPool holds an aggregate of all the containers data.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BeanObjectPoolContainer</td>
<td>The pool of a specific bean type</td>
</tr>
<tr>
<td>BeanObject</td>
<td>The pool specific to a home</td>
</tr>
<tr>
<td>NumGet</td>
<td>The number of calls retrieving an object from the pool</td>
</tr>
</tbody>
</table>
### Measurement | Description
--- | ---
NumGetFound | The number of calls to the pool that resulted in finding an available bean
NumPuts | The number of beans that were released to the pool
NumPutsDiscarded | The number of times releasing a bean to the pool resulted in the bean being discarded because the pool was full
NumDrains | The number of times the daemon found the pool was idle and attempted to clean it
DrainSize | The average number of beans discarded by the daemon during a clean
BeanPoolSize | The average number of beans in the pool

#### OrbThreadPool
These are resources related to the ORB thread pool that is on the server.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ActiveThreads</td>
<td>The average number of active threads in the pool</td>
</tr>
<tr>
<td>TotalThreads</td>
<td>The average number of threads in the pool</td>
</tr>
<tr>
<td>PercentTimeMaxed</td>
<td>The average percent of the time that the number of threads in the pool reached or exceeded the desired maximum number</td>
</tr>
<tr>
<td>ThreadCreates</td>
<td>The number of threads created</td>
</tr>
<tr>
<td>ThreadDestroys</td>
<td>The number of threads destroyed</td>
</tr>
<tr>
<td>ConfiguredMaxSize</td>
<td>The configured maximum number of pooled threads</td>
</tr>
</tbody>
</table>
Chapter 25 • Web Application Server Resource Monitoring

➤ **DBConnectionMgr**

These are resources related to the database connection manager. The manager consists of a series of data sources, as well as a top-level aggregate of each of the performance metrics.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DataSource</strong></td>
<td>Resources related to a specific data source specified by the &quot;name&quot; attribute</td>
</tr>
<tr>
<td><strong>ConnectionCreates</strong></td>
<td>The number of connections created</td>
</tr>
<tr>
<td><strong>ConnectionDestroys</strong></td>
<td>The number of connections released</td>
</tr>
<tr>
<td><strong>ConnectionPoolSize</strong></td>
<td>The average size of the pool, i.e., number of connections</td>
</tr>
<tr>
<td><strong>ConnectionAllocates</strong></td>
<td>The number of times a connection was allocated</td>
</tr>
<tr>
<td><strong>ConnectionWaiters</strong></td>
<td>The average number of threads waiting for a connection</td>
</tr>
<tr>
<td><strong>ConnectionWaitTime</strong></td>
<td>The average time, in seconds, of a connection grant</td>
</tr>
<tr>
<td><strong>ConnectionTime</strong></td>
<td>The average time, in seconds, that a connection is in use</td>
</tr>
<tr>
<td><strong>ConnectionPercentUsed</strong></td>
<td>The average percentage of the pool that is in use</td>
</tr>
<tr>
<td><strong>ConnectionPercentMaxed</strong></td>
<td>The percentage of the time that all connections are in use</td>
</tr>
</tbody>
</table>

➤ **TransactionData**

These are resources that pertain to transactions.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NumTransactions</strong></td>
<td>The number of transactions processed</td>
</tr>
<tr>
<td><strong>ActiveTransactions</strong></td>
<td>The average number of active transactions</td>
</tr>
<tr>
<td><strong>TransactionRT</strong></td>
<td>The average duration of each transaction</td>
</tr>
</tbody>
</table>
Monitoring a Scenario

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BeanObjectCount</td>
<td>The average number of bean object pools involved in a transaction</td>
</tr>
<tr>
<td>RolledBack</td>
<td>The number of transactions rolled back</td>
</tr>
<tr>
<td>Committed</td>
<td>The number of transactions committed</td>
</tr>
<tr>
<td>LocalTransactions</td>
<td>The number of transactions that were local</td>
</tr>
<tr>
<td>TransactionMethodCount</td>
<td>The average number of methods invoked as part of each transaction</td>
</tr>
<tr>
<td>Timeouts</td>
<td>The number of transactions that timed out due to inactivity timeouts</td>
</tr>
<tr>
<td>TransactionSuspended</td>
<td>The average number of times that a transaction was suspended</td>
</tr>
</tbody>
</table>

➤ ServletEngine

These are resources that are related to servlets and JSPs.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ServletsLoaded</td>
<td>The number of servlets currently loaded</td>
</tr>
<tr>
<td>ServletRequests</td>
<td>The number of requests serviced</td>
</tr>
<tr>
<td>CurrentRequests</td>
<td>The number of requests currently being serviced</td>
</tr>
<tr>
<td>ServletRT</td>
<td>The average response time for each request</td>
</tr>
<tr>
<td>ServletsActive</td>
<td>The average number of servlets actively processing requests</td>
</tr>
<tr>
<td>ServletIdle</td>
<td>The amount of time that the server has been idle (i.e., time since last request)</td>
</tr>
<tr>
<td>ServletErrors</td>
<td>The number of requests that resulted in an error or an exception</td>
</tr>
<tr>
<td>ServletBeanCalls</td>
<td>The number of bean method invocations that were made by the servlet</td>
</tr>
</tbody>
</table>
### Chapter 25 • Web Application Server Resource Monitoring

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ServletBeanCreates</td>
<td>The number of bean references that were made by the servlet</td>
</tr>
<tr>
<td>ServletDBCalls</td>
<td>The number of database calls made by the servlet</td>
</tr>
<tr>
<td>ServletDBConAlloc</td>
<td>The number of database connections allocated by the servlet</td>
</tr>
<tr>
<td>SessionLoads</td>
<td>The number of times the servlet session data was read from the database</td>
</tr>
<tr>
<td>SessionStores</td>
<td>The number of times the servlet session data was stored in the database</td>
</tr>
<tr>
<td>SessionSize</td>
<td>The average size, in bytes, of a session data</td>
</tr>
<tr>
<td>LoadedSince</td>
<td>The time that has passed since the server was loaded (UNC time)</td>
</tr>
</tbody>
</table>

#### Sessions

These are general metrics regarding the HTTP session pool.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SessionsCreated</td>
<td>The number of sessions created on the server</td>
</tr>
<tr>
<td>SessionsActive</td>
<td>The number of currently active sessions</td>
</tr>
<tr>
<td>SessionsInvalidated</td>
<td>The number of invalidated sessions. May not be valid when using sessions in the database mode</td>
</tr>
<tr>
<td>SessionLifetime</td>
<td>Contains statistical data of sessions that have been invalidated. Does not include sessions that are still alive</td>
</tr>
</tbody>
</table>
Configuring the WebSphere (EPM) Monitor

To monitor the IBM WebSphere application server (3.5.x), you must first install the IBM WebSphere Administrator’s Console on the Controller machine. You may also need to copy the security keyring.

To install the IBM WebSphere Administrator’s Console:

1. Start the WebSphere installation program from the WebSphere 3.5 Windows NT distribution CD-ROM. The WebSphere Application Server dialog box opens.

2. Disregard the instruction to shut down all Web servers that you plan to run with WebSphere. This is not relevant to the Administrator’s Console installation. Follow the remaining instructions.
Click **Next** to proceed. The Installation Options dialog box opens.
LoadRunner Controller User's Guide • Monitoring a Scenario

4 Select **Custom Installation**, and click **Next**. The Choose Application Server Components dialog box opens.

5 Select **Administrator's Console** and **IBM JDK 1.2.2**. Clear all the other options.
6 Click **Next**. The Get Host Name dialog box opens.

7 Type the name of the machine that you want to monitor.
8 Click **Next**. The Product Directory dialog box opens.

9 Specify the folder in which to install the Administrator's Console. To select a different location, click **Browse**, choose a folder other than the default folder, and click **OK**.
10 Click Next. The Select Program Folder dialog box opens.

11 Specify a program folder, or accept the default folder, IBM WebSphere\Application Server V3.5.

12 Click Next. The installation process begins. To pause or quit the installation, click Cancel.
When the installation is complete, the Setup Complete dialog box opens.

13 In the Setup Complete dialog box, select the check box to view the readme file before starting the program. You can view the readme file at any time by selecting **Start > Programs > Application Server V3.5 > IBM WebSphere > README**.

14 Click **Finish** to complete the installation program. The Restarting Windows dialog box opens.
15 Select either to restart your computer and complete the installation now (recommended) or to wait and complete the installation later.

16 Click OK to complete the installation of the Administrator’s Console.

**Copying the Security Keyring**

If you enabled security on the WebSphere server, you must copy the security keyring from the server to the admin client. (One way to tell whether security is enabled is to see whether the Administrator’s Console can connect to the admin server.) A keyring is a certification used by the server to identify the client.

You need to copy the jar file containing the keyring from the server lib folder to the client lib folder. You also need to add the jar file containing the keyring to the monitoring client command line.

---

**Note:** The keyring used in this file (353Keyring.jar) is the IBM dummy keyring that must be installed on servers using versions 3.52 and below. If your server is using the IBM dummy keyring and is version 3.52 or below, you do not need to change the line. If you are using the dummy keyring and are running version 3.53 or later, you do not need to do anything.

---

**To copy the keyring:**

1 Copy the keyring jar file from the server to the admin client lib folder (by default, C:\Websphere\Appserver\lib):

The jar file containing the keyring, xxxKeyring.jar, is located by default in the following location:

<table>
<thead>
<tr>
<th>NT Server</th>
<th>C:\Websphere\Appserver\lib</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIX Server</td>
<td>OPT/websphere/Appserver/lib</td>
</tr>
</tbody>
</table>
2 Open the `<LR root folder>\dat\monitors\WebSphere35Mon.ini` file in a text editor.

3 Locate the following line:
   JVM_CLASSES4=C:\WebSphere\AppServer\lib\353Keyring.jar

   **Note:** If you did not use the default location for the WebSphere installation, the line will be different.

4 Change `353Keyring.jar` to the keyring you are using.

**Enabling EPM Counters on the WebSphere 3.5.x Server**

To enable the EPM counters, which are by default set to "none," right-click the application you are monitoring in the WebSphere Administrator’s Console browser, and select **Performance**. Expand the Performance Modules tree in the dialog box that opens. In order to manage different levels of performance data, right-click the performance modules and choose a performance level. Click the **Set** button.

Alternatively, ensure that the application server is started, select the **Advanced** tab in the WebSphere Administrator’s Console browser, and in the EPM Specification box, type:
```
epm=high:epm.beanMethodData=none
```

**Activating the WebSphere (EPM) Monitor**

Once you have installed the WebSphere Administrator’s Console and enabled the EPM counters, you can activate the WebSphere (EPM) monitor.

1 Click the WebSphere (EPM) graph in the graph tree, and drag it into the right pane of the Run view.

2 Right-click the graph and choose **Add Measurement(s)**, or choose **Monitors > Add Online Measurement**.
In the Monitored Server Machines section of the WebSphere (EPM) dialog box, click **Add** to enter the server name or IP address of the machine you want to monitor. Select the platform on which the machine runs, and click **OK**.

In the Resource Measurements section of the WebSphere (EPM) dialog box, click **Add** to select the measurements that you want to monitor. The WebSphere Monitor Configuration dialog box displays the available measurements.

Browse the Measured Components tree.

Check the required performance counters in the WebSphere Monitor Configuration window’s right pane. For a list of the available performance counters, see page 386.

Click **OK** in the WebSphere Monitor Configuration dialog box, and in the WebSphere (EPM) dialog box, to activate the WebSphere (EPM) monitor.
You can monitor DB2, Oracle, SQL Server, or Sybase database resource usage during a scenario run using LoadRunner’s Database Server Resource monitors.

This chapter describes:

➤ Configuring the DB2 Monitor
➤ Configuring the Oracle Monitor
➤ Configuring the SQL Server Monitor
➤ Configuring the Sybase Monitor

About Database Resource Monitoring

The DB2, Oracle, SQL Server, or Sybase database server resource monitors measure statistics for DB2, Oracle, SQL Server, or Sybase database servers. During a scenario run, you use these monitors to isolate database server performance bottlenecks.

For each database server, you configure the measurements you want to monitor before running your scenario. Note that in order to run the DB2, Oracle, and Sybase monitors, you must also install the client libraries on the database server you want to monitor.
Configuring the DB2 Monitor

The DB2 database server monitor measures the resource usage on a DB2 database during a scenario run.

**Note:** If there is no application working with a database, you can only monitor the database manager instance.

Before you can monitor a DB2 database server, you must set up the DB2 monitor environment.

**To set up the DB2 monitor environment:**

1. Install all the client files and libraries on the Controller machine. It is recommended that you install DB2 Connect Enterprise Edition 7.2, if you are working on a 390 operating system.

2. Select **Start > Programs > DB2 for Windows NT > Control Center.** Enter your DB2 server username and password (with administrative privileges).

3. In the console that opens, right-click **Systems**, and select **Add**.

4. Enter the following settings in the dialog box:
   - **System Name:** `<server name>`
   - **Remote Instance:** DB2
   - **Host Name:** `<server name>`
   - **Service Name:** the DB2 server port. The default value is 50000.

5. Click **Retrieve**, and then **OK**.

**Note:** If you receive an error message after clicking **Retrieve**, repeat steps 3 and 4, and click **OK**.

6. Expand the `<server name>` node in the console tree.
7 Right-click **Instance**, and select **Add**.

8 Enter the following settings in the dialog box:

   - **Remote Instance**: DB2
   - **Instance Name**: the database instance to be called from the Controller
   - **Host Name**: `<server name>`
   - **Service Name**: the DB2 server port. The default value is 50000.

9 Click **OK** and close the Control Center.

---

**Note:** You can only work with a single Database Manager instance during each monitoring session.

---

**To configure the DB2 monitor:**

1 Click the DB2 graph in the graph tree, and drag it into the right pane of the Run view.

2 Right-click the graph and choose **Add Measurement(s)**, or choose **Monitors > Add Online Measurement**. The DB2 dialog box opens.

3 Click the **Add** button in the Monitored Server Machines section of the dialog box. The Add Machine dialog box opens.

4 In the Name box, enter the DB2 server machine name followed by the @ sign and the database instance you specified in the DB2 Control Center. In the Platform box, select **N/A**.

   ![Add Machine Dialog Box](image)

Click **OK** to save the information you entered and close the dialog box.
5 Click Add in the Resource Measurements section of the DB2 dialog box. In the dialog box that opens, enter your DB2 server username and password, and click OK. The DB2 Monitor Configuration dialog box opens.

6 Expand the Measured Components tree and select the methods and counters you want to monitor.
The following tables describe the default counters that can be monitored.

**DatabaseManager**

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>rem_cons_in</td>
<td>The current number of connections initiated from remote clients to the instance of the database manager that is being monitored.</td>
</tr>
<tr>
<td>rem_cons_in_exec</td>
<td>The number of remote applications that are currently connected to a database and are currently processing a unit of work within the database manager instance being monitored.</td>
</tr>
<tr>
<td>local_cons</td>
<td>The number of local applications that are currently connected to a database within the database manager instance being monitored.</td>
</tr>
<tr>
<td>local_cons_in_exec</td>
<td>The number of local applications that are currently connected to a database within the database manager instance being monitored and are currently processing a unit of work.</td>
</tr>
<tr>
<td>con_local_dbases</td>
<td>The number of local databases that have applications connected.</td>
</tr>
<tr>
<td>agents_registered</td>
<td>The number of agents registered in the database manager instance that is being monitored (coordinator agents and subagents).</td>
</tr>
<tr>
<td>agents_waiting_on_token</td>
<td>The number of agents waiting for a token so they can execute a transaction in the database manager.</td>
</tr>
<tr>
<td>idle_agents</td>
<td>The number of agents in the agent pool that are currently unassigned to an application and are therefore &quot;idle&quot;.</td>
</tr>
<tr>
<td>agents_from_pool</td>
<td>The number of agents assigned from the agent pool</td>
</tr>
<tr>
<td>agents_created_empty_pool</td>
<td>The number of agents created because the agent pool was empty.</td>
</tr>
</tbody>
</table>
### Monitoring a Scenario

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>agents_stolen</td>
<td>The number of times that agents are stolen from an application. Agents are stolen when an idle agent associated with an application is reassigned to work on a different application.</td>
</tr>
<tr>
<td>comm_private_mem</td>
<td>The amount of private memory that the instance of the database manager has currently committed at the time of the snapshot.</td>
</tr>
<tr>
<td>inactive_gw_agents</td>
<td>The number of DRDA agents in the DRDA connections pool that are primed with a connection to a DRDA database, but are inactive.</td>
</tr>
<tr>
<td>num_gw_conn_switches</td>
<td>The number of times that an agent from the agents pool was primed with a connection and was stolen for use with a different DRDA database.</td>
</tr>
<tr>
<td>sort_heap_allocated</td>
<td>The total number of allocated pages of sort heap space for all sorts at the level chosen and at the time the snapshot was taken.</td>
</tr>
<tr>
<td>post_threshold_sorts</td>
<td>The number of sorts that have requested heaps after the sort heap threshold has been reached.</td>
</tr>
<tr>
<td>piped_sorts_requested</td>
<td>The number of piped sorts that have been requested.</td>
</tr>
<tr>
<td>piped_sorts_accepted</td>
<td>The number of piped sorts that have been accepted.</td>
</tr>
</tbody>
</table>

### Database

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>appls_cur_cons</td>
<td>Indicates the number of applications that are currently connected to the database.</td>
</tr>
<tr>
<td>appls_in_db2</td>
<td>Indicates the number of applications that are currently connected to the database, and for which the database manager is currently processing a request.</td>
</tr>
<tr>
<td>Measurement</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>total_sec_cons</td>
<td>The number of connections made by a sub-agent to the database at the node.</td>
</tr>
<tr>
<td>num_assoc_agents</td>
<td>At the application level, this is the number of sub-agents associated with an application. At the database level, it is the number of sub-agents for all applications.</td>
</tr>
<tr>
<td>sort_heap_allocated</td>
<td>The total number of allocated pages of sort heap space for all sorts at the level chosen and at the time the snapshot was taken.</td>
</tr>
<tr>
<td>total_sorts</td>
<td>The total number of sorts that have been executed.</td>
</tr>
<tr>
<td>total_sort_time</td>
<td>The total elapsed time (in milliseconds) for all sorts that have been executed.</td>
</tr>
<tr>
<td>sort_overflows</td>
<td>The total number of sorts that ran out of sort heap and may have required disk space for temporary storage.</td>
</tr>
<tr>
<td>active_sorts</td>
<td>The number of sorts in the database that currently have a sort heap allocated.</td>
</tr>
<tr>
<td>total_hash_joins</td>
<td>The total number of hash joins executed.</td>
</tr>
<tr>
<td>total_hash_loops</td>
<td>The total number of times that a single partition of a hash join was larger than the available sort heap space.</td>
</tr>
<tr>
<td>hash_join_overflows</td>
<td>The number of times that hash join data exceeded the available sort heap space</td>
</tr>
<tr>
<td>hash_join_small_overflows</td>
<td>The number of times that hash join data exceeded the available sort heap space by less than 10%.</td>
</tr>
<tr>
<td>pool_data_l_reads</td>
<td>Indicates the number of logical read requests for data pages that have gone through the buffer pool.</td>
</tr>
<tr>
<td>pool_data_p_reads</td>
<td>The number of read requests that required I/O to get data pages into the buffer pool.</td>
</tr>
</tbody>
</table>
### Measurement | Description
--- | ---
**pool_data_writes** | Indicates the number of times a buffer pool data page was physically written to disk.
**pool_index_l_reads** | Indicates the number of logical read requests for index pages that have gone through the buffer pool.
**pool_index_p_reads** | Indicates the number of physical read requests to get index pages into the buffer pool.
**pool_index_writes** | Indicates the number of times a buffer pool index page was physically written to disk.
**pool_read_time** | Provides the total amount of elapsed time spent processing read requests that caused data or index pages to be physically read from disk to buffer pool.
**pool_write_time** | Provides the total amount of time spent physically writing data or index pages from the buffer pool to disk.
**files_closed** | The total number of database files closed.
**pool_async_data_reads** | The number of pages read asynchronously into the buffer pool.
**pool_async_data_writes** | The number of times a buffer pool data page was physically written to disk by either an asynchronous page cleaner, or a pre-fetcher. A pre-fetcher may have written dirty pages to disk to make space for the pages being pre-fetched.
**pool_async_index_writes** | The number of times a buffer pool index page was physically written to disk by either an asynchronous page cleaner, or a pre-fetcher. A pre-fetcher may have written dirty pages to disk to make space for the pages being pre-fetched.
**pool_async_index_reads** | The number of index pages read asynchronously into the buffer pool by a pre-fetcher.
**pool_async_read_time** | The total elapsed time spent reading by database manager pre-fetchers.
<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>pool_async_write_time</td>
<td>The total elapsed time spent writing data or index pages from the buffer pool to disk by database manager page cleaners.</td>
</tr>
<tr>
<td>pool_async_data_read_reqs</td>
<td>The number of asynchronous read requests.</td>
</tr>
<tr>
<td>pool_lsn_gap_clns</td>
<td>The number of times a page cleaner was invoked because the logging space used had reached a pre-defined criterion for the database.</td>
</tr>
<tr>
<td>pool_drty_pg_steal_clns</td>
<td>The number of times a page cleaner was invoked because a synchronous write was needed during the victim buffer replacement for the database.</td>
</tr>
<tr>
<td>pool_drty_pg_thrsh_clns</td>
<td>The number of times a page cleaner was invoked because a buffer pool had reached the dirty page threshold criterion for the database.</td>
</tr>
<tr>
<td>prefetch_wait_time</td>
<td>The time an application spent waiting for an I/O server (pre-fetcher) to finish loading pages into the buffer pool.</td>
</tr>
<tr>
<td>pool_data_to_estore</td>
<td>The number of buffer pool data pages copied to extended storage.</td>
</tr>
<tr>
<td>pool_index_to_estore</td>
<td>The number of buffer pool index pages copied to extended storage.</td>
</tr>
<tr>
<td>pool_data_from_estore</td>
<td>The number of buffer pool data pages copied from extended storage.</td>
</tr>
<tr>
<td>pool_index_from_estore</td>
<td>The number of buffer pool index pages copied from extended storage.</td>
</tr>
<tr>
<td>direct_reads</td>
<td>The number of read operations that do not use the buffer pool.</td>
</tr>
<tr>
<td>direct_writes</td>
<td>The number of write operations that do not use the buffer pool.</td>
</tr>
<tr>
<td>direct_read_reqs</td>
<td>The number of requests to perform a direct read of one or more sectors of data.</td>
</tr>
<tr>
<td>direct_write_reqs</td>
<td>The number of requests to perform a direct write of one or more sectors of data.</td>
</tr>
<tr>
<td>Measurement</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>direct_read_time</td>
<td>The elapsed time (in milliseconds) required to perform the direct reads.</td>
</tr>
<tr>
<td>direct_write_time</td>
<td>The elapsed time (in milliseconds) required to perform the direct writes.</td>
</tr>
<tr>
<td>cat_cache_lookups</td>
<td>The number of times that the catalog cache was referenced to obtain table descriptor information.</td>
</tr>
<tr>
<td>cat_cache_inserts</td>
<td>The number of times that the system tried to insert table descriptor information into the catalog cache.</td>
</tr>
<tr>
<td>cat_cache_overflows</td>
<td>The number of times that an insert into the catalog cache failed due the catalog cache being full.</td>
</tr>
<tr>
<td>cat_cache_heap_full</td>
<td>The number of times that an insert into the catalog cache failed due to a heap-full condition in the database heap.</td>
</tr>
<tr>
<td>pkg_cache_lookups</td>
<td>The number of times that an application looked for a section or package in the package cache. At a database level, it indicates the overall number of references since the database was started, or monitor data was reset.</td>
</tr>
<tr>
<td>pkg_cache_inserts</td>
<td>The total number of times that a requested section was not available for use and had to be loaded into the package cache. This count includes any implicit prepares performed by the system.</td>
</tr>
<tr>
<td>pkg_cache_num_overflows</td>
<td>The number of times that the package cache overflowed the bounds of its allocated memory.</td>
</tr>
<tr>
<td>appl_section_lookups</td>
<td>Lookups of SQL sections by an application from its SQL work area.</td>
</tr>
<tr>
<td>appl_section Inserts</td>
<td>Inserts of SQL sections by an application from its SQL work area.</td>
</tr>
<tr>
<td>sec_logs_allocated</td>
<td>The total number of secondary log files that are currently being used for the database.</td>
</tr>
<tr>
<td>Measurement</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>log_reads</td>
<td>The number of log pages read from disk by the logger.</td>
</tr>
<tr>
<td>log_writes</td>
<td>The number of log pages written to disk by the logger.</td>
</tr>
<tr>
<td>total_log_used</td>
<td>The total amount of active log space currently used (in bytes) in the database.</td>
</tr>
<tr>
<td>locks_held</td>
<td>The number of locks currently held.</td>
</tr>
<tr>
<td>lock_list_in_use</td>
<td>The total amount of lock list memory (in bytes) that is in use.</td>
</tr>
<tr>
<td>deadlocks</td>
<td>The total number of deadlocks that have occurred.</td>
</tr>
<tr>
<td>lock_escals</td>
<td>The number of times that locks have been escalated from several row locks to a table lock.</td>
</tr>
<tr>
<td>x_lock_escals</td>
<td>The number of times that locks have been escalated from several row locks to one exclusive table lock, or the number of times an exclusive lock on a row caused the table lock to become an exclusive lock.</td>
</tr>
<tr>
<td>lock_timeouts</td>
<td>The number of times that a request to lock an object timed-out instead of being granted.</td>
</tr>
<tr>
<td>lock_waits</td>
<td>The total number of times that applications or connections waited for locks.</td>
</tr>
<tr>
<td>lock_wait_time</td>
<td>The total elapsed time waited for a lock.</td>
</tr>
<tr>
<td>locks_waiting</td>
<td>Indicates the number of agents waiting on a lock.</td>
</tr>
<tr>
<td>rows_deleted</td>
<td>The number of row deletions attempted.</td>
</tr>
<tr>
<td>rows_inserted</td>
<td>The number of row insertions attempted.</td>
</tr>
<tr>
<td>rows_updated</td>
<td>The number of row updates attempted.</td>
</tr>
<tr>
<td>rows_selected</td>
<td>The number of rows that have been selected and returned to the application.</td>
</tr>
<tr>
<td>Measurement</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>int_rows_deleted</td>
<td>The number of rows deleted from the database as a result of internal activity.</td>
</tr>
<tr>
<td>int_rows_updated</td>
<td>The number of rows updated from the database as a result of internal activity.</td>
</tr>
<tr>
<td>int_rows_inserted</td>
<td>The number of rows inserted into the database as a result of internal activity caused by triggers.</td>
</tr>
<tr>
<td>static_sql_stmts</td>
<td>The number of static SQL statements that were attempted.</td>
</tr>
<tr>
<td>dynamic_sql_stmts</td>
<td>The number of dynamic SQL statements that were attempted.</td>
</tr>
<tr>
<td>failed_sql_stmts</td>
<td>The number of SQL statements that were attempted, but failed.</td>
</tr>
<tr>
<td>commit_sql_stmts</td>
<td>The total number of SQL COMMIT statements that have been attempted.</td>
</tr>
<tr>
<td>rollback_sql_stmts</td>
<td>The total number of SQL ROLLBACK statements that have been attempted.</td>
</tr>
<tr>
<td>select_sql_stmts</td>
<td>The number of SQL SELECT statements that were executed.</td>
</tr>
<tr>
<td>uid_sql_stmts</td>
<td>The number of SQL UPDATE, INSERT, and DELETE statements that were executed.</td>
</tr>
<tr>
<td>ddl_sql_stmts</td>
<td>This element indicates the number of SQL Data Definition Language (DDL) statements that were executed.</td>
</tr>
<tr>
<td>int_auto_rebinds</td>
<td>The number of automatic rebinds (or recompiles) that have been attempted.</td>
</tr>
<tr>
<td>int_commits</td>
<td>The total number of commits initiated internally by the database manager.</td>
</tr>
<tr>
<td>int_rollbacks</td>
<td>The total number of rollbacks initiated internally by the database manager.</td>
</tr>
</tbody>
</table>
# Chapter 26 • Database Resource Monitoring

## Measurement

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>int_deadlock_rollbacks</td>
<td>The total number of forced rollbacks initiated by the database manager due to a deadlock. A rollback is performed on the current unit of work in an application selected by the database manager to resolve the deadlock.</td>
</tr>
<tr>
<td>binds_precompiles</td>
<td>The number of binds and pre-compiles attempted.</td>
</tr>
</tbody>
</table>

## Application

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>agents_stolen</td>
<td>The number of times that agents are stolen from an application. Agents are stolen when an idle agent associated with an application is reassigned to work on a different application.</td>
</tr>
<tr>
<td>num_assoc_agents</td>
<td>At the application level, this is the number of sub-agents associated with an application. At the database level, it is the number of sub-agents for all applications.</td>
</tr>
<tr>
<td>total_sorts</td>
<td>The total number of sorts that have been executed.</td>
</tr>
<tr>
<td>total_sort_time</td>
<td>The total elapsed time (in milliseconds) for all sorts that have been executed.</td>
</tr>
<tr>
<td>sort_overflows</td>
<td>The total number of sorts that ran out of sort heap and may have required disk space for temporary storage.</td>
</tr>
<tr>
<td>total_hash_joins</td>
<td>The total number of hash joins executed.</td>
</tr>
<tr>
<td>total_hash_loops</td>
<td>The total number of times that a single partition of a hash join was larger than the available sort heap space.</td>
</tr>
<tr>
<td>hash_join_overflows</td>
<td>The number of times that hash join data exceeded the available sort heap space.</td>
</tr>
<tr>
<td>Measurement</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>hash_join_small_overflows</td>
<td>The number of times that hash join data exceeded the available sort heap space by less than 10%.</td>
</tr>
<tr>
<td>pool_data_l_reads</td>
<td>Indicates the number of logical read requests for data pages that have gone through the buffer pool.</td>
</tr>
<tr>
<td>pool_data_p_reads</td>
<td>The number of read requests that required I/O to get data pages into the buffer pool.</td>
</tr>
<tr>
<td>pool_data_writes</td>
<td>Indicates the number of times a buffer pool data page was physically written to disk.</td>
</tr>
<tr>
<td>pool_index_l_reads</td>
<td>Indicates the number of logical read requests for index pages that have gone through the buffer pool.</td>
</tr>
<tr>
<td>pool_index_p_reads</td>
<td>Indicates the number of physical read requests to get index pages into the buffer pool.</td>
</tr>
<tr>
<td>pool_index_writes</td>
<td>Indicates the number of times a buffer pool index page was physically written to disk.</td>
</tr>
<tr>
<td>pool_read_time</td>
<td>Provides the total amount of elapsed time spent processing read requests that caused data or index pages to be physically read from disk to buffer pool.</td>
</tr>
<tr>
<td>prefetch_wait_time</td>
<td>The time an application spent waiting for an I/O server (pre-fetcher) to finish loading pages into the buffer pool.</td>
</tr>
<tr>
<td>pool_data_to_estore</td>
<td>The number of buffer pool data pages copied to extended storage.</td>
</tr>
<tr>
<td>pool_index_to_estore</td>
<td>The number of buffer pool index pages copied to extended storage.</td>
</tr>
<tr>
<td>pool_data_from_estore</td>
<td>The number of buffer pool data pages copied from extended storage.</td>
</tr>
<tr>
<td>pool_index_from_estore</td>
<td>The number of buffer pool index pages copied from extended storage.</td>
</tr>
<tr>
<td>Measurement</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>direct_reads</td>
<td>The number of read operations that do not use the buffer pool.</td>
</tr>
<tr>
<td>direct_writes</td>
<td>The number of write operations that do not use the buffer pool.</td>
</tr>
<tr>
<td>direct_read_reqs</td>
<td>The number of requests to perform a direct read of one or more sectors of data.</td>
</tr>
<tr>
<td>direct_write_reqs</td>
<td>The number of requests to perform a direct write of one or more sectors of data.</td>
</tr>
<tr>
<td>direct_read_time</td>
<td>The elapsed time (in milliseconds) required to perform the direct reads.</td>
</tr>
<tr>
<td>direct_write_time</td>
<td>The elapsed time (in milliseconds) required to perform the direct writes.</td>
</tr>
<tr>
<td>cat_cache_lookups</td>
<td>The number of times that the catalog cache was referenced to obtain table descriptor information.</td>
</tr>
<tr>
<td>cat_cache_inserts</td>
<td>The number of times that the system tried to insert table descriptor information into the catalog cache.</td>
</tr>
<tr>
<td>cat_cache_overflows</td>
<td>The number of times that an insert into the catalog cache failed due the catalog cache being full.</td>
</tr>
<tr>
<td>cat_cache_heap_full</td>
<td>The number of times that an insert into the catalog cache failed due to a heap-full condition in the database heap.</td>
</tr>
<tr>
<td>pkg_cache_lookups</td>
<td>The number of times that an application looked for a section or package in the package cache. At a database level, it indicates the overall number of references since the database was started, or monitor data was reset.</td>
</tr>
<tr>
<td>pkg_cache_inserts</td>
<td>The total number of times that a requested section was not available for use and had to be loaded into the package cache. This count includes any implicit prepares performed by the system.</td>
</tr>
<tr>
<td>Measurement</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>appl_section_lookups</td>
<td>Lookups of SQL sections by an application from its SQL work area.</td>
</tr>
<tr>
<td>appl_section_inserts</td>
<td>Inserts of SQL sections by an application from its SQL work area.</td>
</tr>
<tr>
<td>uow_log_space_used</td>
<td>The amount of log space (in bytes) used in the current unit of work of the monitored application.</td>
</tr>
<tr>
<td>locks_held</td>
<td>The number of locks currently held.</td>
</tr>
<tr>
<td>deadlocks</td>
<td>The total number of deadlocks that have occurred.</td>
</tr>
<tr>
<td>lock_escals</td>
<td>The number of times that locks have been escalated from several row locks to a table lock.</td>
</tr>
<tr>
<td>x_lock_escals</td>
<td>The number of times that locks have been escalated from several row locks to one exclusive table lock, or the number of times an exclusive lock on a row caused the table lock to become an exclusive lock.</td>
</tr>
<tr>
<td>lock_timeouts</td>
<td>The number of times that a request to lock an object timed-out instead of being granted.</td>
</tr>
<tr>
<td>lock_waits</td>
<td>The total number of times that applications or connections waited for locks.</td>
</tr>
<tr>
<td>lock_wait_time</td>
<td>The total elapsed time waited for a lock.</td>
</tr>
<tr>
<td>locks_waiting</td>
<td>Indicates the number of agents waiting on a lock.</td>
</tr>
<tr>
<td>uow_lock_wait_time</td>
<td>The total amount of elapsed time this unit of work has spent waiting for locks.</td>
</tr>
<tr>
<td>rows_deleted</td>
<td>The number of row deletions attempted.</td>
</tr>
<tr>
<td>rows_inserted</td>
<td>The number of row insertions attempted.</td>
</tr>
<tr>
<td>rows_updated</td>
<td>The number of row updates attempted.</td>
</tr>
<tr>
<td>rows_selected</td>
<td>The number of rows that have been selected and returned to the application.</td>
</tr>
</tbody>
</table>
### Chapter 26 • Database Resource Monitoring

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>rows_written</td>
<td>The number of rows changed (inserted, deleted or updated) in the table.</td>
</tr>
<tr>
<td>rows_read</td>
<td>The number of rows read from the table.</td>
</tr>
<tr>
<td>int_rows_deleted</td>
<td>The number of rows deleted from the database as a result of internal activity.</td>
</tr>
<tr>
<td>int_rows_updated</td>
<td>The number of rows updated from the database as a result of internal activity.</td>
</tr>
<tr>
<td>int_rows_inserted</td>
<td>The number of rows inserted into the database as a result of internal activity caused by triggers.</td>
</tr>
<tr>
<td>open_rem_curs</td>
<td>The number of remote cursors currently open for this application, including those cursors counted by 'open_rem_curs_blk'.</td>
</tr>
<tr>
<td>open_rem_curs_blk</td>
<td>The number of remote blocking cursors currently open for this application.</td>
</tr>
<tr>
<td>rej_curs_blk</td>
<td>The number of times that a request for an I/O block at server was rejected and the request was converted to non-blocked I/O.</td>
</tr>
<tr>
<td>acc_curs_blk</td>
<td>The number of times that a request for an I/O block was accepted.</td>
</tr>
<tr>
<td>open_loc_curs</td>
<td>The number of local cursors currently open for this application, including those cursors counted by 'open_loc_curs_blk'.</td>
</tr>
<tr>
<td>open_loc_curs_blk</td>
<td>The number of local blocking cursors currently open for this application.</td>
</tr>
<tr>
<td>static_sql_stmts</td>
<td>The number of static SQL statements that were attempted.</td>
</tr>
<tr>
<td>dynamic_sql_stmts</td>
<td>The number of dynamic SQL statements that were attempted.</td>
</tr>
<tr>
<td>failed_sql_stmts</td>
<td>The number of SQL statements that were attempted, but failed.</td>
</tr>
<tr>
<td>Measurement</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>commit_sql_stmts</td>
<td>The total number of SQL COMMIT statements that have been attempted.</td>
</tr>
<tr>
<td>rollback_sql_stmts</td>
<td>The total number of SQL ROLLBACK statements that have been attempted.</td>
</tr>
<tr>
<td>select_sql_stmts</td>
<td>The number of SQL SELECT statements that were executed.</td>
</tr>
<tr>
<td>uid_sql_stmts</td>
<td>The number of SQL UPDATE, INSERT, and DELETE statements that were executed.</td>
</tr>
<tr>
<td>ddl_sql_stmts</td>
<td>This element indicates the number of SQL Data Definition Language (DDL) statements that were executed.</td>
</tr>
<tr>
<td>int_auto_rebinds</td>
<td>The number of automatic rebinds (or recompiles) that have been attempted.</td>
</tr>
<tr>
<td>int_commits</td>
<td>The total number of commits initiated internally by the database manager.</td>
</tr>
<tr>
<td>int_rollbacks</td>
<td>The total number of rollbacks initiated internally by the database manager.</td>
</tr>
<tr>
<td>int_deadlock_rollbacks</td>
<td>The total number of forced rollbacks initiated by the database manager due to a deadlock. A rollback is performed on the current unit of work in an application selected by the database manager to resolve the deadlock.</td>
</tr>
<tr>
<td>binds_precompiles</td>
<td>The number of binds and pre-compiles attempted.</td>
</tr>
</tbody>
</table>

7 Click **Add** to place the selected counter on the resource list. Add all the desired resources to the list, and click **Close**.

8 Click **OK** in the DB2 dialog box to activate the monitor.
Configuring the Oracle Monitor

The Oracle server measures information from the V$SESSTAT and V$SYSSTAT Oracle V$ tables, and other table counters defined by the user in the custom query. In order to monitor the Oracle server, you must set up the monitoring environment as described below.

---

**Note:** The port you use to monitor an Oracle server through a firewall depends on the configuration of the Oracle server. Configuration information for the connection between the client and server is located in the Oracle client tnsnames.ora file.

---

**To set up the Oracle monitor environment:**

1. Ensure that the Oracle client libraries are installed on the Controller machine.
2. Verify that \%OracleHome\%\bin is included in the path environment variable. If it is not, add it.
3. Configure the tnsnames.ora file on the Controller machine so that the Oracle client can communicate with the Oracle server(s) you plan to monitor.

You can configure connection parameters either manually, by editing the tnsnames.ora file in a text editor, or using the Oracle service configuration tool (for example, select Start > Programs > Oracle for Windows NT > Oracle Net8 Easy Config).

You specify:

- a new service name (TNS name) for the Oracle instance
- TCP protocol
- the host name (name of monitored server machine)
- the port number (usually 1521)
- the database SID (the default SID is ORCL).
For example:

4 Obtain a username and password for the service from your database administrator, and ensure that the Controller has database administrator privileges for the Oracle V$ tables (V$SESSTAT, V$SYSSTAT, V$STATNAME, V$INSTANCE, V$SESSION).

5 Verify connection with the Oracle server by performing `tns ping` from the Controller machine. Note that there may be a problem connecting if the Oracle server is behind a DMZ/firewall that limits its communication to application servers accessing it.

6 Ensure that the registries are updated for the version of Oracle that you are using and that they have the following key:

   \[ \text{HKEY\_LOCAL\_MACHINE}\backslash \text{SOFTWARE}\backslash \text{ORACLE} \]

7 Verify that the Oracle server you want to monitor is up and running.

---

**Note:** It is possible to monitor several Oracle database servers concurrently.

---

8 Run SQL*Plus from the Controller and attempt to log in to the Oracle server(s) with the desired username/password/server combination.

9 Type `SELECT * FROM V$SYSSTAT` to verify that you can view the V$SYSSTAT table on the Oracle server. Use similar queries to verify that you can view the V$SESSTAT, V$SESSION, V$INSTANCE, V$STATNAME, and V$PROCESS tables on the server. Make sure that the Oracle bin directory is in the search path.
To change the length of each monitoring sample (in seconds), you need to edit the `dat\monitors\vmon.cfg` file in the LoadRunner root folder. The default rate is 10 seconds.

**Note:** The minimum sampling rate for the Oracle Monitor is 10 seconds. If you set the sampling rate at less than 10 seconds, the Oracle Monitor will continue to monitor at 10 second intervals.

**Note:** If a problem occurs in setting up the Oracle environment, view the error message issued by the Oracle server.

**To configure the Oracle monitor:**

1. Click the Oracle graph in the graph tree, and drag it into the right pane of the Run view.

2. Right-click the graph and choose **Add Measurement(s)**, or choose **Monitors > Add Online Measurement**.

3. In the Monitored Server Machines section of the Oracle dialog box, click **Add** to enter the server name or IP address of the machine you want to monitor. Select any platform, and click **OK**.

4. In the Resource Measurements section of the Oracle dialog box, click **Add** to select the measurements that you want to monitor.

The Oracle Logon dialog box opens.
5 Enter your Login Name, Password, and Server Name, and click OK. The Add Oracle Measurements dialog box opens.

6 Select an object, a measurement, and an instance. You can select multiple measurements using the Ctrl key. The instance is relevant only if multiple instances of the highlighted measurement are running. For a description of each measurement, click Explain>> to expand the dialog box. For instructions on creating custom queries, see “Custom Queries,” on page 428.

The following measurements are most commonly used when monitoring the Oracle server (from the V$SYSSTAT table):

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU used by this session</td>
<td>This is the amount of CPU time (in 10s of milliseconds) used by a session between the time a user call started and ended. Some user calls can be completed within 10 milliseconds and, as a result, the start and end user-call time can be the same. In this case, 0 milliseconds are added to the statistic. A similar problem can exist in the operating system reporting, especially on systems that suffer from many context switches.</td>
</tr>
<tr>
<td>Bytes received via SQL*Net from client</td>
<td>The total number of bytes received from the client over Net8</td>
</tr>
</tbody>
</table>
## Chapter 26 • Database Resource Monitoring

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logons current</td>
<td>The total number of current logons</td>
</tr>
<tr>
<td>Opens of replaced files</td>
<td>The total number of files that needed to be reopened because they were no longer in the process file cache</td>
</tr>
<tr>
<td>User calls</td>
<td>Oracle allocates resources (Call State Objects) to keep track of relevant user call data structures every time you log in, parse, or execute. When determining activity, the ratio of user calls to RPI calls gives you an indication of how much internal work gets generated as a result of the type of requests the user is sending to Oracle.</td>
</tr>
<tr>
<td>SQL*Net roundtrips to/from client</td>
<td>The total number of Net8 messages sent to, and received from, the client</td>
</tr>
<tr>
<td>Bytes sent via SQL*Net to client</td>
<td>The total number of bytes sent to the client from the foreground process(es)</td>
</tr>
<tr>
<td>Opened cursors current</td>
<td>The total number of current open cursors</td>
</tr>
<tr>
<td>DB block changes</td>
<td>Closely related to consistent changes, this statistic counts the total number of changes that were made to all blocks in the SGA that were part of an update or delete operation. These are changes that are generating redo log entries and hence will be permanent changes to the database if the transaction is committed. This statistic is a rough indication of total database work and indicates (possibly on a per-transaction level) the rate at which buffers are being dirtied.</td>
</tr>
<tr>
<td>Total file opens</td>
<td>The total number of file opens being performed by the instance. Each process needs a number of files (control file, log file, database file) in order to work against the database.</td>
</tr>
</tbody>
</table>

7 Click **Add** to place the selected measurement on the resource list. Add all the desired resources to the list, and click **Close**.

8 Click **OK** in the Oracle dialog box to activate the monitor.
Note: By default, the database returns the absolute value of a counter. However, by changing the IsRate setting in the dat\monitors\vmon.cfg file to 1, you can instruct the database to report a counter’s rate value—the change in the counter per unit time.

Custom Queries

Using the custom query feature, you can define your own query to the Oracle database and view the result of this query—a single numerical value—in the Oracle online monitor graph. By defining your own query, you can monitor not only the V$SYSSTAT and V$SESSTAT table counters that are currently provided by the Oracle monitor, but other tables that contain useful performance information as well.

To create a custom query:

1. In the third line of the vmon.cfg file, CustomCounters=, indicate the number of custom counters you want to create.

2. Create a new section in the vmon.cfg file for the new counter. Each section has the following format:

   [Custom2]
   Name=Number of sessions
   Description=This counter returns the number of sessions active.
   Query=SELECT COUNT(*) FROM V$SESSION
   IsRate=1

3. In the [Custom#] line, assign the next number in the sequence of counters to the new custom counter. Note that the custom counters must be in consecutive order, beginning with the number 0.

4. In the Name line, enter the name of the new counter.

5. In the Description line, enter the description of the counter that you want the help message to contain.
6 In the Query line, enter the text of the SQL query (on one line of the \textit{vmon.cfg} file) that returns exactly one row from the database. This row must contain one column, a numerical value.

7 In the IsRate line, enter 0 if you want the database to report the counter as an absolute number. If you want the database to report the change in the counter per unit time, enter 1.

\textbf{Note:} Custom queries cannot return negative values.

\section*{Configuring the SQL Server Monitor}

The SQL Server monitor measures the standard Windows resources on the SQL server machine.

\textbf{Note:} To monitor an SQL server through a firewall, use TCP, port 139.

\textbf{To configure the SQL server monitor:}

1 Click the SQL Server graph in the graph tree, and drag it into the right pane of the Run view.

2 Right-click the graph and choose \textit{Add Measurement(s)}, or choose \textit{Monitors} \textgreater \textit{Add Online Measurement}.

3 In the Monitored Server Machines section of the SQL Server dialog box, click \textit{Add} to enter the server name or IP address of the machine you want to monitor. Select the platform on which the machine runs, and click \textit{OK}. 
In the Resource Measurements section of the SQL Server dialog box, select the measurements you want to monitor. The following table describes the default counters that can be monitored on version 6.5 of the SQL Server:

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Total Processor Time (NT)</td>
<td>The average percentage of time that all the processors on the system are busy executing non-idle threads. On a multi-processor system, if all processors are always busy, this is 100%, if all processors are 50% busy this is 50% and if 1/4th of the processors are 100% busy this is 25%. It can be viewed as the fraction of the time spent doing useful work. Each processor is assigned an Idle thread in the Idle process which consumes those unproductive processor cycles not used by any other threads.</td>
</tr>
<tr>
<td>% Processor Time (Win 2000)</td>
<td>The percentage of time that the processor is executing a non-idle thread. This counter was designed as a primary indicator of processor activity. It is calculated by measuring the time that the processor spends executing the thread of the idle process in each sample interval, and subtracting that value from 100%. (Each processor has an idle thread which consumes cycles when no other threads are ready to run). It can be viewed as the percentage of the sample interval spent doing useful work. This counter displays the average percentage of busy time observed during the sample interval. It is calculated by monitoring the time the service was inactive, and then subtracting that value from 100%.</td>
</tr>
<tr>
<td>Cache Hit Ratio</td>
<td>The percentage of time that a requested data page was found in the data cache (instead of being read from disk)</td>
</tr>
<tr>
<td>I/O - Batch Writes/sec</td>
<td>The number of 2K pages written to disk per second, using Batch I/O. The checkpoint thread is the primary user of Batch I/O.</td>
</tr>
<tr>
<td>I/O - Lazy Writes/sec</td>
<td>The number of 2K pages flushed to disk per second by the Lazy Writer</td>
</tr>
<tr>
<td>I/O - Outstanding Reads</td>
<td>The number of physical reads pending</td>
</tr>
</tbody>
</table>
### Chapter 26 • Database Resource Monitoring

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I/O - Outstanding Writes</td>
<td>The number of physical writes pending</td>
</tr>
<tr>
<td>I/O - Page Reads/sec</td>
<td>The number of physical page reads per second</td>
</tr>
<tr>
<td>I/O - Transactions/sec</td>
<td>The number of Transact-SQL command batches executed per second</td>
</tr>
<tr>
<td>User Connections</td>
<td>The number of open user connections</td>
</tr>
</tbody>
</table>

**Note:** To change the default counters for the SQL Server monitor, see “Changing a Monitor’s Default Counters,” on page 553.

5 To select additional measurements, click **Add**. A dialog box displaying the SQL Server object, its counters, and instances opens.

6 Select a counter and an instance. You can select multiple counters using the **Ctrl** key. The instance is relevant only if multiple instances of the highlighted counter are running. For a description of each counter, click **Explain>>** to expand the dialog box.
7 Click **Add** to place the selected counter on the resource list. Add all the desired resources to the list, and click **Close**.

8 Click **OK** in the SQL Server dialog box to activate the monitor.

---

**Note:** Certain measurements or counters are especially useful for determining server performance and isolating the cause of a bottleneck during an initial stress test on the SQL Server. For more information about these counters, see “Useful Counters for Stress Testing,” on page 554.

---

### Configuring the Sybase Monitor

The Sybase monitor enables monitoring of Sybase Adaptive Server Enterprise (Sybase ASE) servers (version 11 or later) on Windows and UNIX. The monitor connects to the Sybase ASE server (via the Adaptive Server Enterprise Monitor Server) and retrieves metrics from the server using standard, Sybase-provided libraries.

---

**Note:** When connecting to the monitored server, you connect to the Adaptive Server Enterprise Monitor Server, not the Sybase ASE server. The Adaptive Server Enterprise Monitor Server is an application that runs on the same machine as Sybase ASE server and retrieves performance information from it. The Adaptive Server Enterprise Monitor Server usually has the same name as the Sybase server, but with the suffix _ms.

---

In order to monitor the Sybase ASE server, you must first set up the Sybase monitor environment.

**To set up the Sybase monitor environment:**

1 Install the Sybase client files and libraries on the Controller machine.
2 Verify a connection between the client and server on the Controller machine. To do so, use the Sybase client’s dsedit tool to ping the Adaptive Server Enterprise Monitor Server.

![Ping](image)

Select a server address to ping.

**Note:** The port you use to monitor a Sybase server through a firewall depends on the configuration of the Sybase server. Configuration information for the connection between the client and server is located in the Sybase client sql.ini file.

**To configure the Sybase ASE monitor:**

1 Click the Sybase graph in the graph tree, and drag it into the right pane of the Run view.

2 Right-click the graph and choose **Add Measurement(s)**, or choose **Monitors > Add Online Measurement**.

3 In the Monitored Server Machines section of the Sybase dialog box, click **Add** to enter the server name or IP address of the machine you want to monitor. Select any platform, and click **OK**.

4 In the Resource Measurements section of the Sybase dialog box, click **Add** to select the measurements that you want to monitor.
The Sybase Logon dialog box opens.

5. Enter the login name and password of a user that has administrative privileges on the Sybase ASE server, as well as the Adaptive Server Enterprise Monitor Server name (usually the same name as the Sybase server but with the suffix _ms).

6. Click OK. The Add Sybase Measurements dialog box opens.

7. Select an object, measurement, and instance. You can select multiple measurements using the CTRL key. The instance is relevant only if multiple instances of the highlighted measurement are running. For a description of the measurements, click Explain>> to expand the dialog box.
The following measurements are available when monitoring a Sybase server:

<table>
<thead>
<tr>
<th>Object</th>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network</td>
<td>Average packet size (Read)</td>
<td>Reports the number of network packets received</td>
</tr>
<tr>
<td></td>
<td>Average packet size (Send)</td>
<td>Reports the number of network packets sent</td>
</tr>
<tr>
<td></td>
<td>Network bytes (Read)</td>
<td>Reports the number of bytes received, over the sampling interval</td>
</tr>
<tr>
<td></td>
<td>Network bytes (Read)/sec</td>
<td>Reports the number of bytes received, per second</td>
</tr>
<tr>
<td></td>
<td>Network bytes (Send)</td>
<td>Reports the number of bytes sent, over the sampling interval</td>
</tr>
<tr>
<td></td>
<td>Network bytes (Send)/sec</td>
<td>Reports the number of bytes sent, per second</td>
</tr>
<tr>
<td></td>
<td>Network packets (Read)</td>
<td>Reports the number of network packets received, over the sampling interval</td>
</tr>
<tr>
<td></td>
<td>Network packets (Read)/sec</td>
<td>Reports the number of network packets received, per second</td>
</tr>
<tr>
<td></td>
<td>Network packets (Send)</td>
<td>Reports the number of network packets sent, over the sampling interval</td>
</tr>
<tr>
<td></td>
<td>Network packets (Send)/sec</td>
<td>Reports the number of network packets sent, per second</td>
</tr>
<tr>
<td>Memory</td>
<td>Memory</td>
<td>Reports the amount of memory, in bytes, allocated for the page cache</td>
</tr>
<tr>
<td>Disk</td>
<td>Reads</td>
<td>Reports the number of reads made from a database device</td>
</tr>
<tr>
<td></td>
<td>Writes</td>
<td>Reports the number of writes made to a database device</td>
</tr>
<tr>
<td></td>
<td>Waits</td>
<td>Reports the number of times that access to a device had to wait</td>
</tr>
<tr>
<td>Object</td>
<td>Measurement</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------</td>
<td>------------------------------</td>
<td>----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Disk</td>
<td>Grants</td>
<td>Reports the number of times access to a device was granted</td>
</tr>
<tr>
<td>Engine</td>
<td>Server is busy (%)</td>
<td>Reports the percentage of time during which the Adaptive Server is in a &quot;busy&quot; state</td>
</tr>
<tr>
<td></td>
<td>CPU time</td>
<td>Reports how much &quot;busy&quot; time was used by the engine</td>
</tr>
<tr>
<td></td>
<td>Logical pages (Read)</td>
<td>Reports the number of data page reads, whether satisfied from cache or from a database device</td>
</tr>
<tr>
<td></td>
<td>Pages from disk (Read)</td>
<td>Reports the number of data page reads that could not be satisfied from the data cache</td>
</tr>
<tr>
<td></td>
<td>Pages stored</td>
<td>Reports the number of data pages written to a database device</td>
</tr>
<tr>
<td>Stored Procedures</td>
<td>Executed (sampling period)</td>
<td>Reports the number of times a stored procedure was executed, over the sampling interval</td>
</tr>
<tr>
<td></td>
<td>Executed (session)</td>
<td>Reports the number of times a stored procedure was executed, during the session</td>
</tr>
<tr>
<td></td>
<td>Average duration (sampling period)</td>
<td>Reports the time, in seconds, spent executing a stored procedure, over the sampling interval</td>
</tr>
<tr>
<td></td>
<td>Average duration (session)</td>
<td>Reports the time, in seconds, spent executing a stored procedure, during the session</td>
</tr>
<tr>
<td>Locks</td>
<td>% Requests</td>
<td>Reports the percentage of successful requests for locks</td>
</tr>
<tr>
<td></td>
<td>Locks count</td>
<td>Reports the number of locks. This is an accumulated value.</td>
</tr>
<tr>
<td>Object</td>
<td>Measurement</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>------------------------------</td>
<td>------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Locks</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Granted immediately</td>
<td>Reports the number of locks that were granted immediately, without having to wait for another lock to be released</td>
</tr>
<tr>
<td></td>
<td>Granted after wait</td>
<td>Reports the number of locks that were granted after waiting for another lock to be released</td>
</tr>
<tr>
<td></td>
<td>Not granted</td>
<td>Reports the number of locks that were requested but not granted</td>
</tr>
<tr>
<td></td>
<td>Wait time (avg.)</td>
<td>Reports the average wait time for a lock</td>
</tr>
<tr>
<td><strong>SqlSrvr</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Locks/sec</td>
<td>Reports the number of locks. This is an accumulated value.</td>
</tr>
<tr>
<td></td>
<td>% Processor time (server)</td>
<td>Reports the percentage of time that the Adaptive Server is in a &quot;busy&quot; state</td>
</tr>
<tr>
<td></td>
<td>Transactions</td>
<td>Reports the number of committed Transact-SQL statement blocks (transactions)</td>
</tr>
<tr>
<td></td>
<td>Deadlocks</td>
<td>Reports the number of deadlocks</td>
</tr>
<tr>
<td><strong>Cache</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>% Hits</td>
<td>Reports the percentage of times that a data page read could be satisfied from cache without requiring a physical page read</td>
</tr>
<tr>
<td></td>
<td>Pages (Read)</td>
<td>Reports the number of data page reads, whether satisfied from cache or from a database device</td>
</tr>
<tr>
<td></td>
<td>Pages (Read)/sec</td>
<td>Reports the number of data page reads, whether satisfied from cache or from a database device, per second</td>
</tr>
</tbody>
</table>
## Monitoring a Scenario

<table>
<thead>
<tr>
<th>Object</th>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cache</strong></td>
<td>Pages from disk (Read)</td>
<td>Reports the number of data page reads that could not be satisfied from the data cache</td>
</tr>
<tr>
<td></td>
<td>Pages from disk (Read)/sec</td>
<td>Reports the number of data page reads, per second, that could not be satisfied from the data cache</td>
</tr>
<tr>
<td></td>
<td>Pages (Write)</td>
<td>Reports the number of data pages written to a database device</td>
</tr>
<tr>
<td></td>
<td>Pages (Write)/sec</td>
<td>Reports the number of data pages written to a database device, per second</td>
</tr>
<tr>
<td><strong>Process</strong></td>
<td>% Processor time (process)</td>
<td>Reports the percentage of time that a process running a given application was in the &quot;Running&quot; state (out of the time that all processes were in the &quot;Running&quot; state)</td>
</tr>
<tr>
<td></td>
<td>Locks/sec</td>
<td>Reports the number of locks, by process. This is an accumulated value.</td>
</tr>
<tr>
<td></td>
<td>% Cache hit</td>
<td>Reports the percentage of times that a data page read could be satisfied from cache without requiring a physical page read, by process</td>
</tr>
<tr>
<td></td>
<td>Pages (Write)</td>
<td>Reports the number of data pages written to a database device, by process</td>
</tr>
<tr>
<td><strong>Transaction</strong></td>
<td>Transactions</td>
<td>Reports the number of committed Transact-SQL statement blocks (transactions), during the session</td>
</tr>
<tr>
<td></td>
<td>Rows (Deleted)</td>
<td>Reports the number of rows deleted from database tables during the session</td>
</tr>
</tbody>
</table>
### Chapter 26 • Database Resource Monitoring

<table>
<thead>
<tr>
<th>Object</th>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transaction</td>
<td>Inserts</td>
<td>Reports the number of insertions into a database table during the session</td>
</tr>
<tr>
<td></td>
<td>Updates</td>
<td>Reports the updates to database tables during the session</td>
</tr>
<tr>
<td></td>
<td>Updates in place</td>
<td>Reports the sum of expensive, in-place and not-in-place updates (everything except updates deferred) during the session</td>
</tr>
<tr>
<td></td>
<td>Transactions/sec</td>
<td>Reports the number of committed Transact-SQL statement blocks (transactions) per second</td>
</tr>
<tr>
<td></td>
<td>Rows (Deleted)/sec</td>
<td>Reports the number of rows deleted from database tables, per second</td>
</tr>
<tr>
<td></td>
<td>Inserts/sec</td>
<td>Reports the number of insertions into a database table, per second</td>
</tr>
<tr>
<td></td>
<td>Updates/sec</td>
<td>Reports the updates to database tables, per second</td>
</tr>
<tr>
<td></td>
<td>Updates in place/sec</td>
<td>Reports the sum of expensive, in-place and not-in-place updates (everything except updates deferred), per second</td>
</tr>
</tbody>
</table>

8 Click **Add** to place the selected measurement on the resource list. Add all the desired resources to the list, and click **Close**.

9 Click **OK** in the Sybase dialog box to activate the monitor.
Streaming Media Monitoring

During a scenario run, you can monitor the Windows Media Server and RealPlayer audio/video servers, as well as the RealPlayer and Media Player clients, in order to isolate server and client performance bottlenecks.

This chapter describes:

➤ Configuring the Windows Media Server Monitor
➤ Configuring the RealPlayer Server Monitor
➤ Viewing the RealPlayer Client Online Graph
➤ Viewing the Media Player Client Online Graph

Note: For instructions on recording a script containing streaming media functions, see the Creating Vuser Scripts guide.

About Streaming Media Monitoring

The streaming media monitors provide you with performance information for the Windows Media Server and RealPlayer audio/video servers, as well as the RealPlayer and Media Player clients. In order to obtain data for the Windows Media Server and RealPlayer Server, you need to activate the streaming media monitor before executing the scenario, and indicate which statistics and measurements you want to monitor. The RealPlayer Client and Media Player Client do not require pre-scenario activation or configuration.
Configuring the Windows Media Server Monitor

To monitor the Windows Media Server, you must first select the counters you want the Windows Media Server monitor to measure. You select these counters using the Windows Media Server dialog box.

To configure the Windows Media Server monitor:

1. Click the Windows Media Server graph in the graph tree, and drag it into the right pane of the Run view.

2. Right-click the graph and choose Add Measurement(s), or choose Monitors > Add Online Measurement.

3. In the Monitored Server Machines section of the Windows Media Server dialog box, click Add to enter the server name or IP address of the machine you want to monitor. Select the platform on which the machine runs, and click OK.

4. In the Resource Measurements section of the Windows Media Server dialog box, select the measurements you want to monitor. The following table describes the default counters that can be monitored:

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active Live Unicast Streams (Windows)</td>
<td>The number of live unicast streams that are being streamed</td>
</tr>
<tr>
<td>Active Streams</td>
<td>The number of streams that are being streamed</td>
</tr>
<tr>
<td>Active TCP Streams</td>
<td>The number of TCP streams that are being streamed</td>
</tr>
<tr>
<td>Active UDP Streams</td>
<td>The number of UDP streams that are being streamed</td>
</tr>
<tr>
<td>Aggregate Read Rate</td>
<td>The total, aggregate rate (bytes/sec) of file reads</td>
</tr>
<tr>
<td>Aggregate Send Rate</td>
<td>The total, aggregate rate (bytes/sec) of stream transmission</td>
</tr>
<tr>
<td>Connected Clients</td>
<td>The number of clients connected to the server</td>
</tr>
<tr>
<td>Connection Rate</td>
<td>The rate at which clients are connecting to the server</td>
</tr>
<tr>
<td>Consoles</td>
<td>The number of Consoles currently connected to the server</td>
</tr>
<tr>
<td>HTTP Streams</td>
<td>The number of HTTP streams being streamed</td>
</tr>
<tr>
<td>Measurement</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Late Reads</td>
<td>The number of late read completions per second</td>
</tr>
<tr>
<td>Pending Connections</td>
<td>The number of clients that are attempting to connect to the server, but are not yet connected. This number may be high if the server is running near maximum capacity and cannot process a large number of connection requests in a timely manner.</td>
</tr>
<tr>
<td>Stations</td>
<td>The number of station objects that currently exist on the server</td>
</tr>
<tr>
<td>Streams</td>
<td>The number of stream objects that currently exist on the server</td>
</tr>
<tr>
<td>Stream Errors</td>
<td>The cumulative number of errors occurring per second</td>
</tr>
</tbody>
</table>

5 To select additional measurements, click Add. The Windows Media Server - Add Measurements dialog box opens, displaying the Windows Media Unicast Service object, its counters, and instances.

6 Select a counter and an instance. You can select multiple counters using the Ctrl key. The instance is relevant only if multiple instances of the highlighted counter are running. For a description of each counter, click Explain>> to expand the dialog box.
7 Click **Add** to place the selected counter on the resource list. Add all the desired resources to the list, and click **Close**.

8 Click **OK** in the Windows Media Server dialog box to activate the monitor.

**Configuring the RealPlayer Server Monitor**

To monitor the RealPlayer Server, you must first select the counters you want the RealPlayer Server monitor to measure. You select these counters using the Real Server dialog box.

**To configure the RealPlayer Server monitor:**

1 Click the Real Server graph in the graph tree, and drag it into the right pane of the Run view.

2 Right-click the graph and choose **Add Measurement(s)**, or choose **Monitors > Add Online Measurement**.

3 In the Monitored Server Machines section of the Real Server dialog box, click **Add** to enter the server name or IP address of the machine you want to monitor. Select the platform on which the machine runs, and click **OK**.

4 Click **Add** in the Resource Measurements section of the Real Server dialog box to select the measurements that you want to monitor.

Another Real Server dialog box opens, displaying the counters that can be monitored.
5 Select a counter and an instance. You can select multiple counters using the Ctrl key. The instance is relevant only if multiple instances of the highlighted counter are running. For a description of each counter, click Explain>> to expand the dialog box.

The following table describes the default counters that can be monitored:

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Encoder Connections</td>
<td>The number of active encoder connections</td>
</tr>
<tr>
<td>HTTP Clients</td>
<td>The number of active clients using HTTP</td>
</tr>
<tr>
<td>Monitor Connections</td>
<td>The number of active server monitor connections</td>
</tr>
<tr>
<td>Multicast Connections</td>
<td>The number of active multicast connections</td>
</tr>
<tr>
<td>PNA Clients</td>
<td>The number of active clients using PNA</td>
</tr>
<tr>
<td>RTSP Clients</td>
<td>The number of active clients using RTSP</td>
</tr>
<tr>
<td>Splitter Connections</td>
<td>The number of active splitter connections</td>
</tr>
<tr>
<td>TCP Connections</td>
<td>The number of active TCP connections</td>
</tr>
<tr>
<td>Total Bandwidth</td>
<td>The number of bits per second being consumed</td>
</tr>
<tr>
<td>Total Clients</td>
<td>The total number of active clients</td>
</tr>
<tr>
<td>UDP Clients</td>
<td>The number of active UDP connections</td>
</tr>
</tbody>
</table>

6 Click Add to place the selected counter on the resource list. Add all the desired resources to the list, and click Close.

7 Click OK in the Real Server dialog box to activate the monitor.
Viewing the RealPlayer Client Online Graph

You can view the RealPlayer Client online monitor graph by dragging it from the graph tree into the right pane of the Run view.

The following table describes the RealPlayer Client measurements that are monitored:

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Bandwidth (Kbits/sec)</td>
<td>The number of kilobytes in the last second</td>
</tr>
<tr>
<td>Buffering Event Time (sec)</td>
<td>The average time spent on buffering</td>
</tr>
<tr>
<td>Network Performance</td>
<td>The ratio (percentage) between the current bandwidth and the actual bandwidth of the clip</td>
</tr>
<tr>
<td>Percentage of Recovered Packets</td>
<td>The percentage of error packets that were recovered</td>
</tr>
<tr>
<td>Percentage of Lost Packets</td>
<td>The percentage of packets that were lost</td>
</tr>
<tr>
<td>Percentage of Late Packets</td>
<td>The percentage of late packets</td>
</tr>
<tr>
<td>Time to First Frame Appearance (sec)</td>
<td>The time for first frame appearance (measured from the start of the replay)</td>
</tr>
<tr>
<td>Number of Buffering Events</td>
<td>The average number of all buffering events</td>
</tr>
<tr>
<td>Number of Buffering Seek Events</td>
<td>The average number of buffering events resulting from a seek operation</td>
</tr>
<tr>
<td>Buffering Seek Time</td>
<td>The average time spent on buffering events resulting from a seek operation</td>
</tr>
<tr>
<td>Number of Buffering Congestion Events</td>
<td>The average number of buffering events resulting from network congestion</td>
</tr>
<tr>
<td>Buffering Congestion Time</td>
<td>The average time spent on buffering events resulting from network congestion</td>
</tr>
</tbody>
</table>
Chapter 27 • Streaming Media Monitoring

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Buffering Live Pause Events</td>
<td>The average number of buffering events resulting from live pause</td>
</tr>
<tr>
<td>Buffering Live Pause Time</td>
<td>The average time spent on buffering events resulting from live pause</td>
</tr>
</tbody>
</table>

**Viewing the Media Player Client Online Graph**

You can view the Windows Media Player Client online monitor graph by dragging it from the graph tree into the right pane of the Run view.

The following table describes the Media Player Client measurements that are monitored:

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stream Quality (Packet-level)</td>
<td>The percentage ratio of packets received to total packets</td>
</tr>
<tr>
<td>Current bandwidth (Kbits/sec)</td>
<td>The number of kbits per second received</td>
</tr>
<tr>
<td>Stream Packet Rate</td>
<td>The number of packets received</td>
</tr>
<tr>
<td>Total number of recovered packets</td>
<td>The number of lost packets that were recovered. This value is only relevant during network playback.</td>
</tr>
<tr>
<td>Total number of lost packets</td>
<td>The number of lost packets that were not recovered. This value is only relevant during network playback.</td>
</tr>
<tr>
<td>Stream Quality (Sampling-level)</td>
<td>The percentage of stream samples received on time (no delays in reception)</td>
</tr>
</tbody>
</table>
ERP Server Resource Monitoring

During a scenario run, you can monitor ERP server resources in order to isolate server performance bottlenecks.

This chapter describes:

➤ Setting Up the SAP Monitor
➤ Configuring the SAP Monitor

About ERP Server Resource Monitoring

The ERP server resource monitor provides you with performance information for the SAP R/3 system server. You can use the SAP monitor to view:

➤ the number of configured instances for each SAP system.
➤ data for all application instances (not just the one you logged on to)
➤ transactions used and the users that call them
➤ number of users working on the different instances
➤ performance history for recent periods of all instances
➤ response time distribution and resource consumption for any application server
➤ application server workload for today or for a recent period

In order to obtain this data, you need to activate the ERP server resource monitor before executing the scenario, and indicate which statistics and measurements you want to monitor.
Setting Up the SAP Monitor

Before monitoring a SAP R/3 system server, you must set up the server monitor environment.

To set up the SAP monitor environment:

1. Install the SAP GUI client on the Controller machine.
2. Click F6 to check whether you can access the st03 transaction and query for last minute load information. If this functionality is not already enabled, enable it from the SAP R/3 client on the Controller machine, using the username and password defined in the Controller.

Configuring the SAP Monitor

To monitor a SAP R/3 system server, you must select the counters you want the SAP monitor to measure. You select these counters using the Add SAP Monitor Measurements dialog box.

Note: The SAP R/3 performance monitor supports SAP server versions 3.1 to 4.6, regardless of the SAP R/3 server's operating system and the platform on which it is installed.

To configure the SAP monitor:

1. Click the SAP graph in the graph tree, and drag it into the right pane of the Run view.
2. Right-click the graph and choose Add Measurement(s), or choose Monitors > Add Online Measurement.
3. In the Monitored Server Machines section of the SAP dialog box, click Add to enter the server name or IP address of the machine you want to monitor. Select the platform on which the machine runs, and click OK.
Note: You can also specify a system number and IP address in the Add Machine dialog box using the following format:
<system number:IP address>
For example: 199.35.106.162:00

4 Click Add in the Resource Measurements section of the SAP dialog box. The SAP Monitor Logon dialog box opens.

![SAP Monitor Logon Dialog Box]

5 Enter your Login Name, Password, Server Name, and Client.

Note: If you want to connect to the SAP monitor through a router, you need to enter the router string into the Server Name field. A router string has the format:
<RouterString/ServerIP/S/sapdp00>

where RouterString is /H/<IP_ADDRESS>/H/<IP_ADDRESS>/H/ServerIP is the application server IP address and xx is the system number.

For example, if the router string = /H/199.35.107.9/H/204.79.199.244/H/, application server IP address = 172.20.11.6, and the system number = 00, you should enter the following string into the Server Name field:

/H/199.35.107.9/H/204.79.199.244/H/172.20.11.6/S/sapdp00
6 Click **OK**. The Add SAP Monitor Measurements dialog box opens.

7 Select an object, a measurement, and an instance. You can select multiple measurements using the **Ctrl** key. The instance is relevant only if multiple instances of the highlighted measurement are running. For a description of each measurement, click **Explain>>** to expand the dialog box.
The following are the most commonly monitored counters:

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average CPU time</td>
<td>The average CPU time used in the work process.</td>
</tr>
<tr>
<td>Average response time</td>
<td>The average response time, measured from the time a dialog sends a request to the dispatcher work process, through the processing of the dialog, until the dialog is completed and the data is passed to the presentation layer. The response time between the SAP GUI and the dispatcher is not included in this value.</td>
</tr>
<tr>
<td>Average wait time</td>
<td>The average amount of time that an unprocessed dialog step waits in the dispatcher queue for a free work process. Under normal conditions, the dispatcher work process should pass a dialog step to the application process immediately after receiving the request from the dialog step. Under these conditions, the average wait time would be a few milliseconds. A heavy load on the application server or on the entire system causes queues at the dispatcher queue.</td>
</tr>
<tr>
<td>Average load time</td>
<td>The time needed to load and generate objects, such as ABAP source code and screen information, from the database.</td>
</tr>
<tr>
<td>Database calls</td>
<td>The number of parsed requests sent to the database.</td>
</tr>
<tr>
<td>Database requests</td>
<td>The number of logical ABAP requests for data in the database. These requests are passed through the R/3 database interface and parsed into individual database calls. The proportion of database calls to database requests is important. If access to information in a table is buffered in the SAP buffers, database calls to the database server are not required. Therefore, the ratio of calls/requests gives an overall indication of the efficiency of table buffering. A good ratio would be 1:10.</td>
</tr>
<tr>
<td>Measurement</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>GUI time</td>
<td>The GUI time is measured in the work process and is the response time between the dispatcher and the GUI.</td>
</tr>
<tr>
<td>Roll ins</td>
<td>The number of rolled-in user contexts.</td>
</tr>
<tr>
<td>Roll outs</td>
<td>The number of rolled-out user contexts.</td>
</tr>
<tr>
<td>Roll in time</td>
<td>The processing time for roll ins.</td>
</tr>
<tr>
<td>Roll out time</td>
<td>The processing time for roll outs.</td>
</tr>
<tr>
<td>Roll wait time</td>
<td>The queue time in the roll area. When synchronous RFCs are called, the work process executes a roll out and may have to wait for the end of the RFC in the roll area, even if the dialog step is not yet completed. In the roll area, RFC server programs can also wait for other RFCs sent to them.</td>
</tr>
<tr>
<td>Average time per logical DB call</td>
<td>The average response time for all commands sent to the database system (in milliseconds). The time depends on the CPU capacity of the database server, the network, the buffering, and on the input/output capabilities of the database server. Access times for buffered tables are many magnitudes faster and are not considered in the measurement.</td>
</tr>
</tbody>
</table>

8 Click Add to place the selected measurement on the resource list. Add all the desired resources to the list, and click Close.

9 Click OK in the SAP dialog box to activate the monitor.
Java Performance Monitoring

During a scenario run, you can monitor the resource usage of Enterprise Java Bean (EJB) objects, Java-based applications, and the TowerJ Java virtual machine, using the Java performance monitors:

This chapter describes:
➤ EJB Performance Monitoring
➤ JProbe Performance Monitoring
➤ Sitraka JMonitor Performance Monitoring
➤ TowerJ Performance Monitoring

About Java Performance Monitoring

The Java performance monitors provide you with performance information for Enterprise Java Bean (EJB) objects and Java-based applications, using the EJB, JProbe, Sitraka JMonitor, and the TowerJ Java virtual machine during scenario execution. In order to obtain this data, you need to activate the Java performance monitors before executing the scenario, and indicate which statistics and measurements you want to monitor.
**EJB Performance Monitoring**

**Support Matrix:**

<table>
<thead>
<tr>
<th>Application Server</th>
<th>Version</th>
<th>Platform</th>
</tr>
</thead>
<tbody>
<tr>
<td>WebLogic</td>
<td>4.x; 5.1; 6.0; 6.1; 7.0</td>
<td>Windows; Solaris; AIX</td>
</tr>
<tr>
<td>WebSphere</td>
<td>3.x; 4.x</td>
<td>Windows; Solaris; AIX</td>
</tr>
<tr>
<td>Oracle 9i</td>
<td>1.0.2.2</td>
<td>Windows; Solaris; AIX</td>
</tr>
</tbody>
</table>

You can monitor Enterprise Java Bean (EJB) objects on a WebLogic, WebSphere, or Oracle 9iAS application server during a scenario run using the EJB performance monitor. In order to monitor EJB objects, you must first install the EJB monitor, run the monitor detector, and activate the EJB monitor on the application server machine. You then configure the EJB monitor on the client machine by selecting the counters you want the monitor to measure.

Note: The server side installation contains new EJBDetector support files for generating EJB Vuser scripts. For more information on the EJBDetector, see the *Creating Vuser Scripts* guide.

**Installing the EJB Monitor and Running the Monitor Detector**

Before EJB objects can be monitored, you must install the EJB monitor support files, and verify that you have a valid JDK environment on the application server machine. You then prepare the EJB monitor for monitoring by running the monitor detector from the batch file, or from the command line.
To install the EJB monitor support files:

Create a home directory for the Mercury Interactive EJB support files—for example, MERC_MONITOR_HOME—and unzip the `<LR_Installation>\Add-ins\J2EE\EJB\jmonitor_<platform>.jar` file into that directory.

On UNIX platforms, use the `jar` utility to extract the installation jar:

Change to the MERC_MONITOR_HOME directory and type the following command:

```
jar -xvf <path to your jmonitor_<platform>.jar
```

To run the monitor detector from the batch file:

1. Open the `env.cmd` (NT) or `env.sh` (UNIX) file and set the following variables:
   - **JAVA_HOME**: Specify the root directory of the JDK installation.
   - **APP_SERVER_DRIVE**: Specify the drive on which the application server is installed (for NT only).
   - **DETECTOR_INS_DIR**: Specify the root directory of the Detector installation.
   - **APP_SERVER_ROOT**: Follow these guidelines:
     - **BEA WebLogic Servers 4.x and 5.x**: Specify the application server root directory.
     - **BEA WebLogic Servers 6.x and 7.x**: Specify the full path of the domain folder.
     - **WebSphere Servers 3.x and 4.0**: Specify the application server root directory.
     - **Oracle OC4J**: Specify the application server root directory.
     - **Sun J2EE Server**: Specify the full path to the deployable `.ear` file or directory containing a number of `.ear` files.
   - **EJB_DIR_LIST** *(optional)*: Specify a list of directories/files, separated by ‘;’ and containing deployable `.ear`/`.jar` files, and any additional classes directory or `.jar` files or used by your EJBs under test.
Run the `Mon_Detector.cmd` (NT) or `Mon_Detector.sh` (UNIX) batch file to collect information about the EJBs deployed. Running the monitor detector generates the following three files in the `<MERC_MONITOR_HOME>\dat` directory: `ejb_monitor.hooks`; `cjhook.ini`; and `regmon.properties`. These files contain information about the EJBs detected on the application server.

**Note:** You must run the monitor detector each time you add, change, or delete EJBs on the application server.

---

**To run the monitor detector from a command line:**

1. Add `<MERC_MONITOR_HOME>\classes`, `<MERC_MONITOR_HOME>\dat`, and the `<MERC_MONITOR_HOME>\classes\xerces.jar` file to the CLASSPATH environment variable.

2. Use the `java MonDetect <search root dir>` command line to collect information about the EJBs deployed.

   `<search root dir>` Specify one or more directories or files in which to search for EJBs (separated by semicolons). Follow these guidelines:

   **BEA WebLogic Servers 4.x and 5.x:** Specify the application server root directory.

   **BEA WebLogic Servers 6.x and 7.x:** Specify the full path of the domain folder followed by the root directory.

   **WebSphere Servers 3.x and 4.0:** Specify the application server root directory.

   **Oracle OC4J:** Specify the application server root directory.

   **Sun J2EE Server:** Specify the full path to the deployable `.ear` file or directory containing a number of `.ear` files.

   *Note that you can also specify a search list of directories and/or files to search. If unspecified, the CLASSPATH will be searched.*
Running the monitor detector generates the following three files in the `<MERC_MONITOR_HOME>\dat` directory: `ejb_monitor.hooks`; `cjhook.ini`; and `regmon.properties`. These files contain information about the EJBs detected on the application server.

---

**Note:** You must run the monitor detector each time you add, change, or delete EJBs on the application server.

---

**Configuring the EJB Monitor on the Application Server**

After you have installed Mercury Interactive's EJB monitor support files on your WebLogic, WebSphere, or Oracle 9iAS machine, you must configure the application server to run with EJB monitor support.

---

**Note:** It is important to set the environment variables in the order in which they appear below.

---

**WebLogic Server**

The WebLogic 4.x-5.x server, WebLogic 6.x server, and the WebLogic 7.x server must be configured differently.

**To configure the WebLogic 4.x-5.x server:**

1. Copy the `<WebLogic Home>\startWeblogic.cmd` file into `<WebLogic Home>\startWeblogicMercury.cmd` so that the file is backed up.

2. Open the `<WebLogic Home>\startWeblogicMercury.cmd` file.

3. In the ‘runWebLogicJava’ section of the file, after the `WEBLOGIC_CLASSPATH` environment settings, set the following environment variables:

   For Windows platforms:
   ```
   set MERC_MONITOR_HOME=<EJB Monitor Home Directory>
   set CLASSPATH=%MERC_MONITOR_HOME%\dat
   ```
set JAVA_CLASSPATH=%MERC_MONITOR_HOME%\dat;%MERC_MONITOR_HOME%\classes;%MERC_MONITOR_HOME%\classes\xerces.jar;%JAVA_CLASSPATH%
set PATH=%PATH%;%MERC_MONITOR_HOME%\bin

For UNIX platforms:
MERC_MONITOR_HOME <EJB Monitor Home Directory>
CLASSPATH ${MERC_MONITOR_HOME}/dat
JAVA_CLASSPATH ${MERC_MONITOR_HOME}/dat:${MERC_MONITOR_HOME}/classes:${MERC_MONITOR_HOME}/classes/xerces.jar:${JAVA_CLASSPATH}
LD_LIBRARY_PATH ${LD_LIBRARY_PATH}:${MERC_MONITOR_HOME}/bin
export CLASSPATH
export LD_LIBRARY_PATH
export JAVA_CLASSPATH

---

Note: For IBM AIX platform replace LD_LIBRARY_PATH with LIBPATH. Replace <EJB Monitor Home Directory> with the EJB monitor installation root directory. Note that on UNIX platforms you may have to export the library path variables.

---

4 In the same section of the file, add a parameter to the command line:
-Xrunjdkhook.

For example on Windows platforms:
%JAVA_HOME%\bin\java -ms64m -mx64m -Xrunjdkhook -classpath %JAVA_CLASSPATH% -Dweblogic.class.path=%WEBLOGIC_CLASSPATH% -Dweblogic.home=. -Djava.security.manager -Djava.security.policy=\weblogic.policy weblogic.Server
Chapter 29 • Java Performance Monitoring

Note: For Solaris installation only.
If you are using JDK 1.2.x add a parameter to the command line:
-Dweblogic.classloader.preprocessor=com.mercuryinteractive.aim.
    MercuryWL5Preprocessor

for example, on Windows platforms:
%JAVA_HOME%\bin\java -ms64m -mx64m -classpath %JAVA_CLASSPATH%
-Dweblogic.classloader.preprocessor=com.mercuryinteractive.aim.
    MercuryWL5Preprocessor
-Dweblogic.class.path=%WEBLOGIC_CLASSPATH%
-Dweblogic.home= -Djava.security.manager
-Djava.security.policy=\weblogic.policy weblogic.Server

5 Run the <WebLogic Home>\startWeblogicMercury.cmd file.

To configure the WebLogic 6.x server:

1 Copy the <WebLogic Home>\config\<domain name>\startWeblogic.cmd file into <WebLogic Home>\config\<domain name>\startWeblogicMercury.cmd so that the file is backed up.

2 Open the <WebLogic Home>\config\<domain name>\startWeblogicMercury.cmd file.

3 In the ‘runWebLogic’ section of the file, set the following environment variables:
   For Windows platforms:
   set MERC_MONITOR_HOME=<your MERC_MONITOR_HOME directory>
   set CLASSPATH=%CLASSPATH%;%MERC_MONITOR_HOME%\dat;%MERC_MONITOR_HOME%\classes;%MERC_MONITOR_HOME%\classes\xerces.jar
   set PATH=%PATH%;%MERC_MONITOR_HOME%\bin

   For UNIX platforms:
   MERC_MONITOR_HOME <EJB Monitor Home Directory>
CLASSPATH ${JAVA_CLASSPATH}:${MERC_MONITOR_HOME}/dat:${MERC_MONITOR_HOME}/classes:${MERC_MONITOR_HOME}/classes/xerces.jar
LD_LIBRARY_PATH ${LD_LIBRARY_PATH}:${MERC_MONITOR_HOME}/bin
export CLASSPATH
export LD_LIBRARY_PATH

Note: For IBM AIX platform replace LD_LIBRARY_PATH with LIBPATH. Replace <EJB Monitor Home Directory> with the EJB monitor installation root directory. Note that on UNIX platforms you may have to export the library path variables.

4 In the same section of the file add a parameter to the command line:
-Xrunjdkhook.

for example, on Windows platforms:
"%JAVA_HOME%\bin\java" -hotspot -ms64m -mx64m -Xrunjdkhook -classpath %CLASSPATH% -Dweblogic.Domain=mydomain -Dweblogic.Name=myserver -Dbea.home=f:\bea -Djava.security.policy=f:\bea\wlserver6.0\lib\weblogic.policy" -Dweblogic.management.password=%WLS_PW% weblogic.Server

5 Run the <WebLogic Home>\config\<domain name>\startWeblogicMercury.cmd file.

To configure the WebLogic 7.x server:

1 Copy the <WebLogic Home>\server\bin\startwls.cmd file into <WebLogic Home>\server\bin\startwlsMercury.cmd so that the file is backed up.

2 Open the <WebLogic Home>\server\bin\startwlsMercury.cmd file.

3 In the ‘runWebLogic’ section of the file, set the following environment variables:

   For Windows platforms:
set MERC_MONITOR_HOME=<your MERC_MONITOR_HOME directory>
set CLASSPATH=%CLASSPATH%;%MERC_MONITOR_HOME%\dat;%MERC_MONITOR_HOME%\classes;%MERC_MONITOR_HOME%\classes\xerces.jar
set PATH=%PATH%;%MERC_MONITOR_HOME%\bin

For UNIX platforms:
MERC_MONITOR_HOME <EJB Monitor Home Directory>
CLASSPATH=$CLASSPATH:$MERC_MONITOR_HOME/dat:$MERC_MONITOR_HOME/classes:$MERC_MONITOR_HOME/classes/xerces.jar
LD_LIBRARY_PATH=$LD_LIBRARY_PATH:$MERC_MONITOR_HOME/bin
export CLASSPATH
export LD_LIBRARY_PATH

---

**Note:** For IBM AIX platform replace LD_LIBRARY_PATH with LIBPATH. Replace `<EJB Monitor Home Directory>` with the EJB monitor installation root directory. Note that on UNIX platforms you may have to export the library path variables.

---

4 In the same section of the file add a parameter to the command line:
-Xrunjdkhook.
for example, on Windows platforms:
"%JAVA_HOME%/bin\java" -hotspot -ms64m -mx64m -Xrunjdkhook -classpath %CLASSPATH% -Dweblogic.Domain=mydomain -Dweblogic.Name=myserver -Dbea.home=f:\bea -Djava.security.policy=f:\bea\wlserver6.0\lib\weblogic.policy" -Dweblogic.management.password=%WLS_PW% weblogic.Server

5 Copy the `<domain name>\startWeblogic.cmd` file into `<domain name>\startWeblogicMercury.cmd` so that the file is backed up.

6 Open the `<domain name>\startWeblogicMercury.cmd` file.
Find the call to the weblogic server. For example, call:  
D:\bea\weblogic700\server\bin\startWLS.cmd

Change the call from startWLS.cmd to startWLSMercury.cmd, and save the file.

Run the <domain name>\startWeblogicMercury.cmd file.

**WebSphere Server - Versions 3.0 and 3.5**

By default, the WebSphere 3.x application server runs as an automatic service, upon machine startup. Since Mercury Interactive does not currently support LoadRunner EJB monitoring on a WebSphere server run as an automatic service, you must change the default WebSphere server startup to manual.

**To change the default WebSphere 3.x server startup:**

1. Select Start > Settings > Control Panel.
2. Double-click Services.
3. Select IBM WS AdminServer, and click the Stop button.
4. Double click IBM WS AdminServer, and select the Manual Startup Type.
5. Click OK to save your settings and close the dialog box.

You can now start the WebSphere Server from <WebSphere Home>\AppServer\bin\debug\adminserver.bat, instead of using the automatic service.

**To add LoadRunner EJB monitor support to the WebSphere 3.x server:**

1. Make a backup copy of the <WebSphere Home>\AppServer\bin\debug\adminserver.bat file.
2. Open the <WebSphere Home>\AppServer\bin\debug\adminserver.bat file.
3. Add the following environment variables at the end of the ‘SET_CP’ section:

   For Windows platforms:
   set CLASSPATH=<MERC_MONITOR_HOME>\dat;<MERC_MONITOR_HOME>\classes;<MERC_MONITOR_HOME>\classes\xerces.jar;
   %CLASSPATH%
set PATH=%PATH%;<MERC_MONITOR_HOME>\bin

For UNIX platforms:

CLASSPATH $(MERC_MONITOR_HOME)/dat:$(MERC_MONITOR_HOME)/classes:$(MERC_MONITOR_HOME)/classes/xerces.jar:$(CLASSPATH)
LD_LIBRARY_PATH $(LD_LIBRARY_PATH):$(MERC_MONITOR_HOME)/bin
export CLASSPATH
export LD_LIBRARY_PATH

**Note:** For IBM AIX platform replace LD_LIBRARY_PATH with LIBPATH.
Replace `<EJB Monitor Home Directory>` with the EJB monitor installation root directory. Note that on UNIX platforms you may have to export the library path variables.

**Note:** For Solaris installation only.
If you are working with JRE1.2.x, you must download the patch file, PQ46831.jar, from IBM’s Web site or FTP site:
Make sure to download the version that corresponds to your server version. Add the patch file to the classpath:
setenv CLASSPATH PQ46831.jar:$(CLASSPATH)

4 Run the `adminserver.bat` file.
5 Open the WebSphere Advanced Administrative Console, and select View > Topology.
6 Expand the WebSphere Administrative Domain tree by selecting `<server machine name>` > Default Server.
7 Select the General tab in the Application Server:Default Server window.
8 Type `-Xrunjdkhook` in the command line Arguments box, and click **Apply**.

If you are working with a WebSphere 3.0 Server with JDK1.1.7 IBM, double-click on **Environment**. Type `_CLASSLOAD_HOOK` in the Variable Name box, and `jdkhook` in the Value box. Click the **Add**, **OK**, and **Apply** buttons.

---

**Note:** For Solaris installation only.

If you are working with a WebSphere 3.5 Server with J2RE 1.2.x, in the Command Line Arguments box, type the following and click **Apply**:

- `-Dcom.ibm.websphere.introscope.implClass=com.mercuryinteractive.aim.MercuryWASPreprocessor`

---

9 Close the WebSphere Advanced Administrative Console.

10 Close and restart the `adminserver.bat` file.

**WebSphere Server - Version 4.0**

You can start the WebSphere 4.0 server using the `startServerBasic.bat` file or the `startServer.bat` file.

To configure the WebSphere 4.0 server:

1 Ensure that the WebSphere Administrative Server is running, and start the Administrator Console.

2 In the WebSphere Administrative Domain tree, expand the Nodes, hostname, and Application Servers subtrees, and select the Default Server (or the Application Server you wish to use with JMonitor).

3 For Windows 2000/NT or Solaris, click the **General** tab, and add the following variables to the **Environment** box:

---

**Note:** Replace `<EJB Monitor Home Directory>` with the EJB monitor installation root directory.
For Windows 2000/NT:
name=PATH
value=<EJB Monitor Home Directory>/bin

For Solaris:
name=LD_LIBRARY_PATH
value=<EJB Monitor Home Directory>/bin

Click OK to close the Environment Editor dialog box.

For AIX:
If the LIBPATH environment variable has been changed, you need to link the EJB monitor libraries to the /usr/lib directory.

Add the following commands:
#ln -s <EJB Monitor Home Directory>/bin/libcjhook_mon.so /usr/lib/libcjhook_mon.so
#ln -s <EJB Monitor Home Directory>/bin/libconfig.so /usr/lib/libconfig.so
#ln -s <EJB Monitor Home Directory>/bin/libjdkhook.so /usr/lib/libjdkhook.so
#ln -s <EJB Monitor Home Directory>/bin/libmlib_ds.so /usr/lib/libcjhook_mon.so
#ln -s <EJB Monitor Home Directory>/bin/libmosifs.so /usr/lib/libmosifs.so
#ln -s <EJB Monitor Home Directory>/bin/libthrdutil.so /usr/lib/libthrdutil.so

Note: You will likely require root permissions in order to create the link. Alternatively, you can place the link in WebSphere’s /bin directory (usually /usr/WebSphere/AppServer/bin).

4 Click the JVM Settings tab in the WebSphere Administrative Console, and add the following values to the classpath:
Note: Replace `<EJB Monitor Home Directory>` with the EJB monitor installation root directory.

For Windows 2000/NT:

`<EJB Monitor Home Directory>/dat`
`<EJB Monitor Home Directory>/classes`
`<EJB Monitor Home Directory>/classes/xerces.jar`

For Solaris or AIX:

`<EJB Monitor Home Directory>/dat`
`<EJB Monitor Home Directory>/classes`
`<EJB Monitor Home Directory>/classes/xerces.jar`

Note: For Solaris installation only.
If you are working with JRE1.2.x, you must download the patch file, PQ46831.jar, from IBM’s Web site or FTP site:
Make sure to download the version that corresponds to your server version.
Add the following value to the classpath:
`<EJB Monitor Home Directory>/classes/PQ46831.jar`

5 Click the Advanced JVM Settings button. In the Command line arguments field, add the following value for Windows 2000/NT, Solaris, and AIX:

-Xrunjdkhook
Chapter 29 • Java Performance Monitoring

Note: For Solaris installation only.
If you are working with JRE1.2.x, instead of -Xrunjdkhook
add the following value:
-Dcom.ibm.websphere.introscope.implClass=com.mercuryinteractive.aim.MercuryWASPreprocessor

6 Click the OK and Apply buttons to save the changes for the Application server. You can now start and stop your WebSphere server using the LoadRunner EJB Monitor.

Oracle 9iAS Server

Once you have configured the support files and set up the JDK environment on the Oracle 9iAS application server, run the oc4jMonitor.cmd file on an NT machine, or the oc4jMonitor.sh file on a UNIX machine. The application server starts running with EJB monitor support.

Configuring the EJB Monitor on the Client Machine

To monitor EJB performance, you must select the counters you want the EJB monitor to measure. You select these counters using the Controller’s EJB Monitor Configuration dialog box.

To configure the EJB monitor:

1 Click the EJB graph in the graph tree, and drag it into the right pane of the Run view.
2 Right-click the graph and choose **Add Measurement(s)**, or choose **Monitors > Add Online Measurement**. The EJB dialog box opens.

3 Click **Add** in the Monitored Server Machines box to enter the server name or IP address of the machine you want to monitor. Select the platform on which the machine runs, and click **OK**.
4 Click **Add** in the Resource Measurements section of the EJB dialog box. The EJB Monitor Configuration dialog box opens, displaying the available EJBs.

5 Expand the Measured Components tree and select the methods and counters you want to monitor. The following counters can be monitored for each method:

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Response Time</td>
<td>The average response time, in milliseconds, of the EJB object being monitored.</td>
</tr>
<tr>
<td>Method Calls per Second</td>
<td>The number of EJB object method calls per second.</td>
</tr>
</tbody>
</table>

6 Click **OK** in the EJB Monitor Configuration dialog box, and in the EJB dialog box, to activate the EJB monitor.
JProbe Performance Monitoring

You can monitor Java-based applications during a scenario run using the JProbe Java profiling tool. In order to monitor Java-based applications, you must first configure the JProbe tool to monitor the specified application. You then use the Controller to select the counters you want the JProbe Java profiling tool to measure.

Note: You must run the JPlauncher before opening the Controller.

Configuring the JProbe Tool to Monitor an Application

In order to monitor Java-based applications—for example, a WebLogic server—you must first configure the JProbe tool to monitor the specified application.

To configure the JProbe tool:

1 Launch JProbe Profiler 3.0.

2 Select Program > Open JProbe Launch Pad. Select the Program tab, and enter the following settings:
   - Target Server: <server name>—for example, BEA WebLogic 5.1.0
   - Server Home Directory: for example, G:\Weblogic
   - Working Directory: for example, G:\Weblogic
   - Classpath: for example, %CLASSPATH%

3 Select the VM (Virtual Machine) tab, and enter the following settings:
   - Virtual Machine Type: for example, Java 2
   - VM Path: for example, g:\JDK1.2\bin\java.exe
   - VM Arguments: for example, -ms64m -mx64m -Dweblogic.home= -Djava.security.manager -Djava.security.policy=.\Weblogic.policy
   - Snapshot Directory: for example, G:\TEMP
Select the **Attach** tab. In the JProbe Console section, select the option that corresponds to your setup (for example, choose **Local** if the JProbe tool is on the same machine as the Controller). In the section relating to the port to be used, select **Use Default Port**.

**Note:** The Controller usually uses port 4444 as the default port for the JProbe tool. To change the default port, edit the `<installation root>/dat/monitors/jprobe.cfg` file, or specify the server machine name in the Controller's Add Machine dialog box as `host:port`.

Click the **Save As** button, and save the file in JProbe Launch Pad (JPL) format.

Close the JProbe Profiler.

In DOS, enter `cd <JProbe Profiler Dir>/jplauncher`. At the prompt, type the following:

```
jplauncher -jp_input=\<JPL file\> -jp_socket="\<Controller machine>:<Port>"
```

The JPlauncher establishes communication with the Controller machine. The Controller receives data from the JProbe tool through the above default port.

**Configuring the JProbe Tool in the Controller**

To monitor a Java-based application, you must select the counters you want the JProbe tool to measure. You select these counters using the Controller's JProbe dialog box.

**To configure the JProbe tool:**

1. Click the JProbe graph in the graph tree, and drag it into the right pane of the Run view.
2 Right-click the graph in the graph and choose Add Measurement(s), or choose Monitors > Add Online Measurement. The JProbe dialog box opens.

3 Click Add in the Monitored Server Machines box to enter the server name or IP address of the machine you want to monitor. Select the platform on which the machine runs, and click OK.

4 Click Add in the Resource Measurements section of the JProbe dialog box. The following two measurements appear.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allocated Memory (heap)</td>
<td>The amount of allocated memory in the heap (in bytes)</td>
</tr>
<tr>
<td>Available Memory (heap)</td>
<td>The amount of available memory in the heap (in bytes)</td>
</tr>
</tbody>
</table>

5 Click OK in the JProbe dialog box to activate the monitor.
Sitraka JMonitor Performance Monitoring

Support Matrix:

<table>
<thead>
<tr>
<th>Application Server</th>
<th>Version</th>
<th>Platform</th>
</tr>
</thead>
<tbody>
<tr>
<td>WebLogic</td>
<td>6.0; 6.1</td>
<td>Windows; Solaris; AIX</td>
</tr>
<tr>
<td>WebSphere</td>
<td>4.0</td>
<td>Windows; Solaris; AIX</td>
</tr>
<tr>
<td>Tomcat</td>
<td>3.2.3, 4.0.3</td>
<td>Windows; Solaris; AIX</td>
</tr>
</tbody>
</table>

Installation Options

The Sitraka JMonitor can be configured and run together with the EJB Monitor, or as a standalone monitor.

If you want to install the Sitraka JMonitor with the EJB Monitor, see “Configuring the EJB Monitor and the Sitraka JMonitor on the Application Server,” on page 484.

Installing the Sitraka JMonitor on the Application Server

To install the Sitraka JMonitor, create a home directory for the Sitraka JMonitor support files—for example, MERC_MONITOR_HOME—and unzip the installation file `<LR_Installation>\Add-ins\J2EE\Sitraka\jmonitor_<platform>.jar` file into that directory.

On UNIX platforms, use the jar utility to extract the installation jar.

Change to the Sitraka JMonitor installation directory and type the following command:

`jar -xvf <path to your Sitraka JMonitor installation jar>`

Configuring the Sitraka JMonitor on the Application Server

After you have installed the Sitraka JMonitor support files on your WebLogic, WebSphere, or Tomcat server, you must configure the application server to run with Sitraka JMonitor support.
**To configure the WebLogic 6.0/6.1 server:**

1. Make a backup copy of the WebLogic startup script.

   For Windows 2000/NT, this will be:
   
   `<WebLogic Home>\config\<domain name>\startWebLogic.cmd`
   
   Name the new file `startWebLogicJMonitor.cmd`

   For Solaris or AIX, this will be in:
   
   `$BEA_HOME/wlserver6.0/config/<domain name>/startWebLogic.sh`
   or `$BEA_HOME/wlserver6.1/config/<domain name>/startWebLogic.sh`

   Name the new file `startWebLogicJMonitor.sh`

2. Open the `startWebLogicJMonitor.cmd` or `startWebLogicJMonitor.sh` file.

3. In the ‘runWebLogic’ section of the file (or just prior to the call to invoke the JVM), set the following environment variables:

   **Note:** Replace any instances of `<install directory>` with the JMonitor installation directory. Note that on Unix platforms you may have to export the library path variables.

   For Windows 2000/NT:
   
   set JMONITOR_HOME=<install directory>
   
   set CLASSPATH=%JMONITOR_HOME%\lib;%JMONITOR_HOME%\lib\miniwebserver.jar;%JMONITOR_HOME%\lib\jlrutils.jar;%JMONITOR_HOME%\lib\jmonitor.jar;%CLASSPATH%
   
   set PATH=%PATH%;%JMONITOR_HOME%\bin\win32_ia32
Chapter 29 • Java Performance Monitoring

For Solaris:

JMONITOR_HOME=<install directory>
LD_LIBRARY_PATH=$JMONITOR_HOME/bin/solaris_sparc:$LD_LIBRARY_PATH
export LD_LIBRARY_PATH

For AIX:

JMONITOR_HOME=<install directory>
LIBPATH=$JMONITOR_HOME/bin/aix_ppc:$LIBPATH
export LD_LIBRARY_PATH

In the same section of the file, modify the java command-line.

For Windows 2000/NT, Solaris, and AIX, add the following parameter:
-Xrunjmonitor:load_mws,proxy

The command line will look similar to the following (paths shown are for Windows, and are for a specific installation of WebLogic):
"%JAVA_HOME%\bin\java" -hotspot -ms64m -mx64m
-Xrunjmonitor:load_mws,proxy -classpath %CLASSPATH%
-Dweblogic.Domain=mydomain -Dweblogic.Name=myserver
-Dbea.home=f:\bea
-Djava.security.policy=f:\bea\wlserver6.0\lib\weblogic.policy"
-Dweblogic.management.password=%WLS_PW% weblogic.Server

Run the startWebLogicJMonitor.cmd or startWebLogicJMonitor.sh file to start the WebLogic instance with JMonitor enabled.
To configure the WebSphere 4.0 server:

1. Ensure that the WebSphere Administrative Server is running, and start the Administrator Console.

2. Expand the WebSphere Administrative Domain tree. Expand the Nodes, hostname, and Application Servers subtrees, and select the Default Server (or the Application Server you wish to use with JMonitor).

3. For Windows 2000/NT and Solaris, click the General tab, and add the following variables to the Environment Editor box:

   \[
   \text{Note: Replace any instances of } \langle \text{install directory} \rangle \text{ with the JMonitor installation directory.}
   \]

   For Windows 2000/NT:
   
   \[
   \text{name=PATH} \\
   \text{value=}\langle \text{install directory} \rangle\bin\win32\_ia32
   \]

   For Solaris:
   
   \[
   \text{name=LD\_LIBRARY\_PATH} \\
   \text{value=}\langle \text{install directory} \rangle\bin\solaris\_sparc
   \]

   Click OK to close the Environment Editor.

4. For AIX:

   If the LIBPATH environment variable has been adjusted, you need to link the Sitraka JMonitor to the /usr/lib directory.

   Add the following command:

   \[
   \#ln -s \langle \text{install directory} \rangle/bin/aix\_ppc/libjmonitor.so /usr/lib/libjmonitor.so
   \]
Chapter 29 • Java Performance Monitoring

Note: you will likely require root permissions in order to create the link. Alternatively, the link can be placed in WebSphere’s /bin directory (usually /usr/WebSphere/AppServer/bin).

4 Click the JVM Settings tab in the WebSphere Administrative Console, and add the following values to the classpath:

Note: Replace any instances of <install directory> with the JMonitor installation directory.

For Windows 2000/NT

<install directory>\lib
<install directory>\lib\jlrutils.jar
<install directory>\lib\miniwebserver.jar
<install directory>\lib\jmonitor.jar

For Solaris or AIX:

<install directory>\lib
<install directory>\lib\jlrutils.jar
<install directory>\lib\miniwebserver.jar
<install directory>\lib\jmonitor.jar
5 Click the **Advanced JVM Settings** button. In the Command line arguments field, add the following value for Windows 2000/NT, Solaris, and AIX:

```
-Xrunjdkhook:jmonitor:load_mws,proxy
```

6 Click the **OK** and **Apply** buttons to save the changes for the Application server. You can now start and stop your WebSphere server using the Sitraka JMonitor.

7 To start your application server without using the Sitraka JMonitor, remove the changes made in step 5.

**To configure the Tomcat 3.2.3 server:**

1 Make a backup copy of the Tomcat startup script.

   For Windows 2000/NT, this will be:
   ```
   <Tomcat Home>/bin/tomcat.bat
   ```
   Name the new file `tomcat_jmonitor.bat`

   For Solaris or AIX, this will be in:
   ```
   <Tomcat home>/bin/tomcat.sh
   ```
   Name the new file `tomcat_jmonitor.sh`

2 Open the `tomcat_jmonitor.bat` or `tomcat_jmonitor.sh` file.

3 Set the following environment variables:

   For Windows 2000/NT, the following additions should be added prior to the line invoking the JVM (in the `startServer` section of the batch file):

   ```
   set JMONITOR_HOME=<install directory>
   set CLASSPATH=%JMONITOR_HOME%\lib;%JMONITOR_HOME%\lib\miniwebserver.jar;%JMONITOR_HOME%\lib\jlrutils.jar;%JMONITOR_HOME%\lib\jmonitor.jar;%CLASSPATH%
   set PATH=%PATH%;%JMONITOR_HOME%\bin\win32_ia32
   ```
Chapter 29 • Java Performance Monitoring

For Solaris, the following lines should be added prior to invoking the JVM (just after the first `export CLASSPATH` found in the file):

```
JMONITOR_HOME=<install directory>
export CLASSPATH
LD_LIBRARY_PATH=$JMONITOR_HOME/bin/solaris_sparc:$LD_LIBRARY_PATH
export LD_LIBRARY_PATH
```

For AIX, the following lines should be added prior to invoking the JVM (just after the first `export CLASSPATH` found in the file):

```
JMONITOR_HOME=<install directory>
export CLASSPATH
LIBPATH=$JMONITOR_HOME/bin/aix_ppc:$LD_LIBRARY_PATH
export LIBPATH
```

4 In the same section of the file, modify the java command-line.
   For Windows 2000/NT, Solaris, and AIX, add the following parameter:
   `-Xrunjmonitor:load_mws,proxy`

5 To start the Tomcat server with JMonitor, use the following command:
   `tomcat_jmonitor start`
To configure the Tomcat 4.0.3 server:

1. Make a backup copy of the Tomcat startup script.

   For Windows 2000/NT, this will be:
   `<Catalina Home>\bin\catalina.bat`

   Name the new file `catalina_jmonitor.bat`

   For Solaris or AIX, this will be in:
   `<Tomcat home>/bin/catalina.sh`

   Name the new file `catalina_jmonitor.sh`

2. Open the `tomcat_jmonitor.bat` or `tomcat_jmonitor.sh` file.

3. Set the following environment variables:

   For Windows 2000/NT, the following additions should be added prior to the line invoking the JVM (in the ‘doStart’ section of the batch file):
   
   ```plaintext
   set JMONITOR_HOME=<install directory>
   set CLASSPATH=%JMONITOR_HOME%\lib;%JMONITOR_HOME%\lib\miniwebserver.jar;%JMONITOR_HOME%\lib\jlrutils.jar;%JMONITOR_HOME%\lib\jmonitor.jar;%CLASSPATH%
   set PATH=%PATH%;%JMONITOR_HOME%\bin\win32_ia32
   ```

   For Solaris, the following lines should be added prior to invoking the JVM (at the beginning of the ‘Execute The Requested Command’ section):

   ```plaintext
   JMONITOR_HOME=<install directory>
   export CLASSPATH

   LD_LIBRARY_PATH=$JMONITOR_HOME/bin/solaris_sparc:$LD_LIBRARY_PATH
   export LD_LIBRARY_PATH
   ```
Chapter 29 • Java Performance Monitoring

For AIX, the following lines should be added prior to invoking the JVM (at the beginning of the ‘Execute The Requested Command’ section):

```
JMONITOR_HOME=<install directory>
export CLASSPATH
LIBPATH=$JMONITOR_HOME/bin/aix_ppc:$LD_LIBRARY_PATH
export LIBPATH
```

4 In the same section of the file, modify the java command-line.

For Windows 2000/NT, Solaris, and AIX, add the following parameter:

```
-Xrunjmonitor:load_mws,proxy
```

For Windows, the Java command line is found in the ‘doneSetArgs’ section. For Solaris and AIX, the Java call to start Tomcat is in the ‘Execute The Requested Command’ section.

5 To start the Tomcat server with JMonitor, use the following command:

```
catalina_jmonitor start
```

To stop the Tomcat server with JMonitor, use the regular `catalina.bat` or `catalina.sh` file.
Configuring the EJB Monitor and the Sitraka JMonitor on the Application Server

If you want to monitor EJB objects using the Sitraka JMonitor and the EJB Monitor together, you must first install the EJB Monitor and run the monitor detector. For more information, see “Installing the EJB Monitor and Running the Monitor Detector,” on page 456.

Installing the Sitraka JMonitor on the Application Server

To install the Sitraka JMonitor, create a home directory for the Sitraka JMonitor support files—for example, MERC_MONITOR_HOME—and unzip the installation file <LR_Installation>\Add-ins\J2EE\Sitraka\jmonitor_<platform>.jar file into that directory.

On UNIX platforms, use the jar utility to extract the installation jar.

Change to the Sitraka JMonitor installation directory and type the following command:

jar -xvf <path to your Sitraka JMonitor installation jar>

Support Matrix:

<table>
<thead>
<tr>
<th>Application Server</th>
<th>Version</th>
<th>Platform</th>
</tr>
</thead>
<tbody>
<tr>
<td>WebLogic</td>
<td>6.0; 6.1</td>
<td>Windows; Solaris; AIX</td>
</tr>
<tr>
<td>WebSphere</td>
<td>4.0</td>
<td>Windows; Solaris; AIX</td>
</tr>
</tbody>
</table>

After you have installed the EJB and Sitraka JMonitor support files on your WebLogic or WebSphere machine, you must configure the application server to run with EJB Monitor and Sitraka JMonitor support.

Note: It is important to set the environment variables in the order in which they appear below.
Chapter 29 • Java Performance Monitoring

To configure the WebLogic 6.0/6.1 server:

1. Make a backup copy of the `<WebLogic Home>\config\<domain name>\startWeblogic.cmd` file.

2. Open the `<WebLogic Home>\config\<domain name>\startWeblogicMercury.cmd` file.

3. In the ‘runWebLogic’ section of the file, just before the Java command line used to start the server, set the following environment variables:

   Note: For IBM AIX platform replace `LD_LIBRARY_PATH` with `LIBPATH`. Replace `<EJB Monitor Home Directory>` with the EJB monitor installation root directory. Replace `<Sitraka JMonitor Home Directory>` with the Sitraka JMonitor installation root directory. On UNIX platforms you may have to export the library path variables.

For Windows platforms:

```plaintext
set MERC_MONITOR_HOME=<EJB Monitor Home Directory>
set CLASSPATH=%MERC_MONITOR_HOME%\dat;%MERC_MONITOR_HOME%\classes;%MERC_MONITOR_HOME%\classes\xerces.jar;%CLASSPATH%
set PATH=%PATH%;%MERC_MONITOR_HOME%\bin
set JMONITOR_HOME=<Sitraka Jmonitor Home Directory>
set CLASSPATH=%JMONITOR_HOME%\lib;%JMONITOR_HOME%\lib\miniwebserver.jar;%JMONITOR_HOME%\lib\jlrutils.jar;%JMONITOR_HOME%\lib\jmonitor.jar;%CLASSPATH%
set PATH=%PATH%;%JMONITOR_HOME%\bin\win32_ia32
```

For UNIX platforms:

```plaintext
MERC_MONITOR_HOME <EJB Monitor Home Directory>
CLASSPATH$(MERC_MONITOR_HOME)/dat:$(MERC_MONITOR_HOME)/classes:$(MERC_MONITOR_HOME)/classes/xerces.jar:$(CLASSPATH)
```
LD_LIBRARY_PATH=${LD_LIBRARY_PATH}:${MERC_MONITOR_HOME}/bin
JMONITOR_HOME <Sitraka Jmonitor Home Directory>
CLASSPATH=${JMONITOR_HOME}/lib:${JMONITOR_HOME}/lib/mi
miniwebserver.jar:${JMONITOR_HOME}/lib/lrutils.jar:${JMONITOR_HOME}/lib/j
monitor.jar:${CLASSPATH}
setenv LD_LIBRARY_PATH=${LD_LIBRARY_PATH}:${JMONITOR_HOME}/bin/
win32_ia32

4 In the same section of the file, add the following parameter:
-Xrunjdkhook:jmonitor:load_mws,proxy

For Windows platforms:
%JAVA_HOME%/bin/java -hotspot -ms64m -mx64m -
-Xrunjdkhook:jmonitor:load_mws,proxy -classpath ...
%CLASSPATH%
-Dweblogic.Domain=mydomain
-Dweblogic.Name=myserver
"-Dbea.home=f:\bea"
"-Djava.security.policy=usr/bea/wlserver6.0/lib/weblogic.policy"
-Dweblogic.management.password=%WLS_PW% weblogic.Server

For UNIX platforms:
${JAVA_HOME}/bin/java -hotspot -ms64m -mx64m -
-Xrunjdkhook:jmonitor:load_mws,proxy -classpath ${CLASSPATH}
-Dweblogic.Domain=mydomain -Dweblogic.Name=myserver "
-Dbea.home=usr/bea"
"-Djava.security.policy=usr/bea/wlserver6.0/lib/weblogic.policy"
-Dweblogic.management.password=${WLS_PW} weblogic.Server

5 Run the <WebLogic Home>/config/<domain name>/
startWeblogicMercury.cmd file to start the server with JMonitor and
LoadRunner EJB monitor support.

To configure the WebSphere 4.0 server:
1 Ensure that the WebSphere Administrative Server is running, and start the
Administrator Console.
In the WebSphere Administrative Domain tree, expand the Nodes, hostname, and Application Servers subtrees, and select the Default Server (or the Application Server you wish to use with JMonitor).

For Windows 2000/NT and Solaris, click the General tab, and add the following variables to the Environment Editor box:

Note: Replace `<EJB Monitor Home Directory>` with the EJB monitor installation root directory, and `<Sitraka Jmonitor Home Directory>` with the JMonitor installation root directory.

For Windows 2000/NT:

name=PATH
definition=<EJB Monitor Home Directory>/bin;<Sitraka Jmonitor Home Directory>/win32_ia32

For Solaris:

name=LD_LIBRARY_PATH
definition=<EJB Monitor Home Directory>/bin:<Sitraka Jmonitor Home Directory>/bin/solaris_sparc

Click OK to close the Environment Editor.

For AIX:

If the LIBPATH environment variable has been changed, you need to link the Sitraka JMonitor and EJB monitor libraries in the /usr/lib directory.

Add the following command:

#ln -s <Sitraka Jmonitor Home Directory>/bin/aix_ppc/libjmonitor.so /usr/lib/libjmonitor.so

#ln -s <EJB Monitor Home Directory>/bin/libcjhook_mon.so /usr/lib/libcjhook_mon.so

#ln -s <EJB Monitor Home Directory>/bin/libconfig.so /usr/lib/libconfig.so

#ln -s <EJB Monitor Home Directory>/bin/libjdkhook.so /usr/lib/libjdkhook.so
# ln -s <EJB Monitor Home Directory>/bin/libmlib_ds.so /usr/lib/
libcjhook_mon.so
# ln -s <EJB Monitor Home Directory>/bin/libmosifs.so /usr/lib/libmosifs.so
# ln -s <EJB Monitor Home Directory>/bin/libthrdutil.so /usr/lib/libthrdutil.so

**Note:** You will likely require root permissions in order to create the link. Alternatively, you can place the link in WebSphere's /bin directory (usually /usr/WebSphere/AppServer/bin).

4 Click the **JVM Settings** tab in the WebSphere Administrative Console, and add the following values to the classpath:

**Note:** Replace `<EJB Monitor Home Directory>` with the EJB monitor installation root directory, and `<Sitraka Jmonitor Home Directory>` with the JMonitor installation root directory.

For Windows 2000/NT:

<EJB Monitor Home Directory>\dat
<EJB Monitor Home Directory>\classes
<EJB Monitor Home Directory>\classes\xerces.jar
<Sitraka Jmonitor Home Directory>\lib
<Sitraka Jmonitor Home Directory>\lib\jlrutils.jar
<Sitraka Jmonitor Home Directory>\lib\miniwebsrever.jar
<Sitraka Jmonitor Home Directory>\lib\jmonitor.jar

For Solaris or AIX:

<EJB Monitor Home Directory>/dat
<EJB Monitor Home Directory>/classes
<EJB Monitor Home Directory>/classes/xerces.jar
Click the Advanced JVM Settings button. In the Command line arguments field, add the following value for Windows 2000/NT, Solaris, and AIX:

-Xrunjdkhook:jmonitor:load_mws,proxy

Click the OK and Apply buttons to save the changes for the Application server. You can now start and stop your WebSphere server using the Sitraka JMonitor.

**Configuring the Sitraka JMonitor in the Controller**

To monitor a Java-based application, you must select the counters you want the Sitraka JMonitor to measure. You select these counters using the Controller’s Sitraka JMonitor dialog box.

**To configure the Sitraka JMonitor monitor:**

1. Click the Sitraka JMonitor graph in the graph tree, and drag it into the right pane of the Run view.
2 Right-click the graph in the graph and choose **Add Measurement(s)**, or choose **Monitors > Add Online Measurement**. The Sitraka JMonitor dialog box opens.

3 Click **Add** in the Monitored Server Machines box to enter the server name or IP address of the machine you want to monitor. Select the platform on which the machine runs, and click **OK**.
4 Click **Add** in the Resource Measurements section of the Sitraka JMonitor dialog box. The Sitraka JMonitor dialog box opens, displaying the available counters.

![Sitraka JMonitor Configuration](image)

5 Expand the Measured Components tree and select the methods and counters you want to monitor.
The following counters are available for the Sitraka JMonitor:

**Summary Memory Metrics**

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Free Heap Space</td>
<td>The percentage of free heap space since the last report.</td>
</tr>
<tr>
<td>% GC-To-Elapsed Time</td>
<td>The percentage of garbage collection to elapsed time.</td>
</tr>
<tr>
<td>% GC-To-Poll Time</td>
<td>The percentage of garbage collection to poll time.</td>
</tr>
<tr>
<td>% Used Heap</td>
<td>The percentage of used heap space since the last report.</td>
</tr>
<tr>
<td>Average GC Time (ms)</td>
<td>The average time, in milliseconds, spent performing garbage collections since the metric was enabled. (Disabling metric resets value to zero).</td>
</tr>
<tr>
<td>GC Time (ms)</td>
<td>The time, in milliseconds, spent performing garbage collections during the last poll period.</td>
</tr>
<tr>
<td>Heap Size (KB)</td>
<td>Total heap size, in kilobytes.</td>
</tr>
<tr>
<td>KB Freed</td>
<td>The number of kilobytes freed in the last poll period.</td>
</tr>
<tr>
<td>KB Freed Per GC</td>
<td>Average number of kilobytes freed per garbage collection since the metric was enabled (Disabling the metric resets value to zero).</td>
</tr>
<tr>
<td>Number of GCs</td>
<td>The number of garbage collections during the last poll period.</td>
</tr>
<tr>
<td>Total GC Time (ms)</td>
<td>The total time, in milliseconds, spent performing garbage collections since the metric was enabled. (Disabling the metric resets the value to zero).</td>
</tr>
<tr>
<td>Total GCs</td>
<td>The total number of garbage collections since the metric was enabled. (Disabling the metric resets value to zero).</td>
</tr>
</tbody>
</table>
### Chapter 29 • Java Performance Monitoring

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total KB Freed</td>
<td>The total number of kilobytes freed since the metric was enabled. (Disabling the metric resets value to zero).</td>
</tr>
<tr>
<td>Used Heap (KB)</td>
<td>Used heap size, in kilobytes.</td>
</tr>
</tbody>
</table>

#### DetailedMemoryMetrics

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average KB Per Object</td>
<td>The average number of kilobytes per object since the metric was enabled. (Disabling the metric resets value to zero).</td>
</tr>
<tr>
<td>Free-to-Alloc Ratio</td>
<td>The objects freed to objects allocated ratio since the metric was enabled. (Disabling the metric resets value to zero).</td>
</tr>
<tr>
<td>KB Allocated</td>
<td>The number of kilobytes allocated since the metric was enabled. (Disabling the metric resets value to zero).</td>
</tr>
<tr>
<td>Live Objects</td>
<td>The change in number of live objects during the last poll period.</td>
</tr>
<tr>
<td>Objects Allocated</td>
<td>The number of objects allocated in the last poll period.</td>
</tr>
<tr>
<td>Objects Freed</td>
<td>The number of objects freed during the last poll period.</td>
</tr>
<tr>
<td>Objects Freed Per GC</td>
<td>The average number of objects freed per garbage collection since the metric was enabled. (Disabling the metric resets value to zero).</td>
</tr>
<tr>
<td>Total KB Allocated</td>
<td>The kilobytes allocated since metric was enabled. (Disabling the metric resets value to zero).</td>
</tr>
</tbody>
</table>
### TowerJ Performance Monitoring

To monitor the TowerJ Java virtual machine, you must select the counters you want the TowerJ monitor to measure. You select these counters using the TowerJ dialog box.

**To configure the TowerJ monitor:**

1. Click the TowerJ graph in the graph tree, and drag it into the right pane of the Run view.

---

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Objects Allocated</td>
<td>The number of objects allocated since the metric was enabled. (Disabling the metric resets value to zero).</td>
</tr>
<tr>
<td>Total Objects Freed</td>
<td>The number of objects freed since the metric was enabled. (Disabling the metric resets value to zero).</td>
</tr>
</tbody>
</table>

6. Click **OK** in the Sitraka JMonitor Configuration dialog box, and in the Sitraka JMonitor dialog box, to activate the Sitraka JMonitor monitor.
2 Right-click the graph and choose Add Measurement(s), or choose Monitors > Add Online Measurement. The TowerJ dialog box opens.

3 Click Add in the Monitored Server Machines box to enter the server name or IP address of the machine you want to monitor. Select the platform on which the machine runs, and click OK.
4 Click Add in the Resource Measurements section of the TowerJ dialog box. The TowerJ dialog box opens, displaying the available counters.

5 Expand the Measured Components tree and select the methods and counters you want to monitor. The following counters are available for the TowerJ Java virtual machine:

<table>
<thead>
<tr>
<th>ThreadResource Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ThreadStartCountTotal</td>
<td>The number of threads that were started.</td>
</tr>
<tr>
<td>ThreadStartCountDelta</td>
<td>The number of threads that were started since the last report.</td>
</tr>
<tr>
<td>ThreadStopCountTotal</td>
<td>The number of threads that were stopped.</td>
</tr>
<tr>
<td>ThreadStopCountDelta</td>
<td>The number of threads that were stopped since the last report</td>
</tr>
<tr>
<td>GarbageCollection Resource Measurement</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>GarbageCollectionCount Total</td>
<td>The number of times the garbage collector has run.</td>
</tr>
<tr>
<td>GarbageCollectionCount Delta</td>
<td>The number of times the garbage collector has run since the last report.</td>
</tr>
<tr>
<td>PreGCHepSizeTotal</td>
<td>The total pre-GC heap space.</td>
</tr>
<tr>
<td>PreGCHepSizeDelta</td>
<td>The total pre-GC heap space since the last report.</td>
</tr>
<tr>
<td>PostGCHepSizeTotal</td>
<td>The total post-GC heap space.</td>
</tr>
<tr>
<td>PostGCHepSizeDelta</td>
<td>The total post-GC heap space since the last report.</td>
</tr>
<tr>
<td>NumPoolsTotal</td>
<td>The number of pools.</td>
</tr>
<tr>
<td>NumPoolsDelta</td>
<td>The number of pools since the last report.</td>
</tr>
<tr>
<td>NumSoBlocksTotal</td>
<td>The number of small object blocks.</td>
</tr>
<tr>
<td>NumSoBlocksDelta</td>
<td>The number of small object blocks since the last report.</td>
</tr>
<tr>
<td>NumLoBlocksTotal</td>
<td>The number of large object blocks.</td>
</tr>
<tr>
<td>NumLoBlocksDelta</td>
<td>The number of large object blocks.</td>
</tr>
<tr>
<td>NumFullSoBlocksTotal</td>
<td>The number of full small object blocks.</td>
</tr>
<tr>
<td>NumFullSoBlocksDelta</td>
<td>The number of full small object blocks since the last report.</td>
</tr>
<tr>
<td>TotalMemoryTotal</td>
<td>Total memory (heap size).</td>
</tr>
<tr>
<td>TotalMemoryDelta</td>
<td>Total memory (heap size) since the last report.</td>
</tr>
<tr>
<td>NumMallocsTotal</td>
<td>The number of current mallocs.</td>
</tr>
<tr>
<td>NumMallocsDelta</td>
<td>The number of current mallocs since the last report.</td>
</tr>
<tr>
<td>NumBytesTotal</td>
<td>The number of current bytes allocated.</td>
</tr>
<tr>
<td>NumBytesDelta</td>
<td>The number of current bytes allocated since the last report.</td>
</tr>
</tbody>
</table>
### Garbage Collection Resource Measurement

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TotalMallocsTotal</td>
</tr>
<tr>
<td>TotalMallocsDelta</td>
</tr>
<tr>
<td>TotalBytesTotal</td>
</tr>
<tr>
<td>TotalBytesDelta</td>
</tr>
</tbody>
</table>

### Exception Resource Measurement

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ExceptionCountTotal</td>
</tr>
<tr>
<td>ExceptionCountDelta</td>
</tr>
</tbody>
</table>

### Object Resource Measurement

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NumberOfObjectsTotal</td>
</tr>
<tr>
<td>NumberOfObjectsDelta</td>
</tr>
</tbody>
</table>

6. Click **OK** in the TowerJ Monitor Configuration dialog box, and in the TowerJ dialog box, to activate the TowerJ monitor.
Troubleshooting Online Monitors

LoadRunner monitors allow you to view the performance of the scenario during execution.

The following sections describe several tips and known issues relating to the online monitors.

➤ Troubleshooting Server Resource Monitors
➤ Troubleshooting the Network Delay Monitor
➤ Network Considerations

Troubleshooting Server Resource Monitors

In order to monitor resources on a server machine, you must be able to connect to that machine. If monitoring is unsuccessful and LoadRunner cannot locate the specified server, make sure that the specified server is available. Perform a “ping” operation by typing ping <server_name> from the Controller machine command line.

Once you verify that the machine is accessible, check this table for additional tips on troubleshooting the monitor.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution</th>
</tr>
</thead>
</table>
| Cannot monitor a Windows machine on a different domain, or “access denied.” | To gain administrative privileges to the remote machine, perform the following from the command prompt: `%net use \<MachineName>\user:<Domain>\<RemoteMachineUsername>`
At the password prompt, enter the password for the remote machine. |
### Problem 1

**Cannot monitor an NT/Win 2000 machine (An error message is issued: “computer_name not found” or “Cannot connect to the host”)**

**Solution**

The NT/Win 2000 machine you want to monitor only enables monitoring for users with administrator privileges. In order to allow monitoring for non-admin users, you must grant read permission to certain files and registry entries (Microsoft tech-note number Q158438.) The required steps are:

1. Using Explorer or File Manager, give the user READ access to:
   - `%windir%\system32\PERFCxxx.DAT`
   - `%windir%\system32\PERFHxxx.DAT`
   where `xxx` is the basic language ID for the system—e.g., 009 for English. These files may be missing or corrupt. If you suspect this; expand these files off of the installation cd.
2. Using REGEDT32, give the user READ access to:
   - `HKEY_LOCAL_MACHINE\Software\Microsoft\Windows NT\CurrentVersion\Perflib`
   - and all sub keys of that key.
3. Using REGEDT32, give the user at least READ access to:
   - `HKEY_LOCAL_MACHINE\System\CurrentControlSet\Control\SecurePipeServers\winreg`

### Problem 2

**Some Win 2000 counters cannot be monitored from an NT machine.**

**Solution**

Run the Controller on a Win 2000 machine.

### Problem 3

**Some Windows default counters are generating errors**

**Solution**

Remove the problematic counters and add the appropriate ones using the “Add Measurement” dialog box.

### Problem 4

**You cannot get performance counters for the SQL server (version 6.5) on the monitored machine.**

**Solution**

There is a bug in SQL server version 6.5. As a workaround, give read permission to the following registry key at the monitored machine (use regedt32):

- `HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\MSSQLServer\MSSQLServer`

(Microsoft tech-note number Q170394)
## Chapter 30 • Troubleshooting Online Monitors

<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>The selected measurements are not displayed in the graph.</td>
<td>Ensure that the display file and online.exe are registered. To register the monitor dll's, without performing a full installation, run the <code>set_mon.bat</code> batch file located in lrun/bin.</td>
</tr>
<tr>
<td>When monitoring a Windows machine, no measurements appear in the graph.</td>
<td>Check the built-in Windows Performance Monitor. If it is not functional, there may be a problem with the communication setup.</td>
</tr>
<tr>
<td>When monitoring a UNIX machine, no measurements appear in the graph.</td>
<td>Ensure that an <code>rstatd</code> is running on the UNIX machine (Refer to Chapter 21, “System Resource Monitoring.”).</td>
</tr>
<tr>
<td>Cannot monitor one of the following Web servers: MS IIS, MS ASP, or ColdFusion</td>
<td>Refer to problem above, “Cannot monitor a Windows machine.”</td>
</tr>
<tr>
<td>Cannot monitor the WebLogic (JMX) server</td>
<td>Open the <code>LoadRunner\root\dat\monitors\WebLogicMon.ini</code> file, and search for: <code>[WebLogicMonitor] JVM=javaw.exe</code> Change <code>javaw.exe</code> to <code>java.exe</code>. A window containing trace information opens.</td>
</tr>
</tbody>
</table>
Troubleshooting the Network Delay Monitor

If monitoring is unsuccessful and LoadRunner cannot locate the source or destination machines, make sure that the specified machines are available to your machine. Perform a “ping” operation. At the command line prompt, type:

```
ping server_name
```

To check the entire network path, use the trace route utility to verify that the path is valid.

For Windows, type `tracert <server_name>`.

For UNIX, type `traceroute <server_name>`.

If the monitoring problem persists once you verify that the machines are accessible and that the network path is valid, perform the following procedures:

1) If you are using the TCP protocol, run `<LR root folder\bin\webtrace.exe` from the source machine to determine whether the problem is related to the Controller, or the WebTrace technology on which the Network Delay monitor is based. If you are using the UDP or ICMP protocols, the problem must be related to the Controller and not WebTrace, since these protocols are not WebTrace technology-based.

2) If you receive results by running `webtrace.exe`, the problem is related to the Controller. Verify that the source machine is not a UNIX machine, and contact Mercury Interactive’s Customer Support with the following information:

- the Controller log file, `drv_log.txt`, located in the temp directory of the Controller machine.

- the `traceroute_server` log file, located on the source machine. Note that in LoadRunner 7.02, this information is located in `<LR root folder\dat\<the latest mdrv log>`. In LoadRunner 7.5, this information is located in `<LR root folder\bin\traceroute_server.log`. 


Chapter 30 • Troubleshooting Online Monitors

- the debug information located in the TRS_debug.txt and WT_debug.txt files in the path directory. These files are generated by adding the following line to the [monitors_server] section of the <LR root folder\dat\mdrv.dat file, and rerunning the Network monitor:

```
ExtCmdLine=-traceroute_debug path
```

3) If you do not receive results by running webtrace.exe, the problem is related to the WebTrace technology, on which the Network Delay monitor is based. Perform the following procedures on the source machine:

- Verify that the packet.sys file (the Webtrace driver) exists in the WINNT\system32\drivers directory.
- Check whether a driver (such as “Cloud” or “Sniffer”) is installed on top of the network card driver. If so, remove it and run WebTrace again.
- Verify that there are administrator permissions on the machine.
- Using ipconfig /all, check that only one IP address is assigned to the network card. WebTrace does not know how to handle multiple IP addresses assigned to the same card (IP spoofing).
- Check the number of network cards installed. Run webtrace –devlist to receive a list of the available network cards.
- If there is more than one card on the list, run webtrace -dev <dev_name> <destination>, where <dev_name> is one of the network card names shown in the list. If you discover that WebTrace is binding to the wrong card, you can use webtrace set_device <dev_name> in order to set a registry key that instructs WebTrace to use a specified card instead of the default one.
- Verify that the network card is of the Ethernet type.
- Contact Mercury Interactive’s Customer Support with the output of webtrace.exe –debug (for example, webtrace.exe –debug www.merc-int.com) and ipconfig /all on the machine.
Network Considerations

If you notice extraordinary delays on the network, refer to one of the following sections to increase the performance:

➤ Network Bandwidth Utilization
➤ Ethernet-bus Based Networks
➤ Working on a WAN or Heavily Loaded LAN

Network Bandwidth Utilization

In most load-testing scenarios, the network card has little impact on scenario performance. Network cards are manufactured to handle the bandwidth of the physical network layer. Packets are transferred over an Ethernet at a rate that complies with IEEE 803.x standards. If the network becomes a bottleneck, the issue is not the brand of the network card, but rather the bandwidth limitations on the physical layer (~i.e. Ethernet, FDDI, ATM, Ethernet Token-ring, etc.).

That is, instead of load testing over a T10 line, upgrade your line to DS3 (45Mbps), or T100 (100Mbps).

Below are a few tips that will help qualify the need to upgrade the network:

1) Run the performance monitor on the Vuser load generators. As the number of Vusers increases, check the network byte transfer rate for saturation. If a saturation point has been reached, do not run any more Vusers without upgrading the network—otherwise performance of Vusers will degrade. Degradation is exponential in networking environments.

2) Run the performance monitor on the server machine. Run many Vusers on several load generator machines. Check the kernel usage and network transfer rate for saturation. If saturation is reached with less than the desired Vuser load, upgrade the network.

3) Every network has a different Maximum Transmission Unit or MTU, which is set by the network administrator. The MTU is the largest physical packet size (in bytes) that a network can transmit. If a message is larger than the MTU, it is divided into smaller packets before being sent.
Chapter 30 • Troubleshooting Online Monitors

If clients and servers are passing large data sets back and forth, instruct the network administrator to increase the MTU in order to yield better bandwidth utilization. Ideally, you want the MTU to be the same as the smallest MTU of all the networks between your machine and a message's final destination.

If you send a message that is larger than one of the MTUs, it will be broken up into fragments, slowing transmission speeds. If the MTU is too high, it may cause unintended degradation. Trial and error is the only sure way of finding the optimal MTU, but there are some guidelines that can help. For example, most Ethernet networks have an MTU of 1500.

If the desired MTU reduces performance, upgrade the network or reduce the MTU to improve performance.

Ethernet-bus Based Networks
The following guidelines apply to Ethernet-bus based networks:

Networks with only 2 active machines communicating yield a maximum of 90% bandwidth utilization.

Networks with 3 active machines communicating yield a maximum of approximately 85% bandwidth utilization.

As the number of active machines on the network increases, the total bandwidth utilization decreases.

Working on a WAN or Heavily Loaded LAN
When you work with LoadRunner on a WAN or heavy loaded LAN, you may notice some unusual LoadRunner behavior, which indicates network problems. The Output window may contain messages about retries, lost packets, or message mismatch. This is because some of the messages from the Controller may not be reaching the LoadRunner agent. To solve this problem, you should reduce the network traffic or improve the network bandwidth.

The following steps may help reduce network traffic:

➤ Click the Run-Time Settings button. In the Log tab, select Disable logging.
➤ Initialize all users before running them. Run them only after initialization is completed.
Part V

Appendixes
Interpreting LoadRunner Online Graphs

LoadRunner online monitor graphs present important information about the performance of your scenario. This appendix describes some of the key online graphs in greater depth and shows how they can be used to identify and pinpoint performance bottlenecks as your scenario is running.

**Online Monitoring Graphs**

Using the online monitor graphs, you can determine whether transactions transpire within an acceptable amount of time, whether your bandwidth is sufficient to keep download times to a minimum, and whether your hardware and operating system can handle peak load.

**Question 1**: Do all transactions in my scenario transpire within an acceptable amount of time? Which particular transactions take too long?

**Answer**: The **Transaction Response Time** graph shows the amount of time it takes for each transaction to be completed. Note that in the graph below, the transaction response time is quick, except for the login transaction. The initial login did not take much time, but subsequent logins were quite slow.
This indicates that the database is unable to process more than one login at a time, which may be due to inefficient database querying.

**Question 2**: Is bandwidth sufficient to keep download times to a minimum?  
**Answer**: The Throughput graph shows the amount of throughput on the Web server during each second of the scenario run. Throughput represents the amount of data received from the server at any given second.
Appendix A • Interpreting LoadRunner Online Graphs

Note that in the above graph, the throughput scales upward as time progresses and the number of users increases, indicating that the bandwidth is sufficient. If the graph were to remain relatively flat as the number of users increased, it would be reasonable to conclude that the bandwidth is constraining the volume of data requested.

Question 3: Can the hardware and operating system handle peak load?
Answer: The Windows Resources graph displays Windows resource usage in real-time. You use this graph to monitor the resources used during a scenario and locate a bottleneck on a particular machine.

![](image)

<table>
<thead>
<tr>
<th>Color</th>
<th>Scale</th>
<th>Measurement</th>
<th>Max</th>
<th>Min</th>
<th>Avg</th>
<th>Std</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>% Total Processor Time (System)</td>
<td>45.04</td>
<td>25.164</td>
<td>35.851</td>
<td>5.4974</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>File Data Operations/sec (System)</td>
<td>104.98</td>
<td>12.338</td>
<td>20.104</td>
<td>20.834</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Page Faults/sec (Memory)</td>
<td>74.91</td>
<td>9.3263</td>
<td>20.301</td>
<td>20.316</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Processor Queue Length (System)</td>
<td>6</td>
<td>3</td>
<td>4.7</td>
<td>1.2893</td>
</tr>
</tbody>
</table>

The % Total Processor Time in the above graph shows the amount of data processed by the server. File Data Operations/sec shows the rate at which the server is issuing Read and Write operations to file system devices. Page Faults/sec counts the number of page faults in the processor, representing virtual memory and caching algorithm opportunities.
It is commonly thought that newer and faster servers can resolve slow download times. However the above graph demonstrates that only a small amount of data is processed by the server. The graph indicates that there is adequate processor capacity, and additional server hardware will not result in increased performance. There are cases, however, in which increased performance can be achieved by optimizing the data file system.
Performing Path Translation

When you run a scenario, LoadRunner gathers run-time data from the participating Vusers. By default, LoadRunner stores the data in temporary files on each Vuser machine. After the scenario, the data is collated in the general results directory.

Alternatively, you can instruct LoadRunner to write the run-time data directly to a shared network drive. (See Chapter 10, “Configuring a Scenario.”) This method is not recommended, since it increases network traffic and necessitates path translation.

Understanding Path Translation

Path Translation is a mechanism used by LoadRunner to convert a remote path name for the Controller. A typical scenario might have the LoadRunner Controller running on a Windows-based machine and include multiple Vusers running on both Windows-based and UNIX load generators. One remote load generator may map the network drive as F, while another load generator maps the same drive as H. In a complex scenario such as this, you need to ensure that all participating machines recognize the same network drive.
You instruct LoadRunner to store scripts and run-time data results on a shared network drive from the Run-time File Storage tab of the Options dialog box.

Result and script files stored on a shared network drive require you to perform path translation.

The Script view contains a list of all the Vuser scripts associated with a scenario—and their locations. A script's location (path) is always based on the Controller machine's mapping of that location. If a Vuser load generator maps to the script's path using a different name, path translation is required.

For example, assume that the Controller is running on a Windows-based machine named pc2, and that a Vuser script is located on a network drive. The Controller machine maps the network drive as m:\lr_tests. If the remote Vuser machine (load generator) hosting the Vusers also maps the path as m:\lr_tests, no translation is necessary. However, if the remote machine maps the path as another drive or path, for example r:\lr_tests, you must translate the path to enable the load generator to recognize the script location.
Similarly, when saving run-time result files to a shared drive that is mapped differently by the Controller and remote load generator, you must perform path translation.

Path translation is also effective across platforms—between Windows and UNIX. You use path translation to translate Windows-based paths (as seen by the Controller) into paths recognized by the UNIX Vuser load generator.

### Adding Entries to the Path Translation Table

To translate a path from one Windows-based computer to another, or between Windows-based and UNIX machines, you create an entry in the Path Translation table. This table contains a list of paths translated into formats that can be recognized by different machines.

Each line of the Path Translation table has the following format:

```
<controller_host><controller_path><remote_path>[<remote_host>]
```

- **controller_host**: The name or type of the machine that is running the Controller. For example, if the Controller is running on a Windows-based computer, you could type `win` in the host field. Alternatively, you could enter the name of the machine running the Controller (for example, LOADPC1).

The value of `controller_host` can be:

- **hostname**: the name of the machine running the Controller
- **win**: the Controller is running on a Windows-based computer
- **unix**: the Controller is running on a UNIX machine
- **all**: the Controller is running on a Windows-based or a UNIX machine
The path of a specific directory—as recognized by the Controller. For example, if the directory `scripts` is located on the network drive `r`—as mapped by the Controller—type the path `r:\scripts` in the `controller_path` field.

The path of a specific directory—as recognized by the remote machine. For example, if the directory `scripts` is located on the network drive `n`—as mapped by the remote load generator—type the path `n:\scripts` in the `remote_path` field.

If a Vuser on the remote UNIX load generator recognizes the above path as `/m/tests`, you would type this path in the `remote_path` field.

The name or type of the remote load generator. For example, if all the remote machines are UNIX workstations, you could type `unix` in the `remote_host` field. The options for the `remote_host` field are the same as the options for the `controller_host` field, listed above. The `remote_host` parameter is optional.

**Editing the Path Translation Table**

You maintain the Path Translation table using the LoadRunner Controller. LoadRunner saves the Path Translation table as an ASCII file, `ppath.mnt`. This file, stored in `loadrunner_directory/dat`, has a one–line entry for each network path to translate.

**To edit the Path Translation table:**

1. Start the LoadRunner Controller.
Appendix B • Performing Path Translation

2 Choose Tools > Options and select the Path Translation Table tab. The Path Translation Table view opens.

![Options Window](image)

3 Before you enter path translation information, consider using the Universal Naming Convention method. If your machines are Windows machines, you can tell the Controller to convert all paths to UNC, and all machines will be able to recognize the path without requiring path translation. An example of UNC format is `\machine_a\results`.

Select the Convert to UNC check box to tell LoadRunner to ignore the path translation table and to convert all paths to the Universal Naming Convention.

4 If your machines are not Windows machines and you require path translation, type the path information into the table. You can insert comments by typing the "#" symbol at the start of a line in the table.

5 Click OK to close the table and save the information.
**Path Translation Examples**

The following section illustrates sample Path Translation Table entries.

Note that when you translate a Windows-based path to a UNIX path, you must enter the appropriate slashes—forward slashes for UNIX and back slashes for Windows-based paths.

The examples below show the use of the Path Translation table for a Windows-based Controller called Merlin.

In the first example, Vusers are running on a Windows 2000 machine, Oasis. Merlin maps the network drive as f:, while Oasis maps it as g:\loadtest.

<table>
<thead>
<tr>
<th>merlin</th>
<th>f:\</th>
<th>g:\loadtest\</th>
<th>Oasis</th>
</tr>
</thead>
</table>

In the second example, Vusers are running on a UNIX machine, Ultra. Ultra maps the networks drive as /u/tests/load.

<table>
<thead>
<tr>
<th>merlin</th>
<th>f:\</th>
<th>/u/tests/load/</th>
<th>Ultra</th>
</tr>
</thead>
</table>

In the third example, the mapping of the network drive by the remote load generator Jaguar, is identical to the Controller's mapping, so no translation is required. This line can be excluded from the Path Translation table.

<table>
<thead>
<tr>
<th>merlin</th>
<th>n:\</th>
<th>n:\</th>
<th>Jaguar</th>
</tr>
</thead>
</table>

In the fourth example, all Windows-based Vuser load generators map the network drive as m:\loadtest.

<table>
<thead>
<tr>
<th>merlin</th>
<th>l\mnt\</th>
<th>m:\loadtest\</th>
<th>win</th>
</tr>
</thead>
</table>
Working in Expert Mode

Advanced users can fine-tune the LoadRunner configuration settings while working in Expert Mode. In Expert mode, additional options are displayed in the Options dialog box and in the Load Generator Information dialog box. This appendix describes the additional settings that are available in the Expert mode:

- Entering Expert Mode
- Options - Agent Settings
- Options - General Settings
- Options - Debug Information Settings
- Options - Output Settings
- Options - Monitor Settings
- Load Generator Information - UNIX Environment Settings
- Load Generator Information - Connection Log Settings

Entering Expert Mode

The LoadRunner Controller Expert mode is intended for support personnel to provide access to system information. When you work in the Expert mode, the Controller dialog boxes contain additional options for fine tuning the Controller operation.

To activate the Expert mode, choose Tools > Expert Mode. An active Expert mode is indicated by a check mark.

To exit the Expert mode, repeat the above process.
Options - Agent Settings

The Agent settings allow you to customize the behavior of the LoadRunner agent on a remote load generator machine. Using the Options dialog box, you set the online configuration parameters for the agent.

To set the Agent settings:

1. Enter Expert mode (see above).
2. Choose Tools > Options. The Options dialog box appears. Select the Agent tab.

3. Select the maximum number of threads to be executed for the current Vuser’s driver. Each driver can run up to a maximum of 50 threads.
4. Select the agent’s working language (English or Japanese).
5. Click OK to accept the settings and close the dialog box.
Appendix C • Working in Expert Mode

Options - General Settings

The General tab in the Options dialog box allows you to specify global settings for data table storage and multiple IP address allocation, and instruct LoadRunner not to collate log files.

Multiple IP address mode: The mode used to allocate IP addresses when the multiple IP address option is enabled (Scenario > Enable IP Spoof). The Controller can allocate an IP address per process or per thread. Allocation per thread results in a more varied range of IP addresses in a scenario.

Data tables global directory: The network location for data tables used as a source for parameter values. This setting is only required for scripts created with earlier versions of LoadRunner.

Do not collate log files: Instructs LoadRunner to collate only result files, and not log files.

To set the General Expert mode settings:

1 Choose Tools > Options. The Options dialog box appears. Select the General tab.
2 Select the Multiple IP address mode.

3 Enter the global directory for data tables.

4 If you want LoadRunner to collate only result files and not log files, check Do not collate log files.

5 Click OK to accept the settings and close the dialog box.

**Options - Debug Information Settings**

The Debug settings in the Options dialog box allow you to determine the extent of the trace to be performed during scenario execution. The debug information is written to the Output window.

The following trace flags are available: General, File Transfer, Incoming Communication, and Outgoing Communication. You only need to select the flags relating to your problem. For example, if you encounter specific problems with the transfer of files, select the File Transfer flag.

The LoadRunner agent and Controller create some temporary files, which collect information such as the parameter file sent to the Vuser, the output compilation file, and the configuration file. The LoadRunner agent files are saved in `brr` folders in the TMP or TEMP directory of the agent machine. The Controller files are saved in `lrr` folders in the TMP or TEMP directory of the Controller machine. At the end of the scenario, all these files are automatically deleted. However, using the Debug Information Expert mode settings, you can instruct LoadRunner to keep these temporary files.
Appendix C • Working in Expert Mode

To set the Debug Information settings:

1 Choose **Tools > Options**. The Options dialog box appears. Select the **Debug Information** tab.

2 Select the check boxes for the desired trace flags.

3 To save the temporary run-time files, select the **Keep temporary files** check box.

4 Click **OK** to accept the settings and close the dialog box.

**Options - Output Settings**

The Output tab in the Options dialog box allows you to configure how running Vusers are displayed on the Controller machine.

**Configuration of the 'Show Vuser' Operation**: The following settings are available:

- **Max simultaneously displayed**: Specifies the maximum number of Vuser logs that may be displayed simultaneously, as well as the maximum number
of active UNIX, GUI, RTE, or Web Vusers that the Controller should display by opening up Run-Time Viewers on your machine. The default number is 10.

**Refresh timeout:** Defines how often to refresh the Vuser log. The default is every 1000 milliseconds.

**Delete Output window messages upon Reset:** Instructs LoadRunner to clear all messages in the Output window when you reset a scenario.

**To set the Output settings:**

1. Choose **Tools > Options.** The Options dialog box appears. Select the **Output** tab.

2. Specify the maximum number of Vuser logs to be displayed simultaneously, in the **Max. simultaneously displayed** box.

3. Specify the frequency at which LoadRunner refreshes the Vuser log, in the **Refresh timeout** box.

4. To clear the messages in the Output window when you reset a scenario, select the **Delete Output window messages upon Reset** check box.
5 Click **OK** to accept the settings and close the dialog box.

**Options - Monitor Settings**

Expert mode provides the following additional monitor setting:

**Send Summary or Raw Data:** sends a summary of the data collected back to the Controller, or sends all of the data in raw form. Sending the data in raw form saves time because the data does not need to be processed. However, since all of the data is being transferred to the Controller, it may cause more network traffic. If the transfer speed is significant to you, it is recommended that you choose **Summary**.
Load Generator Information - UNIX Environment Settings

Expert mode provides the following additional UNIX Environment setting:

**Local User**: UNIX load generators that use the *rsh* shell establish a connection as the current NT user (due to security considerations). To “mislead” *rsh* and log in as a user other than the current NT login, select the **Local user** check box and specify the desired UNIX login name. Since modifying the local user name is a security breach for *rsh*, this option should only be used when you encounter a problem connecting to the remote machine.

![Load Generator Information](image)
Appendix C • Working in Expert Mode

Load Generator Information - Connection Log Settings

The Connection Log tab in the Load Generator dialog box allows you to view the standard output and standard errors generated as the Controller connects to the selected UNIX load generator. You can also change the command that the Controller sends to the remote bridge in order to connect to the load generator.

To set the Connection Log settings:

1 Click the Generators button, or select Scenario > Load Generators. The Load Generators dialog box opens.

2 Click Connect to change the Status of a load generator from Down to Ready.

3 Click the Details button. The Load Generator Information dialog box opens. Select the Connection Log tab.
You can view the rsh standard output and rsh standard errors generated as the Controller sends the connection command to the selected UNIX load generator.

In the Bridge cmd box, enter a new command if you want to change the default bridge command being sent by the Controller to the remote bridge in order to connect the UNIX load generator.
Troubleshooting the Controller

LoadRunner enables you to test entire applications. If one of the components of the application is not configured properly, LoadRunner scenarios will not run.

This appendix discusses the most common LoadRunner problems:

➤ LoadRunner Communications
➤ Failure to Communicate with a Load Generator
➤ Failure to Connect to the AUT Database
➤ Failure to Access Files
➤ Failed Vusers or Transactions
➤ Increasing the Number of Vusers on a Windows Machine
➤ Troubleshooting Firewalls

About Troubleshooting

LoadRunner relies heavily upon communication between machines on a network. If communication is not established properly, the Controller will be unable to send commands to remote load generators and the scenario will fail. By understanding the reason for the failure and determining when the failure occurred, you can solve most of the communication-related problems.
In order to ensure that the problem lies with your scenario and not your Vuser script, you should verify that your script runs properly on all remote load generators as a stand-alone:

➤ Test your GUI Vuser scripts on Windows platforms using WinRunner.
➤ Test your Vuser scripts on UNIX platforms by running them from the command line.
➤ Test all other types of Vuser scripts on Windows platforms by running them from VuGen, or by running a single user from the Controller.

Note: When a test runs in VuGen, the full browser is used. This differs from a test run in the Controller, where only the browser basics are used. There may be occasions when a test passes its run in VuGen, but fails when it is run in the Controller. Before running a scenario in the Controller with multiple Vusers, run a single Vuser to ensure the test is bug free.

For more information on running Vuser scripts in stand-alone mode, refer to the appropriate guide for creating Vuser scripts.

**LoadRunner Communications**

Most communication problems can be solved if you understand your LoadRunner configuration. This knowledge helps you to determine the source of the problem and perform the necessary actions to correct it.

The following diagram illustrates a sample network running LoadRunner. There are five servers: The LoadRunner Controller, the Web server, the application server, the database server, and the file server which stores the scenario results (note that result files can also be saved on a non-dedicated server). There are five remote load generators, each one running multiple Vusers.

The arrows indicate the type of communication necessary between the elements of the network. The Vusers communicate with the Controller in both directions (send/receive), but with the file server in one direction.
Appendix D • Troubleshooting the Controller

(send). The Controller must have access to the file server. All Vusers participating in the scenario must be able to communicate with the Web server in both directions (send/receive). In order for a client machine to connect to the server machine, it must be able to resolve the server machine name.

If any of the connections are broken, the scenario will fail.

**Failure to Communicate with a Load Generator**

The most common communication error is the failure of the Controller machine to connect with a remote load generator. Check the following items:

➤ TCP/IP setup
➤ TCP/IP connectivity
➤ Load generator connections
➤ UNIX shell
Checking TCP/IP Setup

The first step in checking your configuration is to verify your machine’s TCP/IP setup. LoadRunner includes a utility called Hostinfo (hostinfo.exe), located under LoadRunner’s bin directory. This utility provides information about the current machine—local name and local address. It also insures that TCP/IP is properly installed on the current machine.

When you invoke Hostinfo, it automatically verifies the TCP stack by:

➤ retrieving and resolving the local machine name
➤ retrieving and resolving the IP address

To resolve the IP address, Hostinfo tries to communicate using two UDP sockets on the same machine. It verifies that the IP address obtained while resolving the machine name is the same as the actual IP address of this machine.

To display the results of a test in the Details box, highlight the test name.

Note that the Edit menu in Hostinfo allows you to copy all machine information to the clipboard for sending to support personnel.
Checking TCP/IP Connectivity

Make sure that TCP/IP connectivity is functional on the Controller and Vuser machines. Use a ping utility or type ping <server_name> from the DOS command line to verify communication with a remote machine. Make sure that the remote load generator and Controller machines can ping each other by IP addresses and machine names.

If the ping does not respond, or fails with a timeout, then the machine name is not recognized. To solve this problem, edit the hosts file, located in the WINNT\system32\drivers\etc directory, and add a line with both the IP address, and the name. For example:

```
# 102.54.94.97 rhino.acme.com    # source server
# 38.25.63.10  x.acme.com       # x client host
```

Load Generator Connections

To verify the load generator connectivity, connect to each one of the remote load generators from the Controller's Load Generators dialog box. In the load generator's Platform field, select a Windows or UNIX platform. Select the load generator(s) and click the Connect button. The status changes to Connecting.

If the Connection fails, the status changes to Failed and details are written to the Details box. Double-click the details box for more information about a failure.

If a connection succeeds, the status changes to Ready, and the actual platform name appears in the Platform box (such as WINNT, UNIX, etc.)
If your scenario uses several domains (for example, Vusers on a different domain than the Controller), the Controller may have trouble communicating with the load generators. This occurs because the Controller uses the short load generator name—not including the domain—by default. To solve this, you must tell the Controller to determine the full load generator names, including the domains.

Modify the `miccomm.ini` file in the Controller machine’s Windows directory as follows:

```
[tcpcnet]
LocalHostNameType= 1
```

The possible values for `LocalHostNameType` are:

- 0 - Attempt to use the full machine name.
- 1 - Use the short machine name. This is the default.

---

**Note:** In certain environments such as WINS, load generators are unable to resolve machine names.

---

**Connecting to a Controller with Multiple IP Addresses**

If the load generator machine does not recognize the Controller machine by its short name or full name, and the Controller machine has more than one IP address, you can define an alias name for the Controller machine in the load generator’s `hosts` file, located in the `WINNT\system32\drivers\etc` directory. The alias name should point to the IP address you want the load generator to recognize. For example: 255.0.0.1 delta.

**UNIX Shell**

For UNIX Vusers, make sure that the Windows Controller can execute a remote shell command. Type the following at the DOS command prompt:

```
rsh -l <UNIX user login name> <load generator name> <command>
```

If you get a message indicating that permission is denied, make sure the `.rhosts` file in your UNIX home directory contains Controller machine permission for the user login name. In some cases, a “+” character must be added at the end of the `.rhosts` file. For example, if you log on to the Controller as bill and
connect to the UNIX load generator as mike, you must ensure that mike allows bill to log on using his name. This can be done by adding the line "+ bill" at the beginning of mike's .rhosts file.

For more information on setting user login names, see “Configuring Load Generator Settings” on page 62.

To use UNIX without RSH:

1 On the UNIX Load Generator machine, run the agent daemon by running the following command from <LoadRunner directory>/bin:

   m_daemon_setup -install

This runs a daemon called m_agent_daemon, and if successful you will receive a message: m_agent_daemon installed successfully.

The agent will now keep running, even if the user is logged off. It will only stop running using the command explained in step 3, or by rebooting the machine.

➤ If you receive the message ERROR: File m_agent_daemon doesn’t exist, this means that you are not in the same directory as the file (meaning not in <LR_root>/bin directory, or the file really doesn’t exist, which indicates a problem with the installation).

➤ If a daemon of this name is already being run by the same user you will receive the following warning:

   WARNING: Could not install m_agent_daemon, reason - user <user_name> is already running m_agent_daemon on this machine.

➤ If an error occurred, you will receive the following error message:

   ERROR: Could not install m_agent_daemon. Check log file m_agent_daemon[xxx].log in your temp directory.
If you look at the log file `m_agent_daemon[xxx].log` in the temp directory, you will see the following errors, even if the installation succeeded:

If no daemon of this name is being run by this user, you will receive the following warning:

**WARNING:** Could not remove `m_agent_daemon`, reason - user `<user_name>` is not running `m_agent_daemon` on this machine.

If an error occurred, you will receive the following error message:

**ERROR:** Could not remove `m_agent_daemon`. Check log file `m_agent_daemon[xxx].log` in your temp directory.
Appendix D • Troubleshooting the Controller

Failure to Connect to the AUT Database

If you are running a database application, you must ensure that all remote clients can connect with the database server. If network or configuration errors occur when the client accesses the server, you must correct them before running a scenario. To ensure that your client application can connect with the database server, perform the following tests.

➤ Ping
➤ SQL utilities

Ping: Ensure that the client can communicate with the database server using TCP/IP. Use a ping utility or type ping <server_name> from the DOS command line.

SQL Utilities: Use a simple utility such as ISQL or SQLPLUS to log on to the database server and perform several basic operations.

Failure to Access Files

A LoadRunner scenario will fail if the result path or Vuser script is inaccessible to one or more of the participating machines. Check the following items:

➤ Path Translation
➤ Vuser Script
➤ Result Path

Path Translation: A script’s location (path) is always based on the Controller machine's mapping of that location. If a Vuser load generator maps to the script’s path using a different name, path translation is required. Path translation translates the Controller’s mapping of a given location to the Vuser load generator’s mapping. For example, if one machine maps the script directory as g:\test, while another maps it as h:\test, the paths should be translated.
Path translation is also effective across platforms—between Windows and UNIX. You use path translation to translate the Windows Controller paths into paths recognized by UNIX.

**Note:** Path translation is only required if you chose to save all scripts and results to a shared network drive. In the default setup, LoadRunner saves files locally and collates them to the Controller machine; no path translation is required.

Suppose that your script is in the /usr/jon/lr_test1 directory and runs on the UNIX machine, sunny. To translate it from the Windows Controller machine, pc1, where your UNIX directory is mapped as r, enter the following line in the path translation table:

<table>
<thead>
<tr>
<th>pc1</th>
<th>r:\</th>
<th>/usr/jon</th>
<th>sunny</th>
</tr>
</thead>
</table>

To translate the f:\qa Controller directory to all load generator machines running /m/qa/lr_test2/lr_test2.usr on a UNIX platform, type:

<table>
<thead>
<tr>
<th>win</th>
<th>f:\qa</th>
<th>/m/qa</th>
<th>UNIX</th>
</tr>
</thead>
</table>

If the paths are not translated properly, the scenario will fail. For more information about path translation, see Appendix B, “Performing Path Translation.”

**Vuser Script:** Make sure that the Vuser script is accessible to all load generators participating in the scenario through path translation and permissions. View or run the Vuser script as a stand-alone on each of the participating load generators.

**Result Path:** Make sure that the result path is accessible to all load generators participating in the scenario through path translation and permissions. Check the permissions of the result directory files and modify them if necessary.
Failed Vusers or Transactions

LoadRunner Vusers or transactions may fail for a variety of reasons relating to the network, database, or actual script. You can find information about scenario runs from the following sources:

➤ Run View
➤ Output Window
➤ Output File (excluding GUI Vusers)
➤ Analysis Reports and Graphs

Run View

The Run view is part of the LoadRunner Controller. The Scenario Groups window in the top left-hand corner of the view indicates the status of the Vuser groups during and after the scenario run. During the scenario run, the columns will show a PENDING, INITIALIZING, READY, RUNNING, or RENDEZVOUS status. You can also view the status of each individual Vuser in the Vusers dialog box. If a Vuser fails and does not complete the script execution, LoadRunner displays an error status. If a Vuser completes the script execution, LoadRunner indicates the transaction status of a completed script run using the DONE.FAILED or DONE.PASSED status.
For more information about the Vuser states, see Chapter 13, “Running a Scenario.”

Output Window

View the Output window from the Controller. The output window contains useful information for debugging a scenario. The output window lists five types of messages: errors, warnings, notifications, debug, and batch. An error message usually results in a failed script. A warning message indicates that the Vuser encountered a problem, but test execution continued. A notification provides useful information such as recorded think time values and other run-time information. A debug message is sent if you enable the debugging feature in Tools > Options > Debug Information (Expert Mode).
Batch messages are sent instead of message boxes appearing in the Controller, if you are using automation.

For more information about the Output window, see Chapter 14, “Viewing Vusers During Execution.”

**Output File**

You can view information about script execution in an output file located in the Vuser result directory. The output file, `output.txt`, contains:

- a list of the primary functions called during the scenario
- error messages from the database server
- transactions and rendezvous information

The extent of the information sent to the output file depends on the output file settings. In the VuGen’s run-time settings, you specify a Brief or Extended log. For the Extended log, you can specify a full trace, returned data, or current parameter value. An extended log is helpful for debugging a script, but if you are not debugging, Extended log is not recommended as it introduces extra overhead. For more information about configuring run-time settings, refer to the *LoadRunner Creating Vuser Scripts User’s Guide*. 
Analysis Reports and Graphs

You can generate graphs and reports to view information about the scenario run. For example, the Scenario Summary report displays a table containing the scenario’s run-time data and provides links to the following graphs: Running Vusers, Throughput (Web), Hits Per Second (Web), HTTP Responses per Second, Transaction Summary, and Average Transaction Response Time.

For more information on the available graphs and reports, see the LoadRunner Analysis User's Guide.
Appendix D • Troubleshooting the Controller

Increasing the Number of Vusers on a Windows Machine

Under the normal settings of a Windows machine, you are limited to several hundred Vusers. This limitation is related to the operating system and not to the CPU or memory.

To work around the limitation of the Windows operating system, modify the Windows Kernel as follows:

1 Save a copy of the registry file in case you have trouble with these modifications.
2 Run Regedit.
3 Go to following key in KEY_LOCAL_MACHINE:
   System\CurrentControlSet\Control\Session Manager\SubSystems
4 Select the Windows key. The default Windows key for NT 4.0 looks like this:
   %SystemRoot%\system32\csrss.exe ObjectDirectory=\Windows
   SharedSection=1024,3072
   Windows=On SubSystemType=Windows ServerDll=basesrv,1
   ServerDll=winsrv:UserServerDllInitialization,3
   ServerDll=winsrv:ConServerDllInitialization,2
   ProfileControl=Off MaxRequestThreads=16

   The SharedSection=1024,3072 key has the format xxxx,yyyy where:
   xxxx defines the maximum size of the system-wide heap (in kilobytes)
   yyyy defines the size of the per desktop heap.
5 Increase the SharedSection parameter by changing the yyyy settings from 3072 to 8192 (which is 8 MB).

   This setup successfully allowed 1250 Oracle Vusers to run on a Windows machine using 2 Pentium PRO 200 MHz with 1 GB RAM.
   Each Vuser in this setup used approximately 2MB memory. Other Vusers may require more memory.
LoadRunner was able to load over 2500 Vusers when the Windows terminal server was run as the Operating System and the above registry setting was changed.

The above registry changes enable you to run more threads, allowing you to run more Vusers on the machine. This implies that you are not bound by the Windows operating system; you are only bound by hardware and internal scalability limitations.

**Troubleshooting Firewalls**

There are three log files which provide additional information about activity over the firewall.

The **LoadRunner agent log file** contains information about communication activity between the LoadRunner agent and the MI Listener.

➤ To open the file on Windows machines, right-click the LoadRunner agent icon in the system tray of the LoadRunner agent machine, and select View Log. Alternatively, open the latest `<temp_directory>\LoadRunner_agent_startup<unique identifier>.log` file (if the LoadRunner agent is a process), or `<temp_directory>\LoadRunner_agent_service<unique identifier>.log` file (if the LoadRunner agent is a service), in a text editor.

➤ To open the file on UNIX machines, open the `<temp_directory>/m_agent_daemon<unique identifier>.log` file in a text editor.

➤ To increase the logging level, select Agent Settings from Start->Programs->LoadRunner->Advanced Settings (or open file `<LR_root>\launch_service\dat\br_Inch_server.cfg` in a text editor), and in the Log section, set AgentExtended to 1.

The **MI Listener log file** contains information about MI Listener communication with the LoadRunner agent and the Controller.
To open the file, right-click the MI Listener Agent icon in the system tray of the MI Listener machine, and select View Log. Alternatively, open the latest <temp_directory>\LoadRunner_agent_startup<unique identifier>.log file (if the LoadRunner agent is a process), or <temp_directory>\LoadRunner_agent_service<unique identifier>.log file (if the LoadRunner agent is a service), in a text editor.

To increase the logging level, select Start > Programs > LoadRunner > Advanced Settings > Agent Settings, or open the <LR_root>\launch_service\dat\br_linch_server.cfg file in a text editor. In the Log section, set AgentExtended to 1.

The Controller log file contains information about communication activity between the Controller and the MI Listener.

To open the file on Windows machines, open the <temp_directory>\drv_log.txt file in a text editor.

**Verifying Connection Between LoadRunner Agent and MI Listener**

If there is a proper connection between the LoadRunner agent and the MI Listener:

➤ On Windows platforms, the agent icon’s light in the system tray will turn from red to green.

➤ On UNIX platforms, a file called <Local_machine_key>_connected_to_MI_Listener will be created in the temporary directory of the LoadRunner agent machine. Local_machine_key is the value set in the Agent Configuration, as described in Chapter 15, “Working with Firewalls.” The file will be removed when the LoadRunner agent disconnects from the MI Listener.

➤ On both UNIX and Windows platforms, the following message will appear in the LoadRunner agent log file: Notify Connected to MI Listener.
Note: The LoadRunner agent tries to connect to the MI Listener machine every Timeout seconds (as defined in the Agent Configuration). After a successful connection, if no Controller has connected through this MI Listener to the agent after another Timeout, the LoadRunner will disconnect from the Controller. On a Windows machine, the agent icon’s light in the system tray will turn from green to red. On UNIX machines, the file <Local_machine_key>_connected_to_MI_Listener will be removed from the temporary directory in the LoadRunner agent machine. In both Windows and UNIX, the message Disconnected from MI Listener will appear in the LoadRunner agent log file.

UNIX Connection Errors

After installing the m_agent_daemon as described in Chapter 15, “Working with Firewalls,” you should receive a message: m_agent_daemon installed successfully.

Agent Daemon Errors

ERROR: File m_agent_daemon doesn’t exist.

This error means that you are not in the same directory as the file (meaning not in <LR_root>/bin directory, or the file really doesn't exist, which indicates a problem with the installation).

WARNING: Could not install m_agent_daemon, reason - user <user_name> is already running m_agent_daemon on this machine.

This warning message occurs when a daemon of this name is already being run by the same user.

ERROR: Could not install m_agent_daemon. Check log file m_agent_daemon[xxx].log in your temp directory.

This error indicates that some error has occurred when loading the daemon. You should check the log file and consult the following troubleshooting tips.
Appendix D • Troubleshooting the Controller

LoadRunner Agent Log File Errors

Error - 10344 : Communication Error: -59961 : Failed to bind a socket while calling bind function.

Error -10344 : Communication Error: -59927 : Failed to create a TCP server for the HTTP channel's server.

Warning -29974 : Failed to create "router" server.

These messages appear because the LoadRunner agent always tries to open port number 443 (because any agent can be a MI Listener, and the MI Listener always listens to this port), and in UNIX machines, this port cannot be opened by any user except for the root user. However, this will not interfere with using this agent for the Load Generator machine.

Error -10343 : Communication error : -59981 : Failed to connect to remote host - <MI_Listener_name> .

The MI Listener is not being run at the time of the connection attempt on the machine set in MI Listener Name in the Agent Configuration.

Error -10343 : Communication error: -59928 : Unresolved server name .

The name passed in MI Listener Name in the Agent Configuration is not a name, full name or IP address of a valid machine, or no value was set.

Error -10343 : Communication error: -59928 : Unresolved server name .

The name passed in Proxy Name in the Agent Configuration is not a name, full name or IP address of a valid machine.

Error -10343 : Communication error: -59945 : Client failed to connect to a PROXY Server with the following settings:
(-server_port=<proxy_server_port>)(-server_fd_primary=2)(-server_type=8)(-allowed_msg_size=0)(-allowed_msgs_num=0)(-proxy_configuration_on)(-tcp_tunnel_configuration_on).

The Proxy Name field is empty.
Error -10343 : Communication error: -59982 : Failed to connect to remote host - <MI_Listener_Name>. The remote address is not a valid address.

Error -10343 : Communication error: -59945 : Client failed to connect to a PROXY Server with the following settings: (-server_name=<proxy_server_name>)(-server_port=<proxy_server_port>)(-server_fd_primary=2)(-server_type=8)(-allowed_msg_size=0)(-allowed_msgs_num=0)(-proxy_configuration_on)(-tcp_tunnel_configuration_on).

The Proxy Port set in Agent Configuration, has been set to the wrong port number.

Error -10343 : Communication error: -59913 : NTLM authentication to proxy server error - connection to proxy refused.

The proxy server is configured in for NTLM authentication and the Proxy User Name, Proxy Password and/or Proxy Domain are not set correctly in the Agent Configuration.

Error -10343 : Communication error: -59880 : Basic authentication to proxy server error - connection to proxy refused.

The proxy server is configured in for Basic authentication and the Proxy User Name and/or Proxy Password are not set correctly in the Agent Configuration.


This error occurs when you have set the Check Server Certificates setting to True, and have not issued a new certificate to the MI Listener machine (see Appendix H, "Working with Digital Certificates" for more details).


Error -10343 : Communication error: -59907 : SSL connect error : ss1v3 alert handshake failure.

Error -10343 : Communication error: -59907 : SSL connect error : ss1v3 alert bad certificate.
Appendix D • Troubleshooting the Controller


These errors occur when you set the Check Server Certificates setting to True. See Appendix H, “Working with Digital Certificates” to learn how to issue a valid certificate.


Error -10343 : Communication error: -59910 : SSL initialization error : No such file or directory.


These errors occur when the Client Certificate owner setting in the Agent Configuration is set to True, but no certificate was installed in the LoadRunner agent machine (see Appendix H, “Working with Digital Certificates” for more details).

MI Listener Log File Errors

Error -10344 : Communication Error: -59961 : Failed to bind a socket while calling bind function.

Error -10344 : Communication Error: -59927 : Failed to create a TCP server for the HTTP channel's server.

Warning -29974 : Failed to create "router" server.

This error means that another process on the MI Listener machine is occupying port 443 (for instance the IIS service).


These errors occur when you have set the Check Server Certificates setting to True, and the MI Listener's certificate is expired.

These errors occur when you have set the Check Server Certificates setting to True, and either:

➤ The MI Listener’s certificate does not have a signature that is included in the LoadRunner agent’s CA List.

➤ The MI Listener’s certificate has a future verification date.

See Appendix H, “Working with Digital Certificates” to learn how to issue a valid certificate and how to add a Certification Authority to a CA list, or how to create a certificate with a new validation date.

*Error -10343 : Communication error: -59904 : SSL accept error : peer did not return a certificate.*

These errors indicate that the Check Client Certificates setting in the MI Listener Configuration is set to True, but the Client Certificate owner setting in the Agent Configuration is set to False.

*Error -10343 : Communication error: -59904 : SSL accept error : no certificate returned.*

These errors indicate that the Check Client Certificates setting in the MI Listener Configuration is set to True, and the Client Certificate owner setting in the Agent Configuration is set to True, but either:

➤ The LoadRunner agent’s certificate does not have a signature that is included in the MI Listener’s CA List.

➤ The LoadRunner agent’s certificate has a future verification date.

See Appendix H, “Working with Digital Certificates” to learn how to issue a valid certificate and how to add a Certification Authority to a CA list, or how to create a certificate with a new validation date.

*Error -10343 : Communication error: -59904 : SSL accept error : no certificate returned.*

These errors indicate that the Check Client Certificates setting in the MI Listener Configuration is set to True, and the Client Certificate Owner setting in the Agent Configuration is set to True, but the LoadRunner agent’s certificate has expired.
Appendix D • Troubleshooting the Controller

General Connection Errors

These errors can occur when using all configurations.

If no errors appear both in the LoadRunner agent log, and the MI Listener log, but the agent does not connect to the MI Listener, make sure that the FireWallServiceActive attribute in the Firewall section in the <LR_Installation>\dat\br_inch_server.cfg file on the LoadRunner agent machine, is set to 1.

Verifying Connection Between the Controller and Agent through the MI Listener

When there is a successful connection between the LoadRunner agent and the MI Listener, and the Controller machine fails to connect, you should check the following:

➤ The Name field in the Load Generators dialog in the Controller should match the name set in the Local Machine Key in the Agent Configuration.

➤ The MI Listener field in the Load Generators > Details > Firewall tab of the above host matches the name set in the MI Listener Name in the Agent Configuration.

➤ In the Tools menu of the Controller, in the Options > Timeout tab, the Load Generator Connect timeout might need to be increased, because the Firewalls may slow down the communication.

➤ Make sure that the Controller machine recognizes the LoadRunner agent machine (e.g., by using the ping utility). If this fails, there is a configuration problem in the system not related to LoadRunner, and it must be solved before the connection can be made.

➤ Make sure that the Controller has successfully connected to the MI Listener by checking port 50500 on the MI Listener machine (you can use the netstat utility, on the MI Listener machine).
Working with Server Monitor Counters

When you configure the System Resource, Microsoft IIS, Microsoft ASP, ColdFusion, and SQL Server monitors, you are presented with a list of default counters that you can measure on the server you are monitoring. Using the procedure described below, you can create a new list of default counters by including additional counters, or deleting existing counters.

In addition, there are specific counters that are especially useful for determining server performance and isolating the cause of a bottleneck during an initial stress test on a server.

The following sections describe:

➤ Changing a Monitor’s Default Counters
➤ Useful Counters for Stress Testing

Changing a Monitor’s Default Counters

You can change the default counters for the System Resource, Microsoft IIS, Microsoft ASP, or SQL Server monitors by editing the res_mon.dft file found in the LoadRunner/dat directory.

To change the default counters:

1 Open a new scenario and click the Run tab.
2 For each of the monitors, select the counters you want to measure.
3 Save the scenario and open the scenario .lrs file with an editor.
4 Copy the MonItemPlus section of the each counter you selected into the res_mon.dft file.
5 Count the number of new counters in the file and update the ListCount parameter with this number.

**Useful Counters for Stress Testing**

Certain counters are especially useful for determining server performance and isolating the cause of a bottleneck during an initial stress test on a server.

The following is a list of counters that are useful for monitoring Web server performance:

<table>
<thead>
<tr>
<th>Object</th>
<th>Counter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web Service</td>
<td>Maximum Connections</td>
</tr>
<tr>
<td>Web Service</td>
<td>Bytes Total/sec</td>
</tr>
<tr>
<td>Web Service</td>
<td>Current NonAnonymous Users</td>
</tr>
<tr>
<td>Web Service</td>
<td>Current Connections</td>
</tr>
<tr>
<td>Web Service</td>
<td>Not Found Errors</td>
</tr>
<tr>
<td>Active Server Pages</td>
<td>Requests/sec</td>
</tr>
<tr>
<td>Active Server Pages</td>
<td>Errors/sec</td>
</tr>
<tr>
<td>Active Server Pages</td>
<td>Requests Rejected</td>
</tr>
<tr>
<td>Active Server Pages</td>
<td>Request Not Found</td>
</tr>
<tr>
<td>Active Server Pages</td>
<td>Memory Allocated</td>
</tr>
<tr>
<td>Active Server Pages</td>
<td>Requests Queued</td>
</tr>
<tr>
<td>Active Server Pages</td>
<td>Errors During Script Run Time</td>
</tr>
<tr>
<td>Memory</td>
<td>Page Faults/sec</td>
</tr>
<tr>
<td>Server</td>
<td>Total Bytes/sec</td>
</tr>
<tr>
<td>Process</td>
<td>Private Bytes/Inetinfo</td>
</tr>
</tbody>
</table>
The following is a list of counters that are useful for monitoring SQL Server performance:

<table>
<thead>
<tr>
<th>Object</th>
<th>Counter</th>
</tr>
</thead>
<tbody>
<tr>
<td>SQLServer</td>
<td>User Connections</td>
</tr>
<tr>
<td>SQLServer</td>
<td>Cache Hit Ratio</td>
</tr>
<tr>
<td>SQLServer</td>
<td>Net-Network Reads/sec</td>
</tr>
<tr>
<td>SQLServer</td>
<td>I/O-Lazy Writes/sec</td>
</tr>
<tr>
<td>SQLServer-Locks</td>
<td>Total Blocking Locks</td>
</tr>
<tr>
<td>PhysicalDisk</td>
<td>Disk Queue Length</td>
</tr>
</tbody>
</table>

The following is a list of counters that are useful for monitoring both Web and SQL server performance:

<table>
<thead>
<tr>
<th>Object</th>
<th>Counter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processor</td>
<td>% Total Processor Time</td>
</tr>
<tr>
<td>PhysicalDisk</td>
<td>% Disk Time</td>
</tr>
<tr>
<td>Memory</td>
<td>Available Bytes</td>
</tr>
<tr>
<td>Memory</td>
<td>Pool Nonpaged Bytes</td>
</tr>
<tr>
<td>Memory</td>
<td>Pages/sec</td>
</tr>
<tr>
<td>Memory</td>
<td>Committed Bytes</td>
</tr>
<tr>
<td>System</td>
<td>Total Interrupts/sec</td>
</tr>
<tr>
<td>Object</td>
<td>Threads</td>
</tr>
<tr>
<td>Process</td>
<td>Private Bytes:_Total</td>
</tr>
</tbody>
</table>

Note: The % Disk Time counter requires that you run the diskperf -y utility at the command prompt and reboot your machine.
Configuring Multiple IP Addresses

When you run a scenario, the Vusers on each load generator machine use the machine’s IP address. You can define multiple IP addresses on a load generator machine to emulate a real-life situation in which users sit on different machines.

This appendix describes:

- Adding IP Addresses to a Load Generator
- Using the IP Wizard
- Configuring Multiple IP Addresses on UNIX
- Updating the Routing Table
- Enabling Multiple IP Addressing from the Controller

The multiple IP address feature is applicable to the Web and WinSocket protocols. This feature can be implemented on Windows and UNIX platforms.

About Multiple IP Addresses

Application servers and network devices use IP addresses to identify clients. The application server often caches information about clients coming from the same machine. Network routers try to cache source and destination information to optimize throughput. If many users have the same IP address, both the server and the routers try to optimize. Since Vusers on the same load generator machine have the same IP address, server and router optimizations do not reflect real-life situations.
LoadRunner’s multiple IP address feature enables Vusers running on a single machine to be identified by many IP addresses. The server and router recognize the Vusers as coming from different machines and as a result, the testing environment is more realistic.

### Adding IP Addresses to a Load Generator

LoadRunner includes an IP Wizard program that you run on each Windows NT or Windows 2000 load generator machine to create multiple IP addresses. You add new IP addresses to a machine once and use the addresses for all scenarios. For information about adding IP addresses on UNIX machines, see “Configuring Multiple IP Addresses on UNIX” on page 563.

The following procedure summarizes how to add new IP addresses to a load generator:

1. Run the IP Wizard on the load generator machine to add a specified number of IP addresses. Manually configure the new IP addresses for UNIX load generator machines.
2. Restart the machine.
3. Update the server’s routing table with the new addresses, if necessary.
4. Enable this feature from the Controller. Refer to “Enabling Multiple IP Addressing from the Controller” on page 565.

### Using the IP Wizard

The IP Wizard resides on each load generator machine. You run this process once to create and save new IP addresses on Windows machines. The new addresses can be a range of addresses defined by the Internet Assignment Numbers Authority. They are for internal use only, and cannot connect to the Internet. This range of addresses is the default used by the IP Wizard.
Appendix F • Configuring Multiple IP Addresses

To add new IP addresses to a load generator machine:

1. Invoke the IP Wizard from the LoadRunner program group.

2. If you have an existing file with IP address settings, select **Load previous settings from file** and choose the file.

3. If you are defining new settings, select **Create new settings**.

4. Click **Next** to proceed to the next step. If you have more than one network card, choose the card to use for IP addresses and click **Next**.
The optional Web server IP address step enables the IP Wizard to check the server’s routing table to see if it requires updating after the new IP addresses are added to the load generator.

5 To check the server’s routing table directly after adding the addresses, enter the server IP address. Refer to “Updating the Routing Table” on page 564 for more information.

6 Click Next to see a list of the machine’s IP address(es). Click Add to define the range of addresses.
Appendix F • Configuring Multiple IP Addresses

IP addresses include two components, a *netid* and *hostid*. The submask determines where the netid portion of the address stops and where the hostid begins.

7 Select a class that represents the correct submask for the machine's IP addresses.

8 Specify the number of addresses to create. Select **Verify that new IP addresses are not already in use** to instruct the IP Wizard to check the new addresses. The IP Wizard will only add the addresses not in use.

9 Click **OK** to proceed.

After the IP Wizard creates the new addresses, the summary dialog box lists all of the IP addresses.

![IP Wizard - Step 3 of 3](image)
10 Click **Finish** to exit the IP Wizard. The IP Wizard Summary dialog box is displayed.

![IP Wizard Summary](image)

11 Note the address of the `.bat` file, and see “Updating the Routing Table” on page 564 for information about using the batch file to update the routing table, if necessary.

12 After you update the routing table, check **Reboot now to update routing tables** to initialize the NT device drivers with the new addresses.

13 Click **OK**.
Appendix F • Configuring Multiple IP Addresses

Configuring Multiple IP Addresses on UNIX

To configure multiple IP addresses on UNIX, manually configure the addresses on the load generator machine.

Solaris 2.5, 2.6, 7.0, 8.0

To configure the hme0 device to support more than one IP address:

1. Create entries in /etc/hosts for each hostname on your physical machine:
   
   128.195.10.31 myhost
   128.195.10.46 myhost2
   128.195.10.78 myhost3

2. Create /etc/hostname.hme0:n files that contain the hostname for the virtual host n. Note that hostname.hme0:0 is the same as hostname.hme0.

   /etc/hostname.hme0 (Contains name myhost)
   /etc/hostname.hme0:1 (Contains name myhost2)
   /etc/hostname.hme0:2 (Contains name myhost3)

   The above changes will cause the virtual hosts to be configured at boot time.

3. You can also directly enable/modify a logical hosts configuration by running `ifconfig` directly on one of the logical hosts, using the hme0:n naming scheme:

   % ifconfig hme0:1 up
   % ifconfig hme0:1 129.153.76.72
   % ifconfig hme0:1 down

   To verify the current configuration, use `ifconfig -a`.

Linux

To define multiple IP addresses for a single Ethernet card, you need IP Aliasing compiled into the kernel. To do this, use the `ifconfig` command:

/sbin/ifconfig eth0:0 x.x.x.x netmask 255.255.x.x up
Substitute the new IP address for x.x.x.x, and insert the correct information for subnet mask. Place this command in the `rc.local` file so that it executes upon boot.

**HP 11.0 or higher**

To define multiple IP addresses for a single Ethernet card, you need IP Aliasing compiled into the kernel. To do this, use the `ifconfig` command:

```
/sbin/ifconfig lan1:0 x.x.x.x netmask 255.255.x.x up
```

Substitute the new IP address for x.x.x.x, and insert the correct information for subnet mask. Place this command in the `rc.local` file so that it executes upon boot.

**Updating the Routing Table**

Once the client machine has new IP addresses, the server needs the addresses in its routing table, so that it can recognize the route back to the client. If the server and client share the same netmask, IP class, and network, the server’s routing table does not require modification.

**Note:** If there is a router between the client and server machines, the server needs to recognize the path via the router. Make sure to add the following to the server routing table: route from the Web server to the router, and routes from the router to all of the IP addresses on the load generator machine.
To update the Web server routing table:

1. Edit the batch file that appears in the IP Wizard Summary screen. An example .bat file is shown below.

   ```bash
   REM This is a bat file to add IP addresses to the routing table of a server
   REM Replace [CLIENT_IP] with the IP of this machine that the server already recognizes
   REM This script should be executed on the server machine
   route ADD 192.168.1.50 MASK 255.255.255.255 [CLIENT_IP] METRIC 1
   route ADD 192.168.1.51 MASK 255.255.255.255 [CLIENT_IP] METRIC 1
   route ADD 192.168.1.52 MASK 255.255.255.255 [CLIENT_IP] METRIC 1
   route ADD 192.168.1.53 MASK 255.255.255.255 [CLIENT_IP] METRIC 1
   route ADD 192.168.1.54 MASK 255.255.255.255 [CLIENT_IP] METRIC 1
   ```

2. For each occurrence of [CLIENT_IP], insert your IP address instead.

3. Run the batch file on the server machine.

**Enabling Multiple IP Addressing from the Controller**

Once you define multiple IP addresses, you set an option to tell the Controller to use this feature.

**To enable multiple IP addressing from the Controller:**

1. In the Controller Design view, select Scenario > Enable IP Spoofing.

   **Note:** You must select this option before connecting to a load generator.

2. Use the **General Options** of the Controller Expert Mode to specify how the Controller should implement this feature.

   For more information, refer to Appendix C, “Working in Expert Mode.”
Controller Command Line Arguments

When you invoke the Controller from the command line, you can pass arguments to instruct the Controller how to behave. By passing arguments in the command line, you configure Controller scenario settings without the need to manually define them using the Controller UI.

This appendix describes:

➤ Invoking the Controller from the Command Line
➤ TestDirector Arguments
➤ Run-Time Arguments

About Controller Command Line Arguments

When invoked, the Controller checks all of the received arguments and sets its start-up environment accordingly. If no arguments are passed, the Controller uses its default settings.

For example, you can instruct Controller to Connect to TestDirector on start-up, save results to a directory other than the directory defined in the scenario, and invoke Analysis upon scenario termination.

Invoking the Controller from the Command Line

To invoke the Controller, type wlrn in the command line, followed by the arguments. Each argument should be preceded by a dash. Note that the arguments are case-sensitive. For example:

```
wlrun -TestPath C:\LoadRunner\scenario\Scenario.lrs -Run
```
When you invoke the Controller from the command line, the following rules apply:

➤ If the Controller is invoked with no arguments in the command line, the Controller uses its default settings.
➤ The Controller will always overwrite results.
➤ The Controller will automatically terminate upon scenario termination and results will be then collated.
➤ The Controller’s settings are loaded from wlrun5.ini, located in Windows directory.

**TestDirector Arguments**

These arguments define the LoadRunner integration with TestDirector. For more information about the LoadRunner TestDirector integration, refer to Chapter 12, “Managing Scenarios Using TestDirector.”

- **ConnectToTD**: Specifies whether the Controller should connect to TestDirector on startup (0/1 or ON/OFF)
- **TDServer**: TestDirector server name. Must be a machine where TestDirector is installed
- **TDDB**: TestDirector database name, for example, "lrun"
- **UserName**: User name for connecting to TestDirector
- **Password**: Password corresponding to the user name
- **TestPath**: Path to scenario in TestDirector database. For example, "[TD]\Subject\LoadRunner\Scenario1"
  If path includes blank spaces, use quotation marks.
- **TestId**: Test ID (used by TestDirector only)
- **ResultCleanName**: For use with **ResultCycle** only. Example: "Res1"
- **ResultCycle**: TestDirector cycle. For example, "LR_60_SP1_247"

**Note**: The **ResultCycle** and **ResultCleanName** arguments are required if you wish to store the results within the TestDirector database.
### Run-Time Arguments

These arguments specify the run-time related scenario settings. For more information on scenario settings, refer to Chapter 11, “Preparing to Run a Scenario.”

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TestPath</strong></td>
<td>Path to the scenario, for example, C:\LoadRunner\scenario\Scenario.lrs. This argument can also be used for a scenario residing in a TestDirector database. For example, &quot;[TD]\Subject\LoadRunner\Scenario1&quot;. If the path includes blank spaces, use quotation marks.</td>
</tr>
<tr>
<td><strong>Run</strong></td>
<td>Runs the scenario, dumps all output messages into res_dir\output.txt and closes Controller</td>
</tr>
<tr>
<td><strong>InvokeAnalysis</strong></td>
<td>Instructs LoadRunner to invoke Analysis upon scenario termination. If this argument is not specified, LoadRunner uses the scenario default setting.</td>
</tr>
<tr>
<td><strong>ResultName</strong></td>
<td>Full results path. For example, &quot;C:\Temp\Res_01&quot;</td>
</tr>
<tr>
<td><strong>ResultCleanName</strong></td>
<td>Results name. For example, &quot;Res_01&quot;</td>
</tr>
<tr>
<td><strong>ResultLocation</strong></td>
<td>Results directory. For example, &quot;C:\Temp&quot;</td>
</tr>
</tbody>
</table>

**Note:** If the scenario doesn’t specify a results directory, and one of the results arguments was not passed, the scenario will not run.
Working with Digital Certificates

A Digital Certificate is an electronic “credit card” that establishes your credentials when doing business or other transactions on the Web. It is issued by a Certification Authority (CA). It contains the IP address of the machine for which it was issued, a validation date, and the digital signature of the certificate-issuing authority.

This appendix describes:

➤ Using Digital Certificates with Firewalls
➤ Creating and Using Digital Certificates

Using Digital Certificates with Firewalls

When the MI Listener sends its Public Key to the LoadRunner agent, it always sends its certificate as well (this is the server-side certificate). The LoadRunner agent can be configured to authenticate the certificate which it received, as described in Chapter 15, “Working with Firewalls.” If the agent is configured to authenticate the certificate, it can verify whether the sender is really the machine that it claims to be by:

➤ Comparing the certificate’s IP address with the sender’s IP address.
➤ Checking the validation date.
➤ Looking for the digital signature in its Certification Authorities list.

The MI Listener may also require the LoadRunner agent to send a certificate at any point in the session. This is called the client-side certificate, as described in the MI Listener Configuration Settings in Chapter 15, “Working with Firewalls.” If the LoadRunner agent owns a certificate, it sends it to the
MI Listener for the same authentication process. If the LoadRunner agent
does not own a certificate, the communication might not be continued.

An SSL CA list and an SSL Certificate are included in each LoadRunner
installation. This certificate is the same for all LoadRunner installations,
which means that it can be obtained by third parties. Therefore, if you are
interested in a more secure process, you should create your own Certificate
Authority and include it in the list, and issue matching certificates for your
machines.

**Creating and Using Digital Certificates**

You create a Certification Authority using the gen_ca_cert.exe (on UNIX
platforms gen_ca_cert) utility, and a Digital Certificate using the
gen_cert.exe (on UNIX platforms gen_cert) utility. Both utilities can be used
on UNIX and Windows platforms, using a command-line interface.

**To creating a Certificate Authority using gen_ca_cert:**

1. To view the format and usage, run the `gen_ca_cert` utility from the
   `<LoadRunner root folder>\Launch_server\bin` directory.

   ```plaintext
   gen_ca_cert
   Usage: gen_ca_cert [option] <value> ...
   -install <File name to install>
   -install_add <File name to install>
   -country_name <Country Name>
   -organization_name <Organization Name>
   -common_name <Common Name>
   -cert_file_name <CSR Certificate File Name, Default: cacert.cer>
   -pub_key_file_name <Public Key File Name, Default: capvk.cer>
   -not_valid_before <Date> <end_date> <end_date>
   -not_valid_after <start_date> <end_date>
   ```

2. Create a new Certificate Authority by running the `gen_ca_cert` command
   with at least one of the options: `-country_name <country name>
   -organization_name <organization name>` and `-common_name <the name of
   the CA>.

   This process creates two files in the directory from which the utility was run:
   the CA Certificate (cacert.cer), and the CA Private Key (capvk.cer). To
Appendix H • Working with Digital Certificates

provide different file names, use the -CA_cert_file_name and the -CA_pk_file_name options respectively.

By default, the CA is valid for three years, from the time that the CA is generated. To change the validation dates, use the options -nb_time <beginning of validity in dd/mm/yyyy format> and/or -na_time <ending of validity in dd/mm/yyyy format>.

The following example creates two files: ca_igloo_cert.cer and ca_igloo_pk.cer in the current directory:

3 To install this CA, use the -install <name of certificate file> option. This option replaces any previous CA list and creates a new one that includes only this CA.

To add the new CA to the existing CA list, use the -install_add <name of certificate file>.

4 The -install and -install_add options install the certificate file only. Keep the private key file in a safe place and use it only for issuing certificates.
To create a Digital Certificate using `gen_cert`:

1. To view the format and usage, run the `gen_cert` utility from the `<LoadRunner root folder>\launch_service\bin` directory.

2. Create a new Digital Certificate by running the `gen_cert` command with at least one of the options: `-country_name <country name>`, `-organization_name <organization name>`, `-organization_unit_name <organization unit name>`, `-eMail <email address>` and `-common_name <the name, full name or IP address of the machine>`.

   The CA Certificate and the CA Private Key files are necessary for the creation of the certificate. By default, it is assumed that they are in the current directory, and are named `cacert.cer` and `capvk.cer` respectively. In any other case, use the `-CA_cert_file_name` and `-CA_pk_file_name` options to give the correct files and locations.

   In this process, the certificate file is created in the directory from which the utility was run. By default, the file name is `cert.cer`. To provide a different name, use the `-cert_file_name` option.

   By default, the CA is valid for three years, from the time that the CA is generated. To change the validation dates, use the `-nb_time <beginning of validity in dd/mm/yyyy format>` and/or `-na_time <ending of validity in dd/mm/yyyy format>` options.
Appendix H • Working with Digital Certificates

The following example creates the `igloo_cert.cer` file in the current directory:

```bash
$ gen_cert <name of certificate file>
```

If you wish to install this certificate, use the `-install <name of certificate file>` option. This option replaces any previous certificate, as it is possible to own only one certificate per machine.
Index

A
Acrobat Reader xi
activating rstatd 281
Add Destination Machines for Network Delay Monitoring dialog box 308
Add Group dialog box 52
Add Load Generator dialog box 60
Add Machine dialog box
   DB2 monitor 407
Add Oracle Measurements dialog box 425
Add SAP Monitor Measurements dialog box 450
Add Script dialog box 104
Add Sybase Measurements dialog box 433
Add TUXEDO Measurements dialog box 286
Add Vusers dialog box 58
adding measurements 240
agent
daemon 536
defined 7
settings 520
summary window 189
Antara FlameThrower
   monitor 289–301
Apache
   Add Measurements dialog box 320
   monitor 320
application
   analyzing 20–22
   configuration 21
   usage model 22
Ariba
   monitor 336
   Monitor Configuration dialog box 336
ASP
   monitor 361
ATG Dynamo
   monitor 340
   Resources dialog box 340
B
BEA WebLogic
   monitor 376
   Monitor Configuration dialog box 378
Books Online xi
BroadVision
   monitor 346
   Monitor Configuration dialog box 348
C
CA 571
Check Point FireWall-1
   monitor 315
   SNMP Resources dialog box 315
ColdFusion
   dialog box 356
   monitor 356
collating scenario results 145
command line
   arguments 567
   options, Vuser script 79
configuring
   load generator 59–61
   load generator settings 62–77
   scenario 133–140
   script 78–81
   script (goal-oriented scenario) 104–108
   script (Percentage Mode) 88–91
   Vusers 56
connecting to database 537
to TestDirector 150
Connection Log tab 527
Context Sensitive Help xii
Controller 38
  defined 6
  invoking 35
  managing scenario files 42
  overview 38
  quick tour 35–46
  running from the command line 567
Controller window
  Design view 40
  icon bar 40
  menu bar 38
  Output window 40
  Run view 40
  Status bar 38
  title bar 38
  Toolbar 38
controller_host 515
controller_path 516
converting a scenario
  to Percentage mode 84
  to Vuser Group mode 91
counters, for stress testing 554
creating
  goal-oriented scenario 93–108
  manual scenario 49–82
  manual scenario in Percentage Mode 83–91
  Vuser groups 50–55
  Vuser scripts 16
cross result analysis, naming result sets 142
custom queries
  Oracle monitor 428

D
Data Points graph (online) 257
database
  connecting to 537
Database Server Resource monitors 405–439
  DB2 monitor 406
  Oracle monitor 423
  SQL Server monitor 429
  Database Server Resource monitors (cont’d)
    Sybase monitor 432
DB2
  monitor 406
  Monitor Configuration dialog box 407
debug
  information settings 522
  level 217
default counter, changing 553
Details button 185
digital certificate
  agent configuration settings 201
  MI Listener configuration settings 204
  overview 571
disabling
  Vuser groups 54
  Vuser scripts (goal-oriented) 108
  Vuser scripts (manual scenario) 91
disconnecting from TestDirector 152
documentation set xii
Done.Failed - Vuser state
  Scenario Groups window 178
Done.Passed - Vuser state
  Scenario Groups window 178
Down - Vuser state
  Scenario Groups window 178
Duration 115

E
Edit Scenario Goal dialog box 97
  Load Behavior tab 97
  Load Preview 97
  Scenario Settings tab 97
EJB
  monitor 456–471
  Monitor Configuration dialog box 469
ERP Server Resource monitors 449–454
Error - Vuser state
  Running Vusers graph 256
  Scenario Groups window 178
error handling 217
Error Statistics graph 256
Ethernet-bus based network 505
Execution Notes dialog box 188
Exiting - Vuser state
Scenario Groups window 178

Expert mode 519–528
agent settings 520
connecting to UNIX load generator 527
debug settings 522
general settings 521
monitor settings 525
output settings 523

F
files, Vuser script 80
Finished - Vuser state
Running Vusers graph 256
firewalls
configuring agent to operate over firewall 200
Firewall Server monitors 315–318
installation configurations 192
installing MI_Listener 203
monitors over 231–241
network monitoring 311
preparing for data collection 237
running Vusers 191–206
troubleshooting 544
Fujitsu INTERSTAGE
monitor 359
SNMP Resources dialog box 359
Function Reference xi

G
goal-oriented scenario 93–108
assigning load generators to scripts 102
assigning percentage of target to scripts 102
defining goals 96
Select Scenario Type 36
Gradual Exiting - Vuser state
Scenario Groups window 178
Graph Configuration dialog box 221
graph time 220
graphs, See online graphs
Group Information dialog box 55
GUI Vusers, defined 9

H
hardware
checking communications 530
selecting for testing 28–30
Hits per Second graph 264
hme0 device 563
hostid, IP address component 561
Hostinfo utility 532
hosts file 533
HP, configuring IP addresses 564
HTTP
Response per Second graph 265

I
IIS
monitor 323
increasing number of Vusers 543
initialization quota 66
Initialize 169
Initializing - Vuser state
Scenario Groups window 178
installing
LoadRunner, See the LoadRunner Installation Guide
Monitors over Firewall 232
interpreting online graphs 509–512
invoking the Controller 35
IP addresses
adding to a load generator 558
class 561
configuring multiple 557–565
configuring on HP 564
configuring on Linux 563
configuring on Solaris 563
enabling from the Controller 565
hostid 561
IP Wizard 558
load generator machine 557
netid 561
submask 561
IP Spoof er 521
LoadRunner Controller User's Guide

iPlanet (NAS)
   monitor 330

iPlanet (SNMP)
   dialog box 330

iPlanet/Netscape
   Add Measurements dialog box 326
   monitor 325

J
Java
   Java Performance monitors 455–498
JProbe
   dialog box (monitor) 473
   monitor 472–474

L
Linux
   configuring IP addresses 563
lists 16
   load generator list 59–61
   rendezvous list 123–131
   script list 78–81
   script list (goal-oriented scenario) 104–108
   script list (Percentage Mode) 88–91
   sorting 56
   Vuser group list 50–55
load balancing 103
load generator configuration
   checking Controller communication 531
   connecting load generators 60
   disabling load generators 60
   disconnecting load generators 60
   enabling load generators 60
   Expert mode 526
   firewall 68
   initializing quota 66
   limiting of Vusers 67
   run-time files 63
   selecting load generators 58
   UNIX shell 64
   WAN emulation 70

Load Generator Information dialog box 62
   Firewall tab 68
   Run-Time File Storage tab 63
   Run-Time Quota tab 66
   Status tab 62
   Unix Environment tab 64
   Vuser Limits tab 67
   Vuser Status tab 69
   WAN Emulation Advanced options 73
   WAN Emulation tab 71
load generators 6
   adding 61
   adding an IP address 558
   balancing 103
   configuration 59–61
   defined 6
   modifying 61
   multiple IP addresses 521
   selecting 58
   selecting (Percentage Mode) 86
   setting attributes 62–77
   viewing load generator details 60
Load Generators window 60
load testing, defined 3
LoadRunner
   application testing 3
   emulating human users with Vusers 5
   implementation planning 25
   overview 3–13
   testing process, See testing process
   working with LoadRunner 6
lr_user_data_point 257

M
manual scenario
   creating 49–82
   defined 36
   Percentage Mode 83–91
Measurement Configuration dialog box
   Configuration tab 228
   Description tab 228
measurement frequency, setting 241
Media Player Client
   monitor 447
Index

MI_Listener 203
   installing 237
Microsoft
   ASP monitor 361
   IIS monitor 323
middleware
   response time measurements 26
   system configuration 21
monitors
   database server resources 405–439
   ERP Server Resources 449–454
   Firewall Server 315–318
   Java Performance 455–498
   network 303–313
   online 209–212
   run-time 256
   streaming media 441–447
   system resources 271–301
   transaction 258
   Web application server resources
      335–403
   Web resources 263–269
   Web server resources 319–329
monitors over firewall 231–241
   adding and removing measurements
      240
   configuring measurement frequency
      241
   configuring properties 238
   installing 232
   installing MI_Listener 237
   overview 232
   preparing for data collection 237
MS
   Active Server Pages dialog box 361
   IIS dialog box 323
   SQL Server dialog box 429
multiple IP addresses 521
   connecting to Controller 534
   enabling 521

N
   naming results 142
   netid, IP address component 561

Network
   Breakdown dialog box 313
   Delay Time dialog box 308
   Delay Time graph 312
   Monitor Settings for Defined Path
dialog box 308
   Network Delay options 221
   Network monitor 303–313
      configuring 308
      determining bottlenecks 304
      monitoring over a firewall 311
      on UNIX 305
      overview 303
   network segment delay, viewing 313
   New Monitored Server Properties dialog box 238
   New Scenario dialog box 36

O

online graphs 219
   configuring 219
   customizing display view 216
   data point 257
   exporting 229
   interpreting 509–512
   merging two graphs 223
   modifying a measurement scale 226
   opening graphs 214
   remote monitoring 243
   sampling rate 217
   viewing data offline 229
   x-axis style 220
   y-axis style 220
online monitors 209–212
   changing default counters 553
   configuring graphs 219
   configuring measurements 225
   debugging 217
   display type 220
   error handling 217
   graph time 220
   graphs 224
   interpreting online monitoring
      graphs 509
   line color 225
online monitors (cont’d)
  pausing 225
  show/hide lines 227
  starting 212
  viewing data offline 229
online transaction monitoring
  adding transactions 260
  graphs 258
  setup 259
online Web server resource monitoring
  using a proxy server 333
Open a New Graph dialog box 215
Open Scenario from TestDirector project
dialog box 153
Options dialog box
  Agent tab 520
  Debug Information tab 523
  General tab 521
  Output tab 524
  Path Translation Table tab 516
  Run-Time File Storage tab 139
  Run-Time Settings tab 135
  Timeout tab 137
  Web Page Breakdown tab 261
Oracle
  custom queries 428
  Logon dialog box 425
  monitor 423
Oracle9iAS HTTP
  monitor 363
  Server Monitor Configuration dialog box 364
output
  settings 523
output file 541
Output window 183–186
  clearing 185
  debugging information 540
  drilling down on log information 185
  filtering messages 184
  refreshing 186
  saving messages to a file 185
  sorting messages 184
  viewing 40
  viewing message detail 185
Overlay Graphs dialog box 223

P
packets 304
Pages Downloaded per Second graph 267
path translation 513
  debugging file locations 537
  defined 513
  editing the Path Translation Table 516
  examples 518
  scenario configuration 140
  script path 82
  using the Path Translation Table 515
pausing
  monitors 225
  Vusers 170
Pending - Vuser state
  Scenario Groups window 178
Percentage Mode
  creating a scenario 83–91
Percentage mode
  assigning load generators to scripts 86
  assigning percentage of total Vusers to scripts 86
  converting a scenario to Percentage Mode 84
  converting to Vuser Group mode 91
  defining the total number of Vusers 84
performance analysis, defined 6
performance measurement scope 25
planning load tests 19–33
Proxy Server 333

R
Ramp Down 116
Ramp Up 114
Ready - Vuser state
  Running Vusers graph 256
  Scenario Groups window 178
Real Server dialog box 444
RealPlayer
  Client monitor 446
  Server monitor 444
Refresh button 79
registry, modifying 543
relative script paths 81
Remote Agent Dispatcher (Process) 7
Remote Performance monitoring 243–254
  configuring graph measurements 253
  configuring graph settings 250
  connecting to the monitor 245
  installing the monitor 244
  refreshing graphs 252
  scaling graphs 250
  selecting graphs 247
  viewing online graphs 247
remote_host 516
remote_path 516
removing measurements 240
rendezvous 123–131
  attributes 124
  defined 5
  disabling Vusers 129
  enabling Vusers 129
  information 131
  manually releasing Vusers 171
  overview 123
  setting release policy 128
  setting the attributes 125
  setting timeout policy 128
Vuser state 178
Rendezvous Information dialog box 131
renumbering Vusers 170
response time measurement
  end-to-end 25
  GUI 26
  middleware-to-server 26
  network and server 25
  server 26
results 142
  collating 145
  directory file structure 144
  files for debugging 537
  location in TestDirector project 156
  naming 142
  specifying location for 142
Retries per Second graph 268
routing table 564
rsh
  checking Controller connection 534
  connection for UNIX network monitor 306
rsh (cont’d)
  running UNIX without 535
rstatd process
  activating 281
  resource monitors 281
RTE Vuser scripts
  in the Controller 12
Run/Stop Vusers dialog box 172
Running - Vuser state
  Running Vusers graph 256
  Scenario Groups window 178
  running over firewall 191–206
Run-Time graphs 255–260
  interpreting 509
Run-Time settings 89
  in the Controller 106
  setting in the Controller 78
Run-Time Viewer
  view replay from Controller 169
S
  sampling rate 217
SAP
  monitor 450
    Monitor Logon dialog box 450
  Save Scenario to TestDirector project dialog box 154
scenario
  closing 43
  collating results 145
  configuring 133–140
  conversion to Percentage mode 84
  conversion to Vuser Group mode 91
  creating a goal-oriented scenario 93–108
  creating a manual scenario 49–82
  creating a manual scenario in Percentage Mode 83–91
  creating a new scenario 42
  defined 5
  defining scenario goals 96
  goal-oriented scenario defined 36
  managing scenario files 42–43, 44
  manual scenario defined 36
  opening 42

583
scenario (cont’d)
  opening from TestDirector 153
  overview 50
  overview of running 44–46
  preparing to run 141–147
  result directory 144
  running 163–171
  saving 43
  saving to TestDirector 154
  Scenario Goal window 96
  Scenario Scripts window 96
  Scenario Start dialog box 111
  scheduling 113
  summary information 147
  viewing output messages 183
scenario configuration
  path translation 140
  run-time file location 138
  run-time settings 134
  specifying results location 142
  timeout intervals 135
scenario execution 163–171
  activating additional Vusers 172
  controlling individual Vuser groups 166
  controlling individual Vusers 169
  delaying 111, 113
  limiting duration 113
  loading Vuser groups 166
  loading Vusers 170
  manually releasing Vusers from a rendezvous 171
  messages 183
  monitoring active Vusers 178
  overview 44–46, 163
  pausing Vuser groups 167
  running scenarios unattended 165
  running Vuser groups 167
  stopping Vuser groups 168
Schedule Builder 109–121
  creating a schedule 112
  deleting a schedule 113
  modifying a schedule 112
  renaming a schedule 113
  scenario execution 113
Schedule Builder dialog box 113
  Schedule Builder (cont’d)
    selecting a schedule 112–121
    Vuser groups 117
Schedule Definition dialog box
  Duration tab 115
  Ramp Down tab 116
  Ramp Up tab 114
Schedule Definition dialog box (Group)
  Duration tab 119
  Ramp Down tab 120
  Ramp Up tab 118
  Start Time tab 117
Script Information dialog box 105
  script paths, relative 81
  scripts, See Vuser scripts
server monitors
  adding and removing measurements 240
  configuring properties 238
  setting a measurement frequency 241
Server Monitors dialog box 238
server routing table 564
Set Results Directory dialog box
  local or remote location 143
  TestDirector project 156
settings
  agent 520
  debug 522
  general 521
  load generator 62–77
  measurement frequency 241
  monitors 525
  output 523
  timeout 135
show/hide a measurement
  online monitors 225
  Transaction monitor 227
SilverStream
  Add Measurements dialog box 369
  monitor 369
SiteScope
  monitor 301
Sitraka JMitor 475–494
  Monitor Configuration dialog box 489
SNMP
  Resources monitor 282–284
SNMP Resources
dialog box 282
Solaris
  configuring IP addresses 563
  sorting
    Vuser groups 56
SQL Server
dialog box 429
  monitor 429
SSL
  agent configuration settings 201
  MI Listener configuration settings 204
  overview 571
Status bar 38
Stopped - Vuser state
  Scenario Groups window 178
stopping
  Vuser groups 168
  Vusers 169
Streaming Media monitors 441–447
  Media Player Client monitor 447
  RealPlayer Client monitor 446
  RealPlayer Server monitor 444
  Windows Media Server monitor 442
Summary Information dialog box 147
Support Information xii
Support Online xii
Sybase
  Logon dialog box 433
  monitor 432
System Resource monitors 271–301
  Antara FlameThrower monitor 289–301
  SiteScope monitor 301
  SNMP Resources monitor 282–284
  TUXEDO monitor 285–289
  UNIX Resources monitor 278–280

T
TCP/IP setup 532
test objectives
  defining 23–24
  summary of common objectives 31–33
TestDirector
  adding Vuser scripts 157
  command line arguments 568
  connecting to 150
  disconnecting from 152
  integration 149–159
  managing scripts 149
  opening a scenario 153
  saving results to TestDirector 156
  saving scenarios to TestDirector 154
TestDirector Connection dialog box 150
testing process
  analyzing test results 18
  creating the scenario 16
  creating the Vuser scripts 16
  monitoring a scenario 18
  planning the test 16
  running the scenario 17
Throughput graph 264
timeout
  Controller settings 135
Toolbar 38
Total Transactions per Second (Passed) graph 258
TowerJ
  monitor 494–498
  Monitor Configuration dialog box 494
Transaction monitor 255–260
  transactions 5
    deciding which to define 27
    defined 5
    failed 539
  Transaction Response Time graph 258
  Transactions dialog box 180
  Transactions per Second (Failed, Stopped) graph 258
  Transactions per Second (Passed) graph 258
troubleshooting
  Controller 529–551
  firewalls 544
  monitors 499–506
  network considerations 504
TUXEDO
  monitor 285–289
  monitor measurements 288

U
UNIX
  activating rstatd 281
  connection to load generator 527
  Resources monitor 278–280
  rsh 534
  shell 534
  without rsh 535
Unix Kernel Statistics dialog box 278
User-Defined Data Points graph 257

V
viewing Vusers 177–189
  agent summary 189
  Output window 183
  overview 177
Virtual users, See Vusers
Vuser
  group list 50–55
Vuser groups
  adding Vusers to 58
  creating 50–55
  deleting 54
  enabling/disabling 54
  loading 166
  modifying 54
  pausing 167
  running 167
  scheduling 117
  sorting 56
  stopping 168
Vuser scripts 5
  adding (goal-oriented scenario) 104
  adding (Percentage Mode) 88
  adding from TestDirector 157
Vuser scripts (cont’d)
  assigning load generators to (goal-oriented scenario) 102
  assigning load generators to (Percentage mode) 86
  assigning percentage of defined target to (goal-oriented scenario) 102
  assigning percentage of total Vusers to (Percentage mode) 86
  command line options 79
  configuring 78–81
  creating 16
  defined 5
  deleting (goal-oriented scenario) 108
  deleting (Percentage Mode) 91
  editing 80
  enabling/disabling (goal-oriented scenario) 108
  enabling/disabling (manual scenario) 91
  files 80
  modifying script details 78, 80
  selecting for group 59
  selecting for load generator 53
  selecting for scenario 37
Vuser states
  Run-Time graphs 256
Vusers
  activating additional during scenario execution 172
  adding to a group 58
  configuring 56
  deciding how many to run 27
  defined 5
  emulating maximum user load 123
  error, warning, and notification messages 183
  GUI Vusers 9
  loading 170
  monitoring 178
  pausing 170
  renumbering 170
  RTE Vusers 12
  running 169
  status in Scenario Groups window 178
  stopping 169
Vusers (cont’d)
  types of 8
  viewing 177–189
  Vuser Information dialog box 80
  Vuser Log 186
  Vuser script log 171
  Vuser window 45
  Vusers with Error Statistics graph 256
  Vusers window 57

W
WAN emulation 70
  advanced options 73
  configuring the settings 71
  excluding IPs 74
  predefined profile settings 72
  setting up 71
  stopping and restarting 76
Web Application Server Resource monitors 335–403
  Ariba monitor 336
  ATG Dynamo monitor 340
  BroadVision monitor 346
  ColdFusion monitor 356
  Fujitsu INTERSTAGE monitor 359
  Microsoft ASP 361
  Oracle9iAS HTTP monitor 363
  SilverStream monitor 369
  WebLogic (JMX) monitor 376
  WebLogic monitor 372
  WebSphere (EPM) monitor 394
  WebSphere monitor 382
Web page breakdown, enabling 261
Web Resource monitors 263–269
Web Server Resource monitors 319–329
  Apache monitor 320
  iPlanet (NAS) monitor 330
  iPlanet/Netscape monitor 325
  Microsoft IIS monitor 323
WebLogic
  (JMX) monitor 376
  (SNMP) Resources dialog box 372
  monitor 372

WebSphere
  (EPM) monitor 394
  (EPM) Monitor Configuration dialog box 402
  monitor 382
  Monitor Configuration dialog box 384
Windows
  Media Server - Add Measurements dialog box 442
  Media Server monitor 442
  Resources dialog box 273
  Resources monitor 273–278
Windows Resource monitors
  Windows Resources monitor 273–278
Host Resolution Functions Copyright Agreement


The Regents of the University of California. All rights reserved.

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

1. Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
2. Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
3. All advertising materials mentioning features or use of this software must display the following acknowledgement:
   This product includes software developed by the University of California, Berkeley and its contributors.
4. Neither the name of the University nor the names of its contributors may be used to endorse or promote products derived from this software without specific prior written permission.

THIS SOFTWARE IS PROVIDED BY THE REGENTS AND CONTRIBUTORS "AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE REGENTS OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

Portions Copyright (c) 1993 by Digital Equipment Corporation.
Permitted use, copy, modify, and distribute this software for any purpose with or without fee is hereby granted, provided that the above copyright notice and this permission notice appear in all copies, and that the name of Digital Equipment Corporation not be used in advertising or publicity pertaining to distribution of the document or software without specific, written prior permission.

THE SOFTWARE IS PROVIDED "AS IS" AND DIGITAL EQUIPMENT CORP. DISCLAIMS ALL WARRANTIES WITH REGARD TO THIS SOFTWARE, INCLUDING ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS. IN NO EVENT SHALL DIGITAL EQUIPMENT CORPORATION BE LIABLE FOR ANY SPECIAL, DIRECT, INDIRECT, OR CONSEQUENTIAL DAMAGES OR ANY DAMAGES WHATSOEVER RESULTING FROM LOSS OF USE, DATA OR PROFITS, WHETHER IN AN ACTION OF CONTRACT, NEGLIGENCE OR OTHER TORTIOUS ACTION, ARISING OUT OF OR IN CONNECTION WITH THE USE OR PERFORMANCE OF THIS SOFTWARE.

Copyright (c) 1996 by Internet Software Consortium.

Permission to use, copy, modify, and distribute this software for any purpose with or without fee is hereby granted, provided that the above copyright notice and this permission notice appear in all copies.

THE SOFTWARE IS PROVIDED "AS IS" AND INTERNET SOFTWARE CONSORTIUM DISCLAIMS ALL WARRANTIES WITH REGARD TO THIS SOFTWARE INCLUDING ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS. IN NO EVENT SHALL INTERNET SOFTWARE CONSORTIUM BE LIABLE FOR ANY SPECIAL, DIRECT, INDIRECT, OR CONSEQUENTIAL DAMAGES OR ANY DAMAGES WHATSOEVER RESULTING FROM LOSS OF USE, DATA OR PROFITS, WHETHER IN AN ACTION OF CONTRACT, NEGLIGENCE OR OTHER TORTIOUS ACTION, ARISING OUT OF OR IN CONNECTION WITH THE USE OR PERFORMANCE OF THIS SOFTWARE.