

An Introduction to LoadRunner

A Powerful Performance Testing Tool by HP

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1) Introduction

LoadRunner is an industry-leading performance and load testing product by Hewlett-Packard (since it acquired Mercury Interactive in November 2006) for examining system behavior and performance, while generating actual load. LoadRunner can emulate hundreds or thousands of concurrent users to put the application through the rigors of real-life user loads, while collecting information from key infrastructure components (Web servers, database servers etc). The results can then be analysed in detail, to explore the reasons for particular behaviour.

Consider the client-side application for an automated teller machine (ATM). Although each client is connected to a server, in total there may be hundreds of ATMs open to the public. There may be some peak times — such as 10 a.m. Monday, the start of the work week — during which the load is much higher than normal. In order to test such situations, it is not practical to have a testbed of hundreds of ATMs. So, given an ATM simulator and a computer system with LoadRunner, one can simulate a large number of users accessing the server simultaneously. Once activities have been defined, they are repeatable. After debugging a problem in the application, managers can check whether the problem persists by reproducing the same situation, with the same type of user interaction.

LoadRunner

LoadRunner is divided up into 3 smaller applications:

The Virtual User Generator allows us to determine what actions we would like our Vusers, or virtual users, to perform within the application. We create scripts that generate a series of actions, such as logging on, navigating through the application, and exiting the program.

The Controller takes the scripts that we have made and runs them through a schedule that we set up. We tell the Controller how many Vusers to activate, when to activate them, and how to group the Vusers and keep track of them.

The Results and Analysis program gives us all the results of the load test in various forms. It allows us to see summaries of data, as well as the details of the load test for pinpointing problems or bottlenecks.

Client/Server Load Testing

Modern client/server 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 single application, client/server testing focuses on performance and reliability of an entire client/server system.

For example, a typical client/server testing scenario might depict 200 users that login 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 client/server 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 a client/server system under the load of tens, hundreds, or even thousands of potential users

The LoadRunner Solution

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 automatically records the performance of the client/server system during a test. You can choose from a wide variety of graphs and reports how you want 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

Using LoadRunner, you divide your client/server 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--submitting input to the server. 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.

To emulate conditions of heavy user load, you create a large number of Vusers that perform a series of tasks. For example, you can observe how a server behaves when one hundred Vusers simultaneously withdraw cash from the bank ATMs. To accomplish this, you create 100 Vusers, and each Vuser:

Enters an account number into an ATM

Enters the amount of cash to withdraw

Withdraws cash from the account

Checks the balance of the account

Repeats the process numerous times

LoadRunner Vuser Technology

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 the server during the scenario.

To measure the performance of the server, you define transactions. Transactions measure the time that it takes for the server to respond to tasks submitted by Vusers. For instance, 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.

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You insert rendezvous points into Vuser scripts to emulate heavy user load on the server. Rendezvous points instruct multiple Vusers to perform tasks at exactly the same time. For example, to emulate peak load on the bank server, you insert a rendezvous point to instruct 100 Vusers to simultaneously deposit cash into their accounts.

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 host. The host is the machine that executes the Vuser script, enabling the Vuser to emulate the actions of a human user.

Vuser Types

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

```
# GUI (Windows and UNIX)
# RTE (Windows and UNIX)
# Database *(CtLib, DbLib, Informix, Oracle, and ODBC)
# Web*
# TUXEDO*
# APPC*
# Windows Sockets*
# Baan
# Java
# DCOM
# PeopleSoft
```

Working with LoadRunner

Suppose you want to test a bank server that serves many automatic teller machines (ATMs). The ATMs provide a full range of banking services to the bank's customers-- such as withdrawing and depositing cash. To test the bank server using LoadRunner, 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
```

2) The LoadRunner Testing Process

There are five steps in LoadRunner Testing Process:

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.

Step II: Creating the Vuser scripts

Vusers emulate human users interacting with your client/server system. 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

Step III: Creating the Scenario

A scenario describes the events that occur during a client/server testing session. A scenario includes a list of machines that "host" Vusers; a list of Vuser scripts that the Vusers run; and a list of Vusers that run during the scenario. You create scenarios using the LoadRunner Controller.

Creating the List of Hosts to Run Vusers

For each scenario, you create a list of hosts--machines configured to execute Vuser scripts.

Creating the List of Vuser Scripts

For each scenario, you create a list of scripts that Vusers run during scenario execution.

Creating the Vusers

To each Vuser in a scenario, you assign a Vuser script and a host to run the script.

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.

Before you run a scenario, you set the scenario configuration. This determines how all the hosts and Vusers behave when you run the scenario.

For each scenario, you create a list of scripts that Vusers run during scenario execution.

You can run the entire scenario, individual Vusers, or groups of Vusers (Vuser Groups). While a scenario runs, LoadRunner measures and records the transactions that you defined in each Vuser script.

The LoadRunner Testing Process

Step V: Analyzing Test Results

During scenario execution, LoadRunner records the performance of the client/server system under different loads. You use LoadRunner's graphs and reports to analyze the server's performance.

3) Load Test Planning

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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.

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:

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

Client/server 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.

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."

Analyzing the Client/Server System

The first step to load test planning is analyzing the client/server system. 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 system under test.

Identifying System Components

Draw a schematic diagram to illustrate the structure of the client/server system. If possible, extract a schematic diagram from existing documentation. If the system 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 a chain of 60 clothing stores. The clothing stores and clothing distributors each connect to the same database to update the stock information and to check prices. The distributors connect to the database server through the branch office LAN, and the clothing stores connect through a wide area network to the LAN.

Stating Objectives in Measurable Terms

The first step to load test planning is analyzing the client/server system. 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 system under test.

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 database server.

Focused Objective - Product Evaluation: run the same group of 300 virtual users on two different servers, HP and SUN Sparc 6000. When all 300 users simultaneously perform five pre-defined queries, determine which hardware gives a better response time.

Planning LoadRunner Implementation

Defining the Scope of Performance Measurements

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

Measuring end-to-end response time:

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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.

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

4) The LoadRunner Controller at a Glance

The following pages describe the Controller window and explain how to perform basic scenario operations.

- # Opening the Controller
- # Selecting LoadRunner Commands
- # Managing Scenario Files
- # Filtering and Sorting Information
- # Using Controller Layouts

Opening the Controller

Set up the LoadRunner environment according to the instructions in the Installing LoadRunner guide.

To open the Controller:

Select Start > Programs > LoadRunner > Controller.

The Controller window opens with the LoadRunner Controller dialog box inside.

The LoadRunner Controller dialog box includes the following options:

Wizard: Creates a scenario with the aid of the LoadRunner Scenario wizard, an interactive, step-by-step guide to creating a scenario.

New: Creates a new scenario.

Open an existing scenario: Opens an existing scenario

Show at Startup: If you do not want this window to appear the next time you start LoadRunner, clear the "Show at Startup" check box. Once you clear this checkbox, when you open the Controller, the window layout from the last time you worked with the Controller appears.

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.

Tool bar Provides shortcuts for selecting commands. Clicking on a button executes a command.

Status bar Provides information on the current state of the scenario.

Vuser window Displays a list of all the virtual users that can take part in the scenario. You also create Vusers using this window.

Selecting LoadRunner Commands

You select LoadRunner commands from the menu bar or on the toolbar.

Choosing Commands from a Menu: You select LoadRunner commands from the menus on the menu bar. Some commands use standard Microsoft Windows shortcut conventions.

Choosing Commands from the Toolbar You can execute many LoadRunner commands by clicking a button on the toolbar in the LoadRunner Controller.

Managing Scenario Files

A scenario describes the events that occur during each load testing session. A scenario contains lists of hosts, Vusers, Vuser scripts, transactions, and rendezvous points. You create a scenario using the 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.

You can also create a new scenario by using the Scenario wizard. The wizard is an interactive, step-by-step guide to creating a scenario. To create a new scenario by using the Scenario wizard, select File > Scenario Wizard.

Opening an Existing Scenario

The Open command opens any existing scenario.

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

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

Filtering and Sorting Information

Each window in the LoadRunner Controller displays information about the scenario. You can filter and sort the information that appears in each window.

Filtering information displays only those items that meet the selected criteria. For example, you can filter the Vuser window to display only those Vusers that are in the READY state.

Sorting information displays all the items in a list in a certain order. For example, you can sort all Vusers in the Vuser list, in order of their Vuser ID number (1,2,3 etc.).

Using Controller Layouts

By creating Controller layouts, you can define how the Controller window looks before, during, and after executing a scenario.

5) Creating a Scenario

To develop a scenario, you create a host list, a script list and a Vuser list. This chapter describes how to create a host list--the list of machines, or hosts, that execute Vuser scripts during a scenario run.

About Creating a Host List

Hosts are the machines on which Vusers run their scripts. The host list displays the machines that can run Vusers during scenario execution. You can add both UNIX and Windows machines to the host list. The Host window displays the host list and the following information for each host:

The status of the host

The platform type of the host (UNIX or Windows)

Details of the scenario that is currently running

The Host window has its own menu in the Controller menu bar, and a tool bar that lets you create and manage the host list.

Creating a Host List

The following procedure outlines how to create a host list for a scenario:

Install a LoadRunner remote command launcher on every machineB (except for local host) you want to use as a host.

The remote command launcher is an application that enables the Controller to invoke applications on the host. For more information about installing LoadRunner remote command launchers.

Add the names of the hosts to the host list.

Set attributes for each host (optional).

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Host attributes specify the number and type of Vusers that can run on each host. For example, you can set the maximum number of DB Vusers a host can run.

Select which hosts will take part in the scenario (optional).

Each time you run a scenario, some hosts may be unavailable. You can temporarily remove (disable) hosts from the list.

Adding a Host to the Host List

You use the Host window in the LoadRunner Controller to add hosts to the host list. After you create a host, you can set and modify the attributes for the new host.

To add a host to the host list:

Start the LoadRunner Controller and open the Host window. The Host menu appears in the LoadRunner menu bar.

Choose Host > Add. The Host Information dialog box opens.

Type the name of the host in the Name box.

Click a platform in the Platform list (UNIX or Windows).

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

If the host is UNIX-based, set the login information for the host. By default, LoadRunner uses your NT user name for the UNIX login. In other words, if your NT login is Irunner, the Controller will log on to the host as Irunner. You can also specify to login to the UNIX machine as another user.

Click OK to close the Host Information dialog box. The host name you entered appears in the Host window; the host status is set to DOWN

Modifying Host Attributes

Host attributes determine

The maximum number of Vusers that a host runs

The initialization quota for a host

Click a platform in the Platform list (UNIX or Windows).

The location of the WinRunner configuration file (for GUI Vusers)

The location of the files during run-time

Setting the Maximum Number of Vusers that a Host Can Run

You can increase or decrease the maximum number of GUI, DB and RTE Vusers that a host can run. You modify the maximum number according to the available resources, the needs of your scenario, and your LoadRunner license agreement.

To set the maximum number of Vusers that a host can run:

Open the Host window. The Host menu appears in the LoadRunner menu bar.

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Click a host in the Host window. The host is highlighted.

Choose Host > Details. The Host Information dialog box opens.

Click the Vuser Types tab.

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

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.

Click OK to close the Host Information dialog box.

Setting the Initialization Quota

The initialization quota determines how many Vusers a host initializes at a time. Initializing a large number of Vusers simultaneously places large stress on a host. To reduce stress on a host, you can initialize smaller batches of Vusers.

Open the Host window. The Host menu appears in the LoadRunner menu bar.

Click a host in the Host window. The host is highlighted.

Choose Host > Details. The Host Information dialog box opens.

Click the Vuser Types tab.

In the Initialization Quota boxes, enter the maximum number of Vusers of each type that the host will initialize simultaneously.

Click OK to close the dialog box.

Setting the Location of the WinRunner Configuration File

A GUI Vuser, running on a Windows-based host, uses WinRunner to execute its Vuser script. To enable the LoadRunner Controller to open WinRunner, you specify the location of the appropriate WinRunner configuration file (wrun.ini).

To select the location of WinRunner for a GUI Vuser:

Open the Host window. The Host menu appears in the LoadRunner menu bar.

Click a host in the Host window. The host entry is highlighted.

Choose Host > Details. The Host Information dialog box opens.

Click the WinRunner tab, and then click one of the following options:

Scenario Default: Instructs the Vuser to use the WinRunner configuration file specified in the Scenario Configuration dialog box.

Local Configuration File: Instructs the Vuser to use the host's WinRunner configuration file.

Path: Instructs the Vuser to use the WinRunner configuration file that is in a specific location on the network. To specify the path of the configuration file, click the browse button to the right of the Path box, and then set the location using the Choose WinRunner Configuration File dialog box.

Click OK. The Host Information dialog box closes.

Specifying where a Host Saves Files During Run-Time

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When a host runs a Vuser script, the Vuser generates results that describe the execution of the script. By default, these results are saved temporarily on a local drive of each host--until they are collated by the Controller to a central location. Alternatively, you can select to save the results directly to a shared network drive.

To change how individual hosts save their results:

Open the Host window. The Host menu appears in the LoadRunner menu bar.

Click a host in the Host window. The host entry is highlighted.

Double-click the host or choose Host > Details. The Host Information dialog box appears. Ensure that the Runtime File Storage tab is visible.

To store the scenario results on a shared network drive, click "On a shared network drive," and then select the Results check box. This option overrides the setting for the scenario.

To store the results temporarily on a hard drive of the host computer, click "On local host." The temporary result files will be stored under the temporary directory specified by the host's environment variables (on Windows, TEMP or TMP and on UNIX, \$TMPDIR or \$TMP). This option overrides the setting for the scenario. These temporary results are deleted either when the agent goes down or when you run the scenario again.

To store the scenario results according to the scenario default, click "Scenario default". This is the default setting.

Selecting the Hosts for a Scenario

Before you run a scenario, you can select which hosts will run Vusers. This compensates for the possibility that some hosts will be unavailable. For example, a machine may already be in use when you want to run the scenario.

You select which hosts will take part in the scenario by using the Enable and Disable commands. Disabling a host temporarily removes it from the list. Enabling a host reinstates it.

Disabling Hosts

When you disable a host, the host will not execute Vuser scripts during a scenario execution.

To disable a host:

Open the Host window. The Host menu appears in the LoadRunner menu bar.

Click a host in the Host window. The host is highlighted.

Click the Disable button or choose Host > Disable. The host name changes from black to gray. The host is disabled.

Enabling Hosts

Enabling a host reinstates a previously disabled host.

To enable a host:

Click a disabled host in the Host window. The host is highlighted.

Click the Enable button or choose Host > Enable. The host name changes from gray to black, and the host is enabled.

Creating a Multi-Platform Host List

You can add both UNIX and Windows machines to the host list. When you create a multi-platform scenario, information located on one machine may be inaccessible to other machines. LoadRunner's Path-Translation table enables many different machines and platforms to share information

Saving and Loading the Default Host List

Using LoadRunner, you can save a host list as the standard (default) list of hosts for creating scenarios. When you create a scenario, you then adapt the default list to the needs of the new scenario.

You can save the host list currently displayed in the Host window as the default host list. You can use this list each time you want to create a new scenario.

To save the host list as the default:

Choose Host > Save List As Default.

To load the default host list:

Choose Host > Load Default List. The default host list appears in the Host window, together with any host previously displayed.

About Creating a Script List

A Vuser script defines the actions that a Vuser performs during scenario execution. The script list contains all the Vuser scripts that Vusers can run. The script list may contain scripts for GUI, DB, and RTE type Vusers.

The Script window, which displays the script list, has its own menu in the Controller menu bar. The Script window includes the following information for each script in the list:

The name of the Vuser script

The type of Vuser that will run the script

The location (path) of the script

Command line options associated with the script

Adding a Script to the Script List

When you add a script to the script list, ensure that the Controller can recognize the script's path. During run time, the Controller sends a copy of the scripts to the Vuser hosts.

To add a script to the script list:

Start the LoadRunner Controller and open the Script window. The Script menu appears in the LoadRunner menu bar.

Choose Script > Add. The Vuser Script Information dialog box opens

Click the browse button to the right of the Path box. The Open dialog box appears.

In the "Files of Type" box select the Vuser type, and then select the path and file name of the new script.

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Click Open to select the files. The Open dialog box closes, and the new script name and its Vuser type appear in the Vuser Script Information dialog box.

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

Click OK to close the Vuser Script Information dialog box.

Modifying Script Details

You can modify the details of a script in the script list using the Vuser Script Information dialog box.

To modify the details of a script in the script list:

Start the LoadRunner Controller and open the Script window. The Script menu appears in the LoadRunner menu bar.

Click a script in the Script window. The script is highlighted.

Choose Script > Details. The Vuser Script Information dialog box opens, displaying the details of the selected script.

Modify the details as necessary. Note that you cannot modify the transactions, rendezvous, or Vusers associated with a script.

Click OK to close the Vuser Script Information dialog box and save the changes. The modified script details appear in the Script window.

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

Click OK to close the Vuser Script Information dialog box.

Using Relative Paths for Vuser Scripts

When you specify the location of a Vuser 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\user.usr, you could type:

About Creating the Vuser List

With LoadRunner, you test your client/server system by creating and running scenarios. A scenario describes the events that occur during a client/server load testing session. Each scenario contains a list of many virtual users (Vusers). Vusers emulate human users interacting with your client/server system. When you run a scenario, the Vusers generate load on the server, and LoadRunner monitors the server's performance.

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For example, to test a bank server you could create Vusers that deposit and withdraw cash using automatic teller machines (ATMs). LoadRunner would monitor the bank server's performance while varying numbers of customers simultaneously perform deposit and withdrawal operations

Scheduling Vusers

After you create a Vuser, you can schedule the Vuser by setting:

To schedule a Vuser:

1. Open the Vuser window, and click in the Vuser side of the window. The Vuser menu appears in the LoadRunner menu bar.
2. Choose Vuser > Details. The Vuser Information dialog box appears.
3. Click the Scheduling tab.
4. Set one of the scheduling options.
5. Click OK to close the dialog box.

Creating Vuser Groups

You can use Vuser Groups to organize the Vusers in a scenario into manageable groups. You create Vuser Groups that contain Vusers with shared or similar characteristics. For example, you can create a Vuser Group for all Vusers that run the same Vuser script.

To create a Vuser Group:

1. Open the Vuser window. The Vuser menu appears in the LoadRunner menu bar.
2. Click anywhere in the Vuser Group column. The Vuser Group menu appears in the LoadRunner menu bar.
3. Choose Group > Add. The Vuser Group Information dialog box opens.
4. In the Name box, enter the name of the Vuser Group and then click OK. The new Vuser Group appears at the bottom of the Vuser Group list in the Vuser window.
5. In the Command Line box, type any command line options to use when running the group. For example: -x value -y value

Scheduling Vuser Groups

After you create a Vuser Group, you can schedule the group by setting:

To schedule a Vuser Group:

1. Open the Vuser window, and click in the Vuser Group (left) side of the window. The Group menu appears in the LoadRunner menu bar.
2. Choose Group > Details. The Group Information dialog box opens.
3. Set one or both of the scheduling options
4. Click OK to close the dialog box.

Scheduling Vuser Groups

A GUI Vuser can execute a Vuser script either on a Windows-based machine or on a UNIX workstation. By setting the GUI Vuser type you inform the Controller how to execute the script. For example, if you set the Vuser type to GUI:XRRunner, LoadRunner executes the Vuser script on a UNIX workstation--using XRRunner. You can set the default GUI Vuser type for new GUI Vusers.

To set the default GUI Vuser type:

1. Invoke the Controller and create a new scenario or open an existing one.
2. Choose Options > Settings. The Settings dialog box appears.
3. Click the Default Types tab.
4. Click the arrow to the right of the Default GUI Vuser box. The list of available GUI Vuser types opens.
5. Click an option in the Default GUI Vuser list. See below for a list and explanation of the available options.
6. Click OK to close the dialog box and save the information.

Controlling Server Load: 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.

For example, suppose you want to measure how a bank server performs when ten Vusers simultaneously withdraw cash from ten different automatic teller machines (ATMs). In order to emulate the required user load on the server, you instruct all the Vusers to withdraw cash 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 arrive, or when a specified amount of time has passed.

You define a rendezvous by inserting a rendezvous point into a Vuser script. At the start of the Vuser script, you declare the names of all the rendezvous points in the script. This declaration enables the Controller to display rendezvous information when you execute the scenario.

Disabling and Enabling Rendezvous Points

By disabling and enabling rendezvous points, you can influence the level of server load. Disabling a rendezvous temporarily removes it from the rendezvous list and excludes it from the scenario. Enabling a rendezvous returns it to the Rendezvous list and includes it in the scenario.

You use the Disable and Enable commands to change the status of rendezvous points during a scenario.

To disable a rendezvous:

1. Open the Rendezvous window. The Rendezvous menu appears in the LoadRunner menu bar.

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2. Click a rendezvous. The selected rendezvous is highlighted.
3. Choose Rendezvous > Disable, or click the Disable button. The rendezvous name changes from black to gray and the rendezvous is disabled.

To enable a rendezvous:

1. Open the Rendezvous window. The Rendezvous menu appears in the LoadRunner menu bar.
2. Click a disabled rendezvous. The selected rendezvous is highlighted.
3. Choose Rendezvous > Enable, or click the Enable button. The rendezvous name changes from gray to black and the rendezvous is enabled.

Disabling and Enabling Vusers at Rendezvous Points

You can influence the level of server load by disabling and enabling Vusers at a rendezvous. 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. Open the Rendezvous window. The Rendezvous menu appears in the LoadRunner menu bar
2. Click a rendezvous in the Rendezvous window. A list of all the Vusers in the rendezvous is displayed on the right side of the Rendezvous window.
3. Click a Vuser in the list.
4. Choose Rendezvous > Disable, or click the Disable button. The Vuser changes from black to gray. The Vuser will not take part in the rendezvous.

To enable a Vuser in a rendezvous:

1. Open the Rendezvous window. The Rendezvous menu appears in the LoadRunner menu bar.
2. Click a rendezvous. A list of all the Vusers in the rendezvous is displayed on the right side of the Rendezvous window.
3. Click a disabled Vuser in the list.
4. Choose Rendezvous > Enable, or click the Enable button. The Vuser changes

Setting Rendezvous Attributes

Setting the Timeout Attribute

The timeout determines the maximum time (in seconds) that LoadRunner waits for each Vuser to arrive at a rendezvous. After each Vuser arrives at the rendezvous, LoadRunner waits up to timeout seconds for the next Vuser to arrive. If the next Vuser does not arrive within the timeout period, then 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. You set a timeout for each rendezvous point.

To set a timeout:

1. Open the Rendezvous window. The Rendezvous menu appears in the LoadRunner menu bar.
2. Click a rendezvous in the Rendezvous window.
3. Choose Rendezvous > Details. The Rendezvous Information dialog box opens.
4. In the Timeout box, enter a timeout value, and then click OK. The timeout is set for the rendezvous.

To set the policy attribute:

1. Open the Rendezvous window. The Rendezvous menu appears in the LoadRunner menu bar.
2. Click a rendezvous in the Rendezvous window.
3. Double-click the Policy field. The field turns into a list.
4. To set the policy to All Arrived, select All Arrived from the list. The new policy appears in the Policy field.

Alternatively, to set the policy to Quota, select Quota from the list.

The Rendezvous - Quota dialog box appears.

Enter the number of Vusers in the Quota box.

5. Click OK to close the dialog box. The new policy appears in the Policy field.

About Configuring a Scenario

You can configure how hosts and Vusers behave when you run a scenario so that the scenario accurately emulates a real-world situation. Most of the configuration settings are set using the Scenario Configuration dialog box.

Setting the Location where Run-Time Files are Stored

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

Besides other file types, run-time files include Vuser script files and result files:

- 1. Script files:** When you run a Vuser, the Controller sends a copy of the associated Vuser script to the Vuser host. The script is stored in the host's temporary run-time directory.
- 2. 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 hosts are transferred to the results directory.

Specifying the Location of WinRunner

A GUI Vuser running on a Windows host uses WinRunner to execute its Vuser script. To enable the LoadRunner Controller to open WinRunner, you must specify the location of the appropriate WinRunner configuration file (wrun.ini). The configuration file in the location you specify is the default configuration file for the entire scenario--all the Windows GUI Vusers in the scenario will access this file.

To set the default location of WinRunner for GUI Vusers:

1. on each host
2. in a public directory on the network

The default location you specify can be located:

1. Choose Scenario > Configure. The Scenario Configuration dialog box opens.

Click the Environment tab.

2. Click one of the WinRunner Configuration File options
3. Click OK to close the dialog box.

Setting the Scenario Duration

You can set the length of time that a scenario runs.

To set the scenario duration:

1. Choose Scenario > Configure. The Scenario Configuration dialog box appears.
2. In the Session tab, select the Limit Scenario Duration check box.
3. Enter the length of time, in minutes, you want the scenario to run.
4. Click OK to close the dialog box.

Specifying the Applications that the Scenario Invokes

You can create a list of applications that the Controller invokes when you begin a scenario run. You specify each application and the host on which the application will run.

To specify the applications that the scenario invokes:

1. Choose Scenario > Configure. The Scenario Configuration dialog box opens. Ensure that the Session tab is visible.
2. For each application to be invoked, type the following statement in the Applications to start at the beginning of the Scenario box
3. Click OK to close the dialog box.

6) LoadRunner Analysis

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During scenario execution, Vusers generate result data as they perform their transactions. After running a scenario, you can view the results to determine how your system performed. You can view scenario results in several ways:

The **Analysis graphs and reports** provide information about transactions and Vusers that can be used to determine system performance.

The **Export data** utility enables you to export scenario results to external applications such as spreadsheets. You can export scenario data as text files or in one of the common spreadsheet formats.

The **Controller Output window** displays information about the scenario run. If your scenario run fails, look for debug information in this window.

The **Vuser output file**, output.txt, contain a full trace of the scenario run for DB Vusers. This file is located in the scenario results directory. (When you run a DB Vuser script in standalone mode, this file is placed in the Vuser script directory.)

Result 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 a header file _t_rep.hdr, and an event file _t_rep.eve . LoadRunner creates a directory for each Group in the scenario and a subdirectory for each Vuser.

Analysis Graphs and Reports

Vusers generate data as they perform transactions during a scenario. You can use this data to generate graphs and reports that show the performance of your client/server system. Before generating reports and graphs, you should determine the type of information that you would like to see. LoadRunner's graphs and reports are divided into the following three categories:

Activity

Performance

Web Vuser

Activity graphs and reports provide information about the number of Vusers and the number of transactions executed during the scenario run.

Performance graphs and reports analyze Vuser performance and transaction times.

Web Vuser graphs provide information about the throughput and connection times of Web Vusers.

LoadRunner cross-scenario analysis lets you compare the graphs from several scenarios. This feature is useful for benchmarking hardware in determining how a superior system will improve performance.

Viewing a Part of the Scenario

You can instruct LoadRunner to calculate graphs and reports based on a part of the scenario. For example, if you have a scenario with a duration of 400 seconds, but you are only interested in the period beginning at 60 and ending with 360 seconds, you specify that interval in the Time Filter dialog box. After setting the time filter, you must rebuild the result database in order for the changes to take

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effect. All subsequently generated graphs and reports are calculated using data only from the specified interval.

To filter the scenario time:

1. Choose Options > Time Filter in the Analysis window. The Time Filter dialog box opens.
2. Enter the desired time interval
3. Click OK to accept the settings.
4. Choose File > Open (Rebuild)

Working with Analysis Graphs

You generate graphs in the Analysis window by selecting the desired graphs from the Graph menu. LoadRunner also provides tools which enable you to modify the way that graphs are displayed. For each graph you can:

- # Filter specific transactions and Vusers
- # Enlarge a section of the graph
- # Change the interval of the x-axis.

Viewing Specific Transactions and Vusers

When you generate a graph, the graph initially includes all the transactions in the scenario. You can filter the graph to display one or more specific transactions. For example, if three transactions were monitored during a scenario, you can generate a graph that displays only one of the transactions. By default, the Transaction Performance and Transaction per Second graphs display all the transactions, while the Transaction Performance Summary and Transaction Distribution graphs display only the first transaction.

To select transactions and Vusers to display:

1. Select Results > Analyze Results, or click the Analysis button. The LoadRunner Analysis window opens, and the Running Vusers graph is displayed.
2. Select a graph from the Graphs menu. The graph is displayed. You can display multiple copies of the same graph.
3. Select View > Filter, or click the Graphic Filters button.
4. Select the transactions that you want to include in the graph. Use the CTRL key to select multiple transactions. For graphs that show individual Vuser performance, such as Transaction Performance Summary by Vuser graph, you can filter the graphs to display information for a single Vuser. Click the Group and Vuser tab and select the Vuser that you want to display.
5. Click OK. The Filter dialog box closes. The graph appears and displays the selected transactions or Vusers.

To enlarge a section of a graph using the mouse:

1. Select a graph from the Graphs menu. The graph is displayed.
2. Move the mouse pointer to the beginning of the section that you want to enlarge.
3. Hold down the left mouse button. A vertical bar appears on the x-axis. This marks the first boundary of the section to enlarge.

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4. While holding down the left mouse button, move the mouse to the left or right of the vertical bar. A second vertical bar appears. This marks the second boundary of the section to enlarge.
5. Release the left mouse button. The section is enlarged.
6. Click the right mouse button to return the graph to its original size.

To enlarge a section of a graph using the Zoom In command:

1. Select a graph from the Graphs menu.
2. Select View > Zoom In, or click the Zoom button. The Zoom In dialog box opens.
3. In the From box, enter the point that marks the left boundary of the section to enlarge. Note that this point must be on the x-axis.
4. In the To box, enter the point that marks the right boundary of the section to enlarge.
5. Click OK. The section is enlarged.
6. Select View > Zoom Out to return the graph to its previous size.
7. Select View > Full View to return the graph to its original size

To change the granularity of the x-axis for a graph:

1. Select a graph from the Graphs menu
2. Select View > Granularity, or click the Granularity button. The Set Granularity dialog box opens.
3. Enter a new scale in the Granularity box

Working with Analysis Reports

In order to view a report, you must generate the report from the LoadRunner Analysis window. LoadRunner reports are displayed in a Report Viewer. You can print, save, or export the data using the viewer.

Selecting and Displaying Reports

When you run a scenario, LoadRunner stores the scenario results in the specified directory. When you run the analysis, LoadRunner processes the data and formats them into a database. The formatted data is used to generate reports and graphs. You can instruct LoadRunner to run the analysis automatically at the end of a scenario by selecting Results > Auto Load Analysis.

To display reports:

1. Select Results > Analyze Results, or click the Analysis button. The Analysis window opens.
2. From the Reports menu choose a report. The report is generated and displayed. You can display multiple copies of the same report.

The Report Viewer

Each report is displayed in its own report viewer. Each viewer contains a header and a toolbar.

Report Header

The header displays general scenario information. The report header contains the following information:

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Title: The name of the report.

Scenario: The name of the scenario described in the report.

Result: The pathname of the scenario results directory.

Start time: The time at which the Run Scenario command was executed.

End time: The time at which the scenario script was terminated.

Duration: The total run time of the scenario.

Report Viewer Toolbar

Each report viewer has a toolbar that lets you perform operations on displayed reports. The report viewer toolbar contains the following buttons:

Zoom: Toggles between an actual size, full page, and magnified views of the report.

Print: Prints the displayed report.

7) Exporting Performance Data

You can export performance data to a spreadsheet application or to a statistical analysis application for further processing. You can export from the:

Analysis Window - to generate files with performance information

Report Viewer - to generate files in a format compatible with a spreadsheet application

Exporting from the Analysis Window

To generate simple text files with performance information, export the data from the Analysis window.

To export performance data from the Analysis window:

1. Click the Analysis button or choose Results > Analyze Results. The Analysis window opens.
2. Click the Export button or choose File > Export. The Export dialog box opens.
3. In the Export Data to Directory box, type the path of the directory to which you want to export the information. Alternatively, click the browse button next to the box and select a directory with the Export Path dialog box.
4. From the Data Files list, select the information you want to export. Use the CTRL key to select multiple files.
5. Click OK to close the dialog box. The data files are exported to the specified directory in text format with .txt extensions. Each file begins with an explanation of the report and its fields.

Types of Performance Data

You can export the following types of performance data:

Transaction Meter contains information on all the transactions in the scenario, such as the ID of the Users performing the transaction and transaction performance times. The exported file name is tr_meter.txt .

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Transaction Distribution contains the distribution of the time taken to perform a transaction. The exported file name is distr.txt .

Running Vusers contains the total number of active Vusers during scenario execution. The exported file name is vurun.txt .

Transaction Summary contains general information about all transactions in the scenario, such as the minimum, maximum, and average performance times for all transactions in the scenario. The exported file name is trans.txt .

General Scenario Information contains the path of the scenario file and the total number of Vusers in the scenario. The exported file name is sc_map.txt

General Result Information contains the path of the results file and the start and end times for the scenario. The exported file name is sc_res.txt .

Sgroups contains the name and ID of each Sgroup in the scenario. The exported file name is sg_res.txt.

Vuser Information contains all the Vusers that were in the RUNNING state during scenario execution. The exported file name is vu_res.txt .

Vuser Status Contains the status of each Vuser at the end of the scenario (PASS , FAIL , ABORT , ERROR). The exported file name is vu_stat.txt .

Transactions per Second contains the number of completed transactions during each second of the scenario. The exported file name is tps.txt.

Performance by Vuser contains transaction performance information for each Vuser in the scenario. The exported file name is vu_trans.txt.

Performance Under Load contains the performance time for transactions according to the total number of active Vusers during scenario execution. The exported file name is perf_run.txt.

Data Point contains performance information about user defined points known as data points. The exported file name is dpoint.txt.

Data Point Map contains a list of the data points measured throughout the scenario. The exported file name is dp_map.txt

Rendezvous contains information about the rendezvous such as the number of members arrived, the arrival and release times, and the reason for the release. The exported file name is rendz.txt

Rendezvous Map contains a list of the rendezvous points in the scenario. The exported file name is rendzmap.txt

Percentile contains the percentage of transactions performed within a given time range. The exported file name is percent.txt.

Exporting Data from the Report Viewer

From the Report Viewer, you can export analysis data to a file, an Exchange folder, or a Lotus Notes database for further processing. You can also export LoadRunner reports through Microsoft Mail. The Report Viewer can export the data into many different file formats such as dBASE, html, and other popular database or wordprocessor formats. For a list of the available formats, click the arrow to the right of the Format box to open the drop- down list box.

To export report data to a file:

1. Click the Analysis button or choose Results > Analyze Results. The Analysis window opens.

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2. From the Reports menu choose a report to generate. Wait for the report to open.
3. Click the Export button from the report viewer toolbar. The Export dialog box opens.
4. Click the arrow to the right of the Format box and select a file format from the list.
5. Click the arrow to the right of the Destination box and select a destination from the list.
6. Click OK. The Choose Export File dialog box opens.
7. Specify a name for the export file and click OK. LoadRunner displays the report title in the window banner and exports the information. A dialog box displays the progress of the export. For example, if you are exporting the Detailed Vuser report, the dialog box title will read Printing Detailed Vuser.

To export report information using Microsoft Mail

Select Results > Analyze Results to open the LoadRunner Analysis window.

1. From the Reports menu, choose a report to generate. Wait for LoadRunner to display the report.
2. Click the Export button from the report viewer toolbar. The Export dialog box opens.
3. Select Character separated values from the Format box.
4. Select Microsoft Mail from the Destination box
5. Click OK to close the dialog box. The Character-Separated Values dialog box opens.
6. Specify a character to separate between values in the report. The default is a comma. Click OK to close the dialog box. The Number and Date Format dialog box opens.
7. Check the appropriate boxes and click OK. LoadRunner begins to export the information.

About Scenario Activity

During scenario execution, Vusers generate data as they perform transactions. LoadRunner enables you to generate graphs that show scenario activity or overall scenario performance. Scenario activity graphs and reports let you track Vuser behavior throughout the scenario. The graphs map the transactions, rendezvous, and active status of the Vusers, according to the elapsed scenario time.

When working with graphs, you can focus on specific segments of the scenario using the zoom tools. In addition, you can change the granularity of the graph.

About Transaction Breakdown

After running a scenario, you perform an analysis of the run by generating graphs and reports. If the graphs show a reasonable transaction time for the Vusers, you do not need to further analyze the transactions. However, if the transaction response time is not acceptable, you can use one of LoadRunner's monitoring tools to pinpoint the problem. The monitoring tools are Transaction Breakdown, Network Monitoring, and Resource Monitoring.

You use the Transaction Breakdown utility to determine where the bottleneck lies. This utility indicates the cause of the slow response time: Network or client delays, CPU performance, I/O delays, database locking, or other issues at the database server. The transaction breakdown utility gives you detailed information about each of the components by displaying the client/network and server components for each of the transactions in the scenario.

Once you determine where the problem lies, you can upgrade or reconfigure your system accordingly.

Understanding Transaction Components

The Transaction Breakdown utility shows the following elements:

Network and Client: The Network and Client component indicates the effect of the network and client machine on the transaction response time.

CPU: The CPU component indicates the effect of database server's CPU time on the transaction response time.

I/O: The I/O component indicates the effect of file and disk operations on the transaction response time.

Lock: The Lock component indicates the effect of database locking on the transaction response time.

Latch: The Latch component indicates the effect of the latch operation in Oracle on the transaction response time.

System Locks: The System Locks component indicates the effect of server system locks on the transaction response time.

General: The General component shows the effect of all other server elements that do not fit into one of the above categories on the transaction response time.

Pinpointing Problems

You use the Transaction Breakdown utility to determine which component caused the poor response time. Prolonged transactions may result from a misconfigured network, a slow CPU, database locking, I/O (file and disk operations), or other factors.

Without transaction breakdown, you might upgrade the CPU when the real problem lay with database locking. The transaction breakdown enables you to pinpoint the exact problem, to avoid unnecessary upgrades and costs.

Database Locking

In the following example, the transaction breakdown indicates that most of the delay to the transaction time was caused by database locking

In order to improve transaction response time, you should reconfigure the application or modify its code to prevent database locking. Upgrading the CPU will be of little use, since CPU performance is not the cause of the problem

To improve transaction response time caused by network delays, use LoadRunner's Network Monitor to determine the node causing the delay.

To analyze the resource usage on an NT or UNIX machine, use LoadRunner's Resource monitoring.

Improving Response Time

The transaction breakdown graphs show the various components of the transaction time. The network component always appears on top. The server components are displayed in the order of CPU, I/O, lock, latch, system locks and general.

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To best utilize the Transaction Breakdown utility, run it several times. First determine the primary cause of delay. After solving one problem, run the scenario again and use the breakdown utility to determine the next reason for delay.

In the following example, three scenarios were executed with the same settings and the same number of Vusers.

The Network Traffic

In the second version there was an improvement, but the response time of 10 seconds was still not acceptable. The bottleneck in version 2 was in the network.

Further investigation determined that 1,000 fetches were performed, resulting in heavy network traffic. The user modified the application to perform one fetch of 1,000 rows instead of 1,000 fetches of one row. This lowered the network traffic.

(If the network traffic could not be decreased by modifying the application, use the Network Monitor to determine the bottleneck.)

In the final version, the transaction response time of 2 seconds was acceptable and the current configuration was used.

After performing a transaction breakdown for your scenarios, you will have a series of graphs showing your progress throughout the analysis.

Compare the results from the various scenarios

To compare the results from the various scenarios, use Cross-Scenario analysis to generate a single graph showing the transaction response time for the various versions. The following graph shows a Cross-Scenario analysis of the three scenarios.

Enabling Transaction Breakdown

To enable LoadRunner to break down transactions, you must enable transaction breakdown from the Controller before the scenario run. By default, in order to conserve resources, LoadRunner does not log the breakdown information.

Note that the Transaction Breakdown feature requires an additional license. If the Transaction Breakdown option does not appear in the Monitor menu, you must enter a new license code to include it. You can enter a new license code from the Help > About menu.

To Enabling Transaction Breakdown

Choose Monitors > Transaction Breakdown from the Controller window. The Transaction Breakdown Monitoring dialog box opens.

1. Select the check box to enable server monitoring for transaction breakdown.
2. Click Add to specify the Oracle server. The Server Information dialog box opens.
3. Enter the name of the Oracle server to monitor and specify a database instance (SID).
4. Select the platform type from the list.
5. Click OK to accept the settings and close the dialog box.
6. Repeat steps 3-6 for each Oracle machine whose transactions you want to monitor.

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7. Choose a monitoring policy. Specify the percent of Vusers you want to monitor. To monitor all Vusers, specify 100%. Choosing a lower percentage of Vusers conserves disk space and reduces processing time. The default is 10%.
8. Click OK to accept the settings and close the Transaction Breakdown Monitoring dialog box.

To Performing a Transaction Breakdown

The Transaction Breakdown utility is available for three graphs:

Percentile

Performance Under Load

Transaction Performance

To perform a transaction breakdown:

1. Enable Transaction Breakdowns in the Controller.
2. Run the scenario.
3. If Automatic Analysis is not enabled, choose Tools > Analysis to run the analysis.
4. Open one or more of the supported graphs (Percentile, Performance Under Load, or Transaction Performance).
5. Click the Break Down button or perform a right click and choose Break Down. LoadRunner displays the components of the transaction.
6. To turn off transaction breakdown, click the Break Down button or perform a right click and choose Break Down.

8) LoadRunner Features & Benefits

New Tuning Module Add-In

The LoadRunner Tuning Module allows customers to isolate and resolve system performance bottlenecks. Once the application has been stress tested using LoadRunner, the Tuning Module provides component test libraries and a knowledgebase that help users isolate and resolve performance bottlenecks.

WAN Emulation Support

This powerful feature set enables LoadRunner to quickly point out the effect of the wide area network (WAN) on application reliability, performance, and response time. Provided through technology from Shunra Software, this WAN emulation capability introduces testing for bandwidth limits, latency, network errors, and more to LoadRunner.

Sun ONE Studio4 IDE Add-in

Mercury Interactive and Sun Microsystems have worked together to integrate LoadRunner with the Sun ONE Studio4 add-in.

JBuilder for Java IDE Add-in

LoadRunner now works with Borland's JBuilder integrated development environment (IDE) to create powerful support for J2EE applications. This add-in enables LoadRunner users who create J2EE applications and services with JBuilder to create virtual users based on source code within a JBuilder project.

Native ICA Support for Citrix MetaFrame

LoadRunner now supports Citrix's Independent Computing Architecture (ICA) for the testing of applications being deployed with Citrix MetaFrame. This support is the first native ICA load testing solution of its kind, jointly developed with Citrix.

Web Transaction Breakdown Monitor for Isolating Performance Problems

Now you can more efficiently isolate performance problems within your architecture. LoadRunner's Web Transaction Breakdown Monitor splits end-to-end transaction response times for the client, network, and server and provides powerful drill-down capabilities.

Data Wizard for Data-Driven Testing

LoadRunner's Data Wizard enables you to quickly create data-driven tests and eliminate manual data manipulation. It connects directly to back-end database servers and imports desired data into test scripts.

Goal-Oriented Testing with AutoLoad

The new AutoLoad technology allows you to pre-define your testing objectives beyond the number of concurrent users to streamline the testing process.

Enterprise Java Bean Testing

By testing EJB components with LoadRunner, you can identify and solve problems during the early stages of application development. As a result, you can optimize performance before clients have been developed and thereby save time and resources.

XML Support

With LoadRunner's XML support, you can quickly and easily view and manipulate XML data within the test scripts

9) Hosted Virtual Users

How it Work

LoadRunner Hosted Virtual Users complements in-house load testing tools and allows companies to load test their Web-based applications from outside the firewall using Mercury Interactive's infrastructure. Customers begin by using LoadRunner Hosted Virtual Users' simple Web interface to schedule tests and reserve machines on Mercury Interactive's load farm. At the scheduled time, they select the recorded scripts to be uploaded and start running the tests on the host machines*. These scripts will emulate the behavior of real users on the application and generate load on the system.

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Through LoadRunner Hosted Virtual Users' Web interface, testers can view real-time performance metrics, such as hits per second, throughput, transaction response times and hardware resource usage (e.g., CPU and memory levels). They also can view performance metrics gathered by Mercury Interactive's server monitors and correlate this with end-user performance data to diagnose bottlenecks on the back end.

The interface to LoadRunner Hosted Virtual Users enables test teams to control the load test and view tests in progress, no matter their locations. When the test is complete, testers can analyze results online, as well as download data for further analysis.

*Customers who do not own LoadRunner can download the VUGen component for free to record their scripts. Likewise, the LoadRunner analysis pack can be downloaded for free.

LoadRunner Hosted Virtual Users gives testers complete control of the testing process while providing critical real-time performance information, as well as views of the individual machines generating the load.

Features and Benefits

Provides pre- and post-deployment testing.

At any time in the application lifecycle, organizations can use LoadRunner Hosted Virtual Users to verify performance and fine-tune systems for greater efficiency, scalability and availability. The application under test only needs to be accessible via the Web.

Complements in-house solutions to provide comprehensive load testing.

By combining LoadRunner Hosted Virtual Users with Mercury Interactive's LoadRunner or another in-house load testing tool, operations groups can thoroughly load test their Web applications and Internet infrastructures from inside and outside the firewall.

Gives customers complete control over all load testing.

Testing groups create the scripts, run the tests and perform their own analyses. They can perform testing at their convenience and easily access all performance data to quickly diagnose performance problems.

Provides access to Mercury Interactive's extensive load testing infrastructure.

With LoadRunner Hosted Virtual Users, organizations do not need to invest in additional hardware, software or bandwidth to increase their testing coverage. Mercury Interactive's load testing infrastructure is available 24x7 and consists of load farms located worldwide. As a result, organizations can generate real-user loads over the Internet to stress their Web-based applications at any time, from anywhere.

10) How the Monitors Work

To minimize the impact of the monitoring on the system under test, LoadRunner enables IT groups to extract data without having to install intrusive capture agents on the monitored servers. As a result, LoadRunner can be used to monitor the performance of the servers regardless of the hardware and operating system on which they run. Setup and installation of the monitors therefore is trivial. Since all the monitoring information is sampled at a low frequency (typically 1 to 5 seconds) there is only a negligible effect on the servers.

Supported Monitors

Astra LoadTest and LoadRunner support monitors for the following components:

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Client-side Monitors

End-to-end transaction monitors - Provide end-user response times, hits per second, transactions per second

Hits per Second and Throughput

Hits per Second

The Hits per Second graph shows the number of hits on the Web server (y-axis) as a function of the elapsed time in the scenario (x-axis). This graph can display the whole scenario, 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

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 kilobytes 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.

HTTP Responses

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 returned from the Web server during each second of the scenario run (x-axis), grouped by status code.

Load Testing Monitors

Pages Downloaded per Second

Pages Downloaded per Second The Pages Downloaded per Second graph shows the number of Web pages downloaded from the server during each second of the scenario run. This graph helps you evaluate the amount of load Vusers generate, in terms of the number of pages downloaded. 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.

User-defined Data Point

User Defined Data Points graph allows you to add your own measurements by defining a data point function in your Vuser script. Data point information is gathered each time the script executes the function or step. The User-Defined Data Point graph shows the average value of the data points during the scenario run. The x-axis represents the number of seconds elapsed since the start time of the run. The y-axis displays the average values of the recorded data point statements.

Transaction Monitors

Transaction Response Time The Transaction Response time graph shows the response time of transactions in seconds (y-axis) as a function of the elapsed time in the scenario (x-axis).

Transaction per Second (Passed) The Transaction 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).

Transaction per Second (Failed) The Transaction per Second (Failed) graph shows the number of failed transactions per second (y-axis) as a function of the elapsed time in the scenario (x-axis).

Virtual User Status

An Introduction to LoadRunner – A Powerful Performance Testing Tool by HP

The monitor's Runtime graph provides information about the status of the Vusers running in the current scenario on all host machines. The graph shows the number of running Vusers, while the information in the legend indicates the number of Vusers in each state.

The Status field of each Vuser displays the current status of the Vuser. The following table describes each Vuser status.

Running The total number of Vusers currently running on all load generators.

Ready The number of Vusers that completed the initialization section of the script and are ready to run.

Finished The number of Vusers that have finished running. This includes both Vusers that passed and failed

Error The number of Vusers whose execution generated an error.

Web Transaction Breakdown Graphs

DNS Resolution Displays the amount of time needed to resolve the DNS name to an IP address, using the closest DNS server. The DNS Lookup measurement is a good indicator of problems in DNS resolution, or problems with the DNS server.

Connection Time Displays the amount of time needed to establish an initial connection with the Web server hosting the specified URL. The connection measurement is a good indicator of problems along the network. It also indicates whether the server is responsive to requests.

Time To First Buffer Displays the amount of time that passes from the initial HTTP request (usually GET) until the first buffer is successfully received back from the Web server. The first buffer measurement is a good indicator of Web server delay as well as network latency.

Server and Network time The Time to First Buffer Breakdown graph also displays each Web page component's relative server and network time (in seconds) for the period of time until the first buffer is successfully received back from the Web server. If the download time for a component is high, you can use this graph to determine whether the problem is server- or network related.

Receive Time Displays the amount of time that passes until the last byte arrives from the server and the downloading is complete. The Receive measurement is a good indicator of network quality (look at the time/size ratio to calculate receive rate).

Client Time Displays the average amount of time that passes while a request is delayed on the client machine due to browser think time or other client-related delays.

Error Time Displays the average amount of time that passes from the moment an HTTP request is sent until the moment an error message (HTTP errors only) is returned

SSL Handshaking Time Displays the amount of time taken to establish an SSL connection (includes the client hello, server hello, client public key transfer, server certificate transfer, and other stages). The SSL Handshaking measurement is only applicable for HTTPS communications

FTP Authentication Displays the time taken to authenticate the client. With FTP, a server must authenticate a client before it starts processing the client's commands. The FTP Authentication measurement is only applicable for FTP protocol communications.

Server Monitors

NT /UNIX / Linux monitors - Provide hardware, network and operating system performance metrics, such as CPU, memory and network throughput.