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# Learning More About Load Testing

Welcome to this introduction to application performance testing and the LoadRunner load testing solution. This document provides a short overview of LoadRunner's features, and includes the following sections:

- ▶ The HP LoadRunner Solution
- ▶ Using HP LoadRunner
- ▶ Working with HP LoadRunner
- ▶ HP LoadRunner Vuser Technology
- ▶ The LoadRunner Testing Process

For more details, see the *HP LoadRunner Controller User Guide*.

HP LoadRunner load tests your application by emulating an environment in which multiple users work concurrently. While the application is under load, LoadRunner accurately measures, monitors, and analyzes a system's performance and functionality.

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 HP LoadRunner Solution**

LoadRunner addresses the drawbacks of manual performance testing:

- ▶ LoadRunner reduces 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 amount of hardware required for testing.
- ▶ The HP 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 HP LoadRunner

- ▶ **Scenario.** Using HP 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.
- ▶ **Vusers.** 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, so 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.
- ▶ **Controller.** You use the **HP LoadRunner Controller** to manage and maintain your scenarios. Using the Controller, you control all the Vusers in a scenario from a single workstation.
- ▶ **Load Generator.** When you execute a scenario, the 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.
- ▶ **Performance analysis.** 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 HP 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.

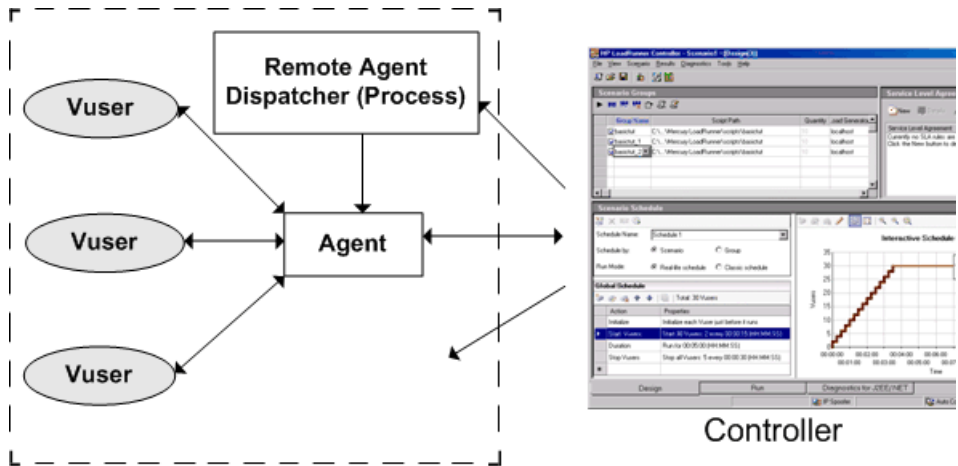
During the scenario that loads and monitors the bank server, you want to:

- ▶ 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

## HP LoadRunner Vuser Technology

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



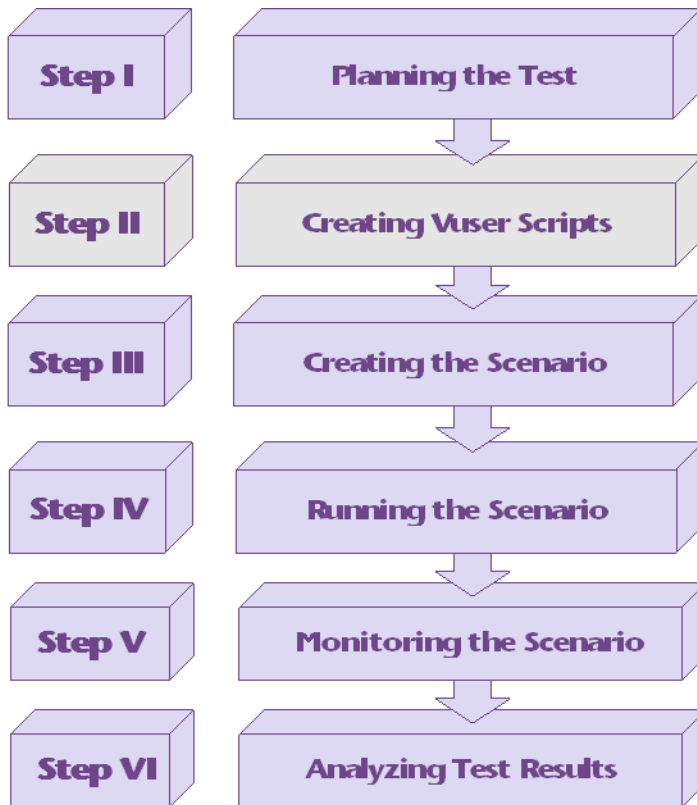
- ▶ **Remote Agent Dispatcher.** The Remote Agent Dispatcher (Process) enables the Controller to start applications on the load generator.
- ▶ **Agent.** The LoadRunner Agent enables the Controller and the load generator to communicate with each other. When you run a scenario, the Controller instructs 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.

## The LoadRunner Testing Process

You can easily create and run load test scenarios by following the LoadRunner testing process below.

This section gives you an overview of LoadRunner’s six-step process for testing your Web-based application under load. For detailed explanations, refer to the HP LoadRunner documentation.

The following illustration outlines the 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 Web-based application. A Vuser script contains the actions that each Vuser 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, see the *HP Virtual User Generator User 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 Controller.

### 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.

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 generators and percentage of the total number of Vusers to be assigned to each Vuser script.

### **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.

## **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 and scheduling. This determines how all the load generators and Vusers behave when you run the 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.



## **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/CRM server resource, Java performance, J2EE & .NET Diagnostics, application deployment, middleware performance, application component, and infrastructure resources monitors.

## **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 *HP LoadRunner Analysis User Guide*.

