Performance Testing:
Roles, Activities, and QA Inclusion

Michael Lawler

NueVista Group

nuevista group

Today’s Agenda

- Outline the components of a performance test and considerations
- Discuss various roles, tasks, and activities
- Review several design approaches specific to performance testing

Performance Testing Definition

- A category of testing in which the system's performance requirements are measured and/or tested against specified service objectives.
- Performance/stress testing is performed by an independent test team, not by developers.

nuevista group

Performance Testing

Primary Goals of Performance Testing

- Utilize technology to provide repeatable, consistent testing of the System Under Test (SUT)
- Increase quality through greater scope of testing performed
- Conduct testing that is very difficult, no, impossible to do with just humans
- Ensure application infrastructure can handle desired volume

Performance Testing

Functional vs. Performance Test Automation

- Functional testing is designed to insure that the application is working as designed from a screen to screen and control to control standpoint.
- Performance testing is intended to insure that the software AND hardware can handle the number of users or load of data that will make it stable for day to day use.
- Testing these look for 2 different results
  - Functional Defects, buttons or controls don't work
  - Performance Defects, when 2000 users hit this page, the server crashed

Performance Testing

Performance in the News

- RBS boss blames software upgrade for account problems – 06/25/2011
- Google wallet anniversary falls flat as new software problems emerge – 05/30/2012
- Apple iOS5 Upgrade Causing Problems – 10/13/2011
- Software Problems at PokerStars – 05/24/2011

Justification Survey

nuevista group

Performance Testing
Justification for Testing

- Downtime
- Loss of Revenue
- Loss of Productivity
- Confirm that application infrastructure can handle anticipated volumes
- Confirm that application infrastructure is sized correctly
- Confirm performance to Service Level Agreements
- Identify and resolve bottlenecks before going live

Challenges Survey

nuevista group

Benefits of Performance Testing

Common Challenges

- Lack of clarity on true application usage
- Insufficient test environment
- Insufficient test data
- Extrapolation as a testing effort
- Lack of expertise in test design
- Lack of expertise in test results analysis

Goals Survey

Performance Testing
Test Management Goals

- Ensuring clarity on true application usage
- Collection and validation of performance requirements
- Ensuring test design is based upon on true application usage
- Selection and acquisition of test scenarios or test cases
- Enabling identification and preparation of test data
- Validation of test design
- Validation of test results analysis
- Providing meaningful insight on performance testing to the project team

Performance Testing
The Vendor Landscape

Vendor	Product	Typical Use
HP	LoadRunner, Performance Center	Many protocols
MicroFocus – Borland	SilkPerformer, SilkPerformer Cloudburst	Many protocols
Original Software	TestDrive	GUI, Web, AJAX, JAVA, IBM Green Screen
SOASTA	CloudTest	Web and Mobile
IBM Rational	Performance Tester	Web, J2EE, Siebel, Citrix, SIP and SAP
Itko\Lisa	LISATest, Virtualize	Middleware, Virtual Test Environment
RadView Software	WebLOAD Professional	Web 2.0 AJAX, JSON data types, SOAP, and XML
Compuware – dynaTrace, Gomez	Application Performance Management	Many protocols
Oracle Empirix	Load Testing	Web applications

nuevista group

Components of Performance Testing

Performance Testing

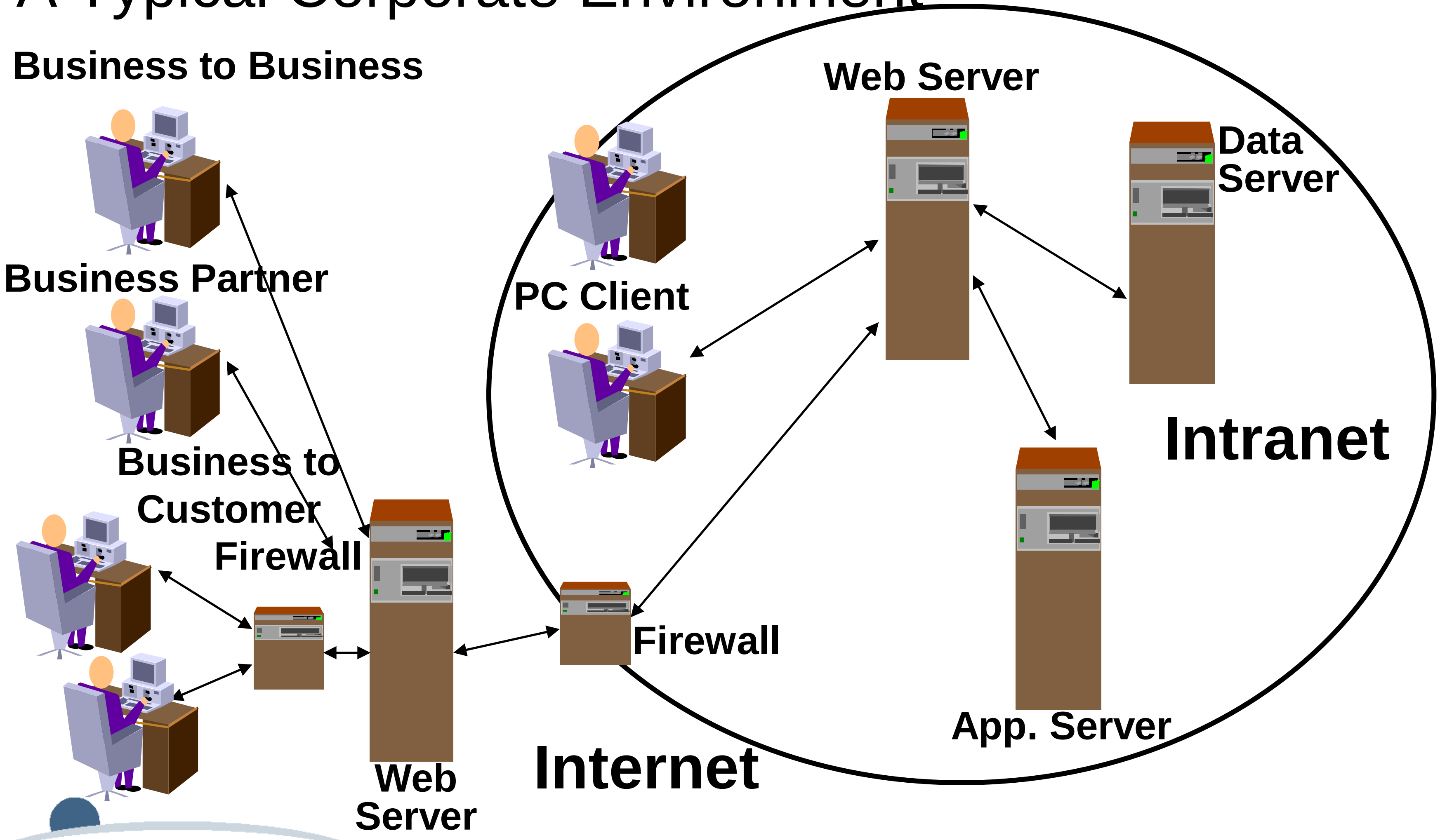
Testing Categories and Types

Role	Responsibilities
Human Interface	Usability Testing, Standards Compliance Testing
Unit	Unit Testing
Infrastructure Driven	Environment Configuration Testing, Performance Testing, Recovery Testing, Security Testing, Coexistence Testing
Business Driven	Functional Testing, Interface Testing, End to End Testing, Data Integrity Testing
Readiness	Implementation Testing, Beta Testing, User Acceptance Testing
Regression	Regression Testing, Sanity/Smoke Testing

nuevista group

Performance Testing

A Typical Corporate Environment



Performance Testing

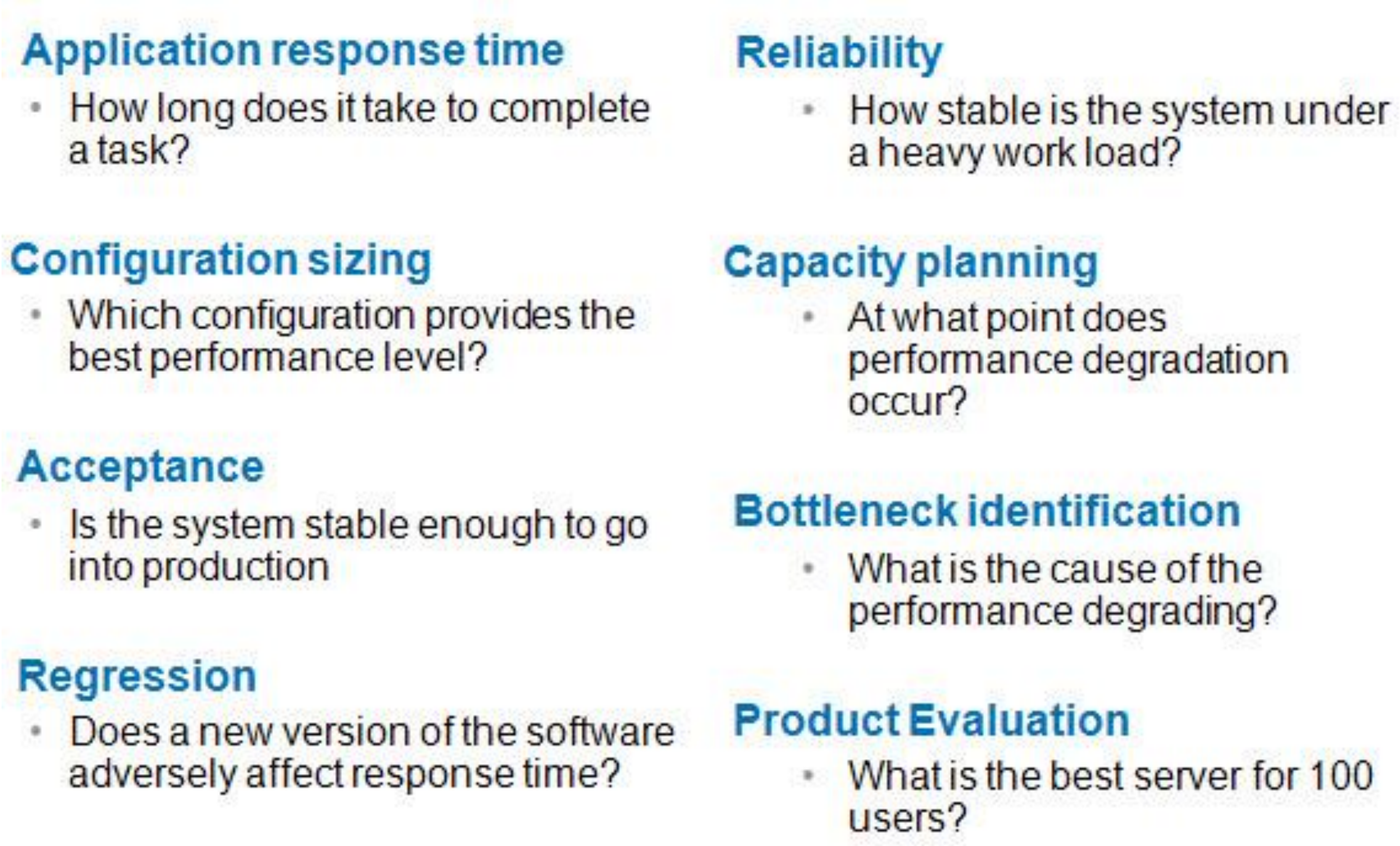
A Variety of Components

Performance testing can be performed on both hardware and software, below are several places where most business will conduct this type of testing

- Software Applications
- Networks
- Databases
- Mainframes
- Firewalls
- Routers

nuevista group

Performance Testing
Test Objectives



Application response time

- How long does it take to complete a task?

Configuration sizing

- Which configuration provides the best performance level?

Acceptance

- Is the system stable enough to go into production

Regression

- Does a new version of the software adversely affect response time?

Reliability

- How stable is the system under a heavy work load?

Capacity planning

- At what point does performance degradation occur?

Bottleneck identification

- What is the cause of the performance degrading?

Product Evaluation

- What is the best server for 100 users?

Performance Testing
Test Analysis – Common Measurements

- Processor
  - CPU Utilization
- Memory
  - % Committed Bytes
  - Pages / Sec
- Hard Drive
  - Average Disk Queue Length
  - Disk Transfer Rate
- Database
  - Number of Concurrent Connections
  - Number of Record Locks

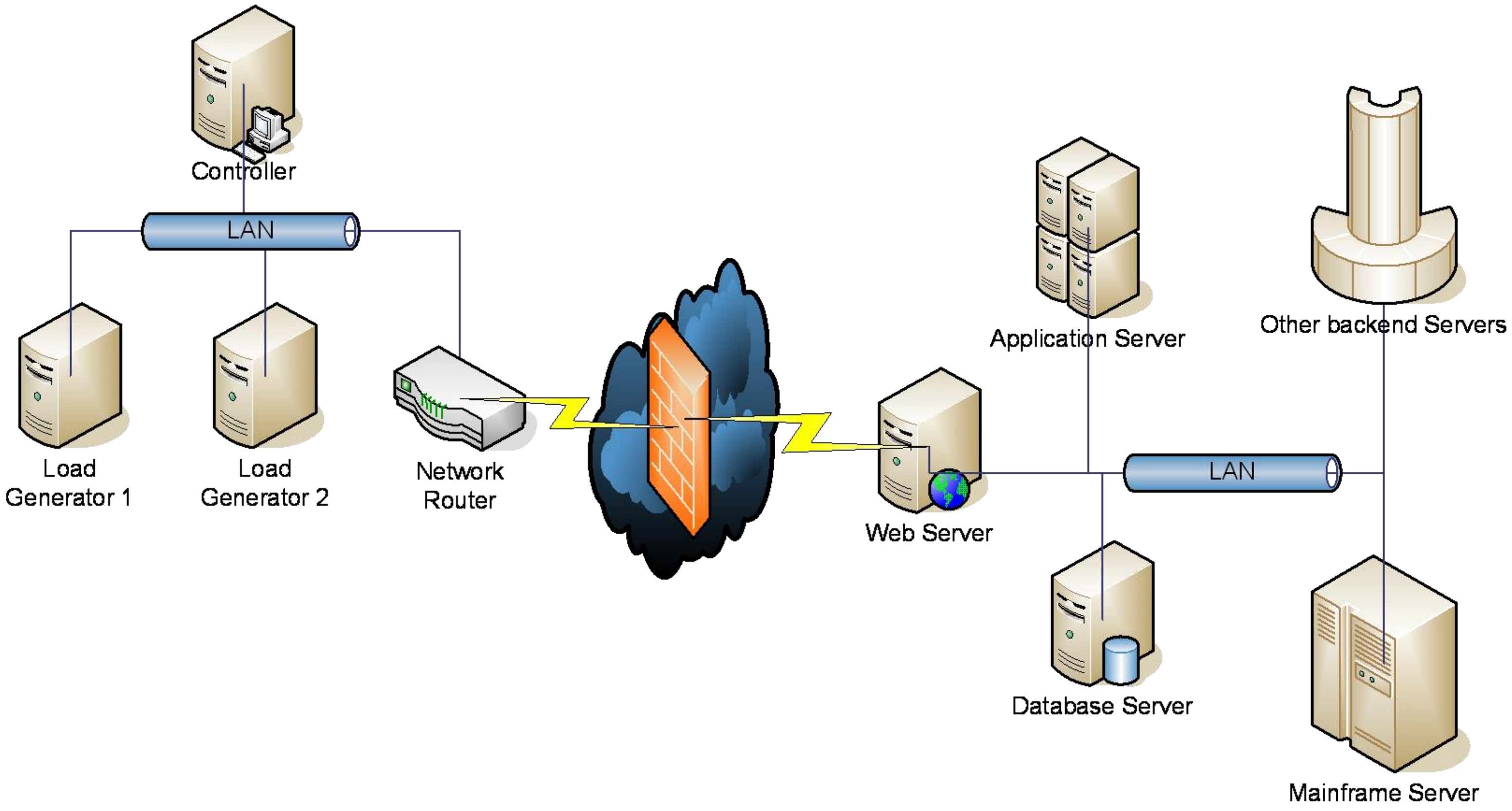
Performance Testing
Test Tool Components

Most Performance or Load Testing Tools will be broken down into these 3 main pieces. They may be named differently, but they will perform the same action

- Controller
- Load Generator(s)
- Virtual Users

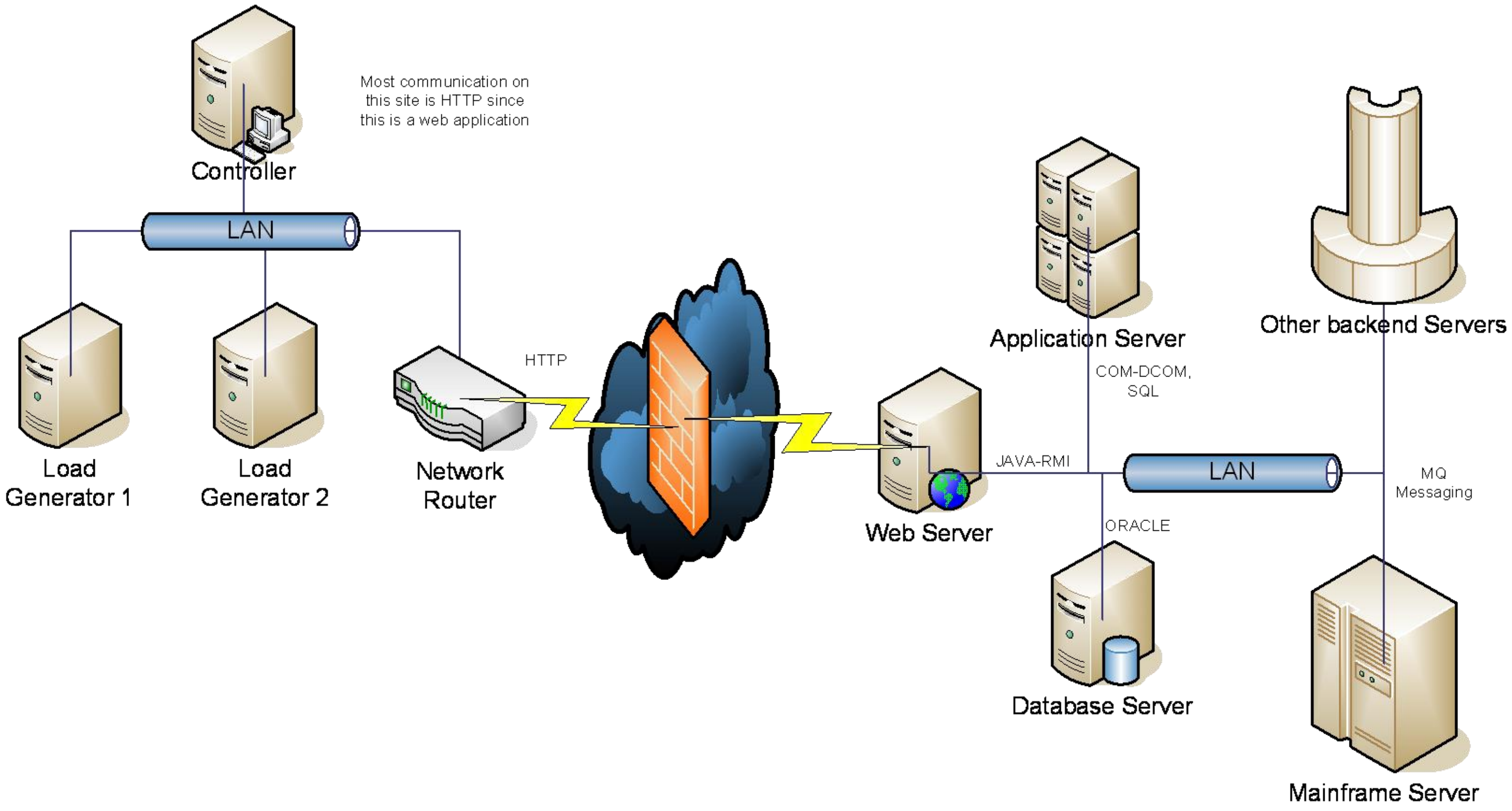
nuevista group

Performance Testing
Test Tool Components



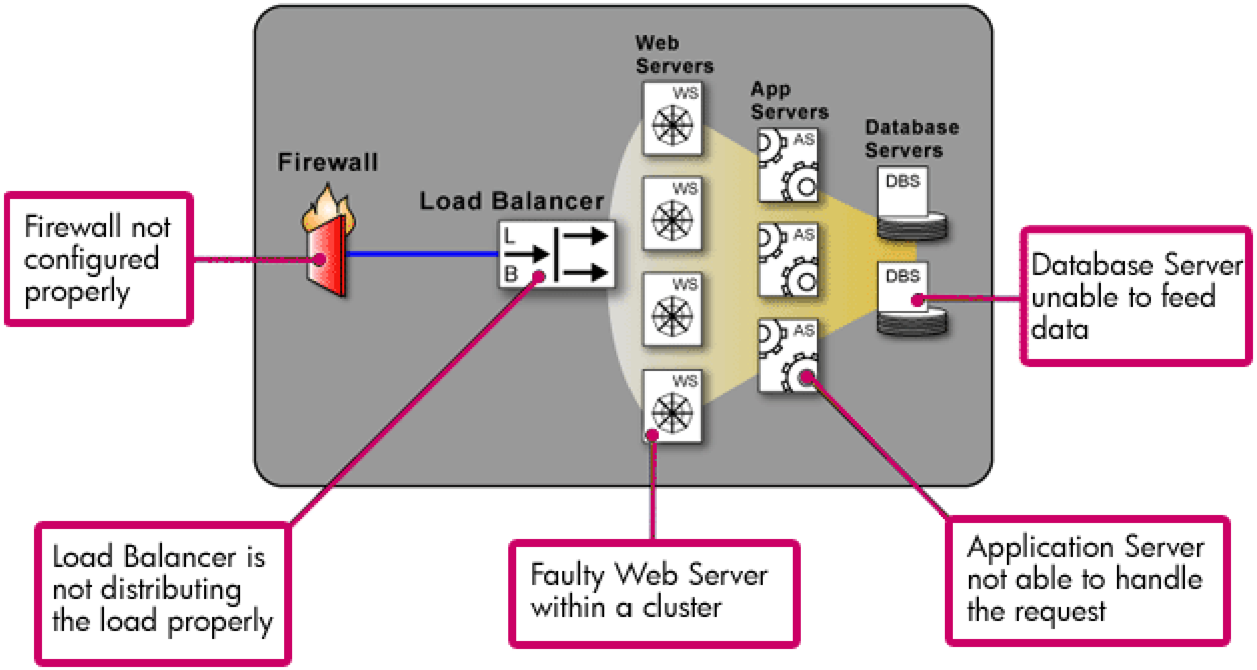
nuevista group

Performance Testing
Test Tool Components



Performance Testing

Monitoring Application Components



Firewall not configured properly

Load Balancer is not distributing the load properly

Faulty Web Server within a cluster

Application Server not able to handle the request

Database Server unable to feed data

Performance Testing Roles, Tasks, and Activities

nuevista group

Performance Testing

Roles and Responsibilities

- Automation Architect
- Automation Developer
- Test Manager
- Application SME
- Hardware / Network SME
- Database Administrator

Performance Testing
Requirements Gathering

- Use a Project Questionnaire and Performance Testing Informational Survey to gather information such as:
  - Project scope
  - Workload
  - Test data
  - Monitoring Tools
  - Environment
- Use Techniques such as Joint Requirements Planning (JRP) and Reverse Engineering to gather requirements

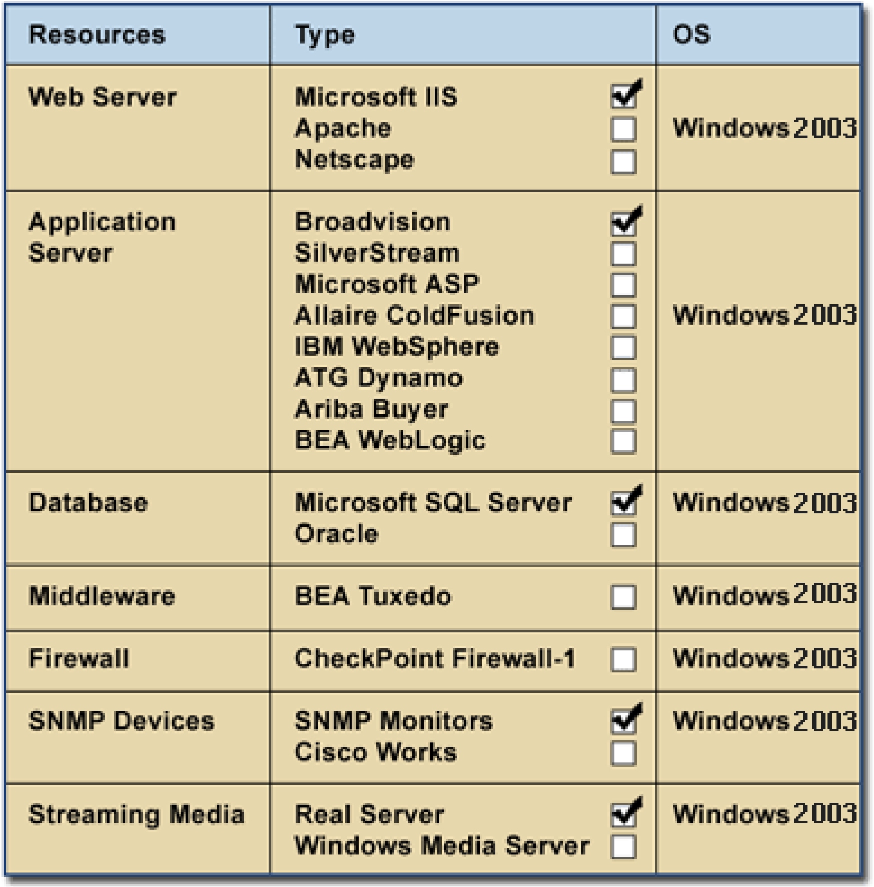
Performance Testing
Requirements Gathering

- Operating Systems – Windows, Linux, etc.
- Application Languages - .Net, Java, J2EE, SAP, Oracle, etc.
- Communication Protocols – http, COM/DCOM, MQSeries, etc.
- Browsers – Internet Explorer, Firefox, etc.
- Platform
  - Mainframe
  - Object Oriented
  - Service Oriented Architecture

nuevista group

Performance Testing

Requirements Gathering – Another View



Resources	Type	OS
Web Server	Microsoft IIS ☑ Apache □ Netscape □	Windows 2003
Application Server	Broadvision ☑ SilverStream □ Microsoft ASP □ Allaire ColdFusion □ IBM WebSphere □ ATG Dynamo □ Ariba Buyer □ BEA WebLogic □	Windows 2003
Database	Microsoft SQL Server ☑ Oracle □	Windows 2003
Middleware	BEA Tuxedo □	Windows 2003
Firewall	CheckPoint Firewall-1 □	Windows 2003
SNMP Devices	SNMP Monitors ☑ Cisco Works □	Windows 2003
Streaming Media	Real Server ☑ Windows Media Server □	Windows 2003

Performance Testing
Analyze System Under Test (SUT)

- Map System Architecture Data Flow
- Identify key components within the system architecture
- Verify performance testing tool compatibility with the SUT
- Review System Architecture with Project Team

Performance Testing
Plan and Acquire the Test Environment

Confirm the infrastructure

- Options include production-like test environment or Disaster Recovery site

Confirm the source and volume of test data

- Performance testing can use large amounts of data
  - Login IDs for all virtual users
  - Data for all types of transactions
- Determine how test data will be obtained and used

Performance Testing
Transaction Concurrency

How many transactions will need to be run per minute if a load test has to be run for two hours with 5000 users, assuming an average transaction length of five minutes?

Determine how many transactions run per minute:

- 120 min / 5 min = 24 iterations for each user
- 5000 users X 24 iterations = 120,000 transactions
- 120,000 transactions / 120 minutes = 1000 transactions per minute

Apply the transactional concurrency to the application:

- The test is run during the 10 AM-12 NOON time slot
- The test should consist of 5000 users running 24 iterations
- The system must be able to handle 1000 transactions per minute

Performance Testing

Utilize a Transaction Matrix

A Critical Tool to Successful Design

- Identify user profiles to the System Under Test (SUT)
- Identify the transactions within each user profile
- Document Transaction Matrix

Performance Testing

Benefits of a Transaction Matrix

- Tells the probable kinds of users to the system
- Tells which transactions are to be performed by each of the identified users to the system
- Helps in scripting the performance test cases, by easily making out what transaction is performed by each of the identified users to the system.

Concurrency Survey

Performance Testing

Create the Transaction Matrix

- Analyze the SUT
- Review the business requirements documentation
- Identify the different transactions that could be performed in the application during peak load
- Create a Distribution Matrix
- Identify the probable different end-users who you think will be visiting the site
- Identify what transactions will be performed by each of the users you have identified

Performance Testing
Sample Distribution Matrix

	8:00am	9:00am	10:00am	11:00am	12:00pm	1:00pm	2:00pm
Login	20	10	5	30	50	20	10
Search	40	30	10	50	100	40	30
Search Top 100	15	5	2	10	20	15	5
Search by Artist	20	20	6	30	50	20	20
Search by Title	5	5	2	10	30	5	5
Add to Cart	20	10	4	20	30	20	10
Checkout	20	5	4	10	20	20	5

Performance Testing

Sample Transaction Matrix

		Home Page	Login	Search	Add to Cart	Checkout
Casual User		30				
1st Time User		10	10	40	10	10
	1st Time Buyer	5	5	20	5	5
Repeat User		40	40	60	25	15

Performance Testing

Test Scenario Selection

- It is not feasible to load test every transaction \ Business Process
- Identify transactions that are:
  - Data intensive
  - High Volume
  - Mission Critical
- Concentrate on a peak time frame to find peak load
- Create a transaction matrix to identify possible scenarios and user profiles
- Typically 20% of the users will generate 80% of the load on a system so not all user types need to be represented.

Performance Testing

Creation of Performance Test Scenarios

- Analyze and document the performance requirements
- Interview the Business and Development personnel
  - Review performance test objectives
  - Review user profiles
  - Review transactions to be performed by the users
  - Review metrics
  - Identify and document the Scenarios for the test

Performance Testing

Creation of Performance Scenario Document

- Scenario document tells the probable percentage of users identified to the system
- The metrics identified for each of the users will be used while constructing a work load definition before executing the scripts
- Scenario document helps in creating a test suite execution plan enabling the smooth flow in the communication channel before executing the scripts.

nuevista group

Performance Testing
Sample Performance Scenarios

- Load Test

– Home Page User	20%
– Product User	20%
– Search User	10%
– Repeat User	50%

Ramp of users at an interval of 1 user every 5 seconds until 350 users are logged in for 60 minutes

Performance Testing

Sample Performance Scenarios

- Scalability Test

– Home Page User	25%
– Product User	25%
– Search User	15%
– Repeat User	55%

Ramp of users at an interval of 1 user every 3 seconds with continuous ramp up for 30 minutes

Performance Testing

Test Execution

- Run the script with one virtual user to verify a baseline for the test
- Run the script with five virtual users to verify a baseline for the test with multiple users
- Verify / schedule test script execution by communicating to the team members
- Run the script as per the scenarios developed

Performance Testing

Test Analysis

- Analyze results in the Performance Test Suite and the SUT
- Generate defect report for the SUT
- Meet with the technical experts to analyze the test results
- Generate Performance Test Suite (PTS) modifications report
- Create Summary report of the results
- Analyze reports to identify trends, problems and opportunities

Performance Testing

Test Analysis

During the execution of a performance test, a failure does not always mean that a defect has been found. The result will need to be analyzed to find the root cause:

- A test tool problem may arise
- A piece of hardware may be down for maintenance during the test or unavailable
- The data source may be unavailable or have incorrect data in it

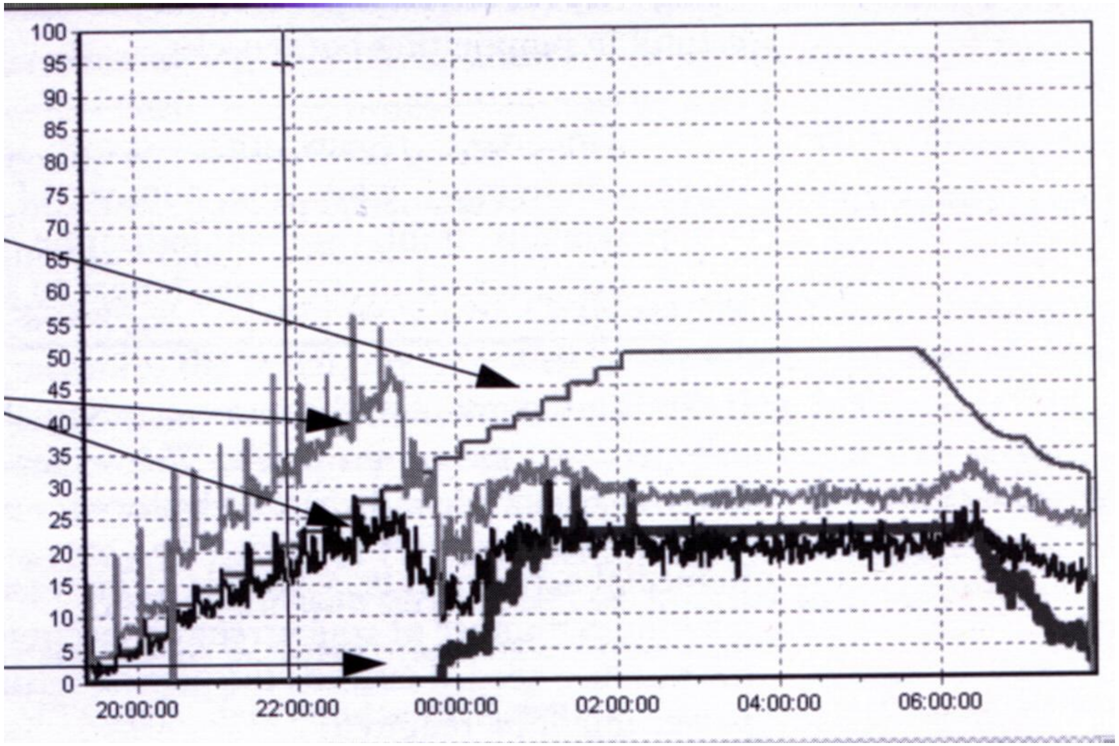
Performance Testing

Test Analysis – Sample Results Graph

Number of visitors increases

But KB per second and transaction per second falls

Because transactions start to fail



Performance Testing

Test Evaluation

- Verify that all requirements were met
- Identify and evaluate any outages
- If there are any items that need action, decide on the best way of addressing the items. Options include:
  - do not close the project
  - define a follow-on project
  - initiate a maintenance process.
- Consider how the Test Suite will be maintained

nuevista group

Performance Testing Design Options

nuevista group

Performance Testing

Test Design Options

- Testing approach should meet the “client” test objectives. Typically it is a combination of the following types of performance tests:
  - Load Testing
  - Baseline
  - Scalability / Capacity
  - Stress and Hot Spot Testing
  - Spike and Bounce Testing
  - Endurance Testing
  - Integrity Testing

Performance Testing
Test Design Options

- Load Testing

  Attempts to model the anticipated real world usage and utilization over a short period of time, with the expected number of users and average user interaction delay times. This is looking for the typical user experience.

- Baseline

  Initial test from which remaining tests are measured, typically measured with one user.

- Scalability / Capacity

  Testing by increasing the workload in an effort to determining stress points and to measure the limits of the capacity of the system.

- Stress and Hot Spot Testing

  Testing over a short period of time when the site is hit with larger than expected loads, requiring extensive computations/data retrieval. Here you are looking for how the system breaks down under stress. A variation is “hot spot testing”, where you focus the stress on a specific portion of the product, looking for a weak link.

Performance Testing

Test Design Options

- Spike and Bounce Testing

  Testing with a sudden growth in load over a very short period of time, looking to see if the system can respond to abrupt changes in the workload. A variation is to follow the spike with a bounce down to a very low load level, and then continue repeating the up and down pattern. This tests whether the system can recycle its resources properly.

- Endurance Testing

  A load or stress test that is run for an extended period of time, typically several days, with the purpose of detecting slow-to-appear defects. This measures the reliability of the system.

- Integrity Testing

  Combines functional testing with stress testing to ensure that functionality, which worked under low volumes still works.

Design Survey

Performance Testing

Test Scripting Techniques

When creating a Performance Testing script you will use a method called “Record & Playback”.

- While discouraged in Functional Test Automation, it is the recommended method of script creation in Functional Test Automation
- The script will be recorded, then modifications will be made as necessary to add user data from files or databases to simulate different users at test time

Performance Testing Exercise

Performance Testing

Review

- Outline the components of a performance test and considerations
- Discuss various roles, tasks, and activities
- Review several design approaches specific to performance testing

Questions and Discussion

Michael Lawler

mikelawler@nuevista.com

www.nuevista.com

630-472-6838, x 104