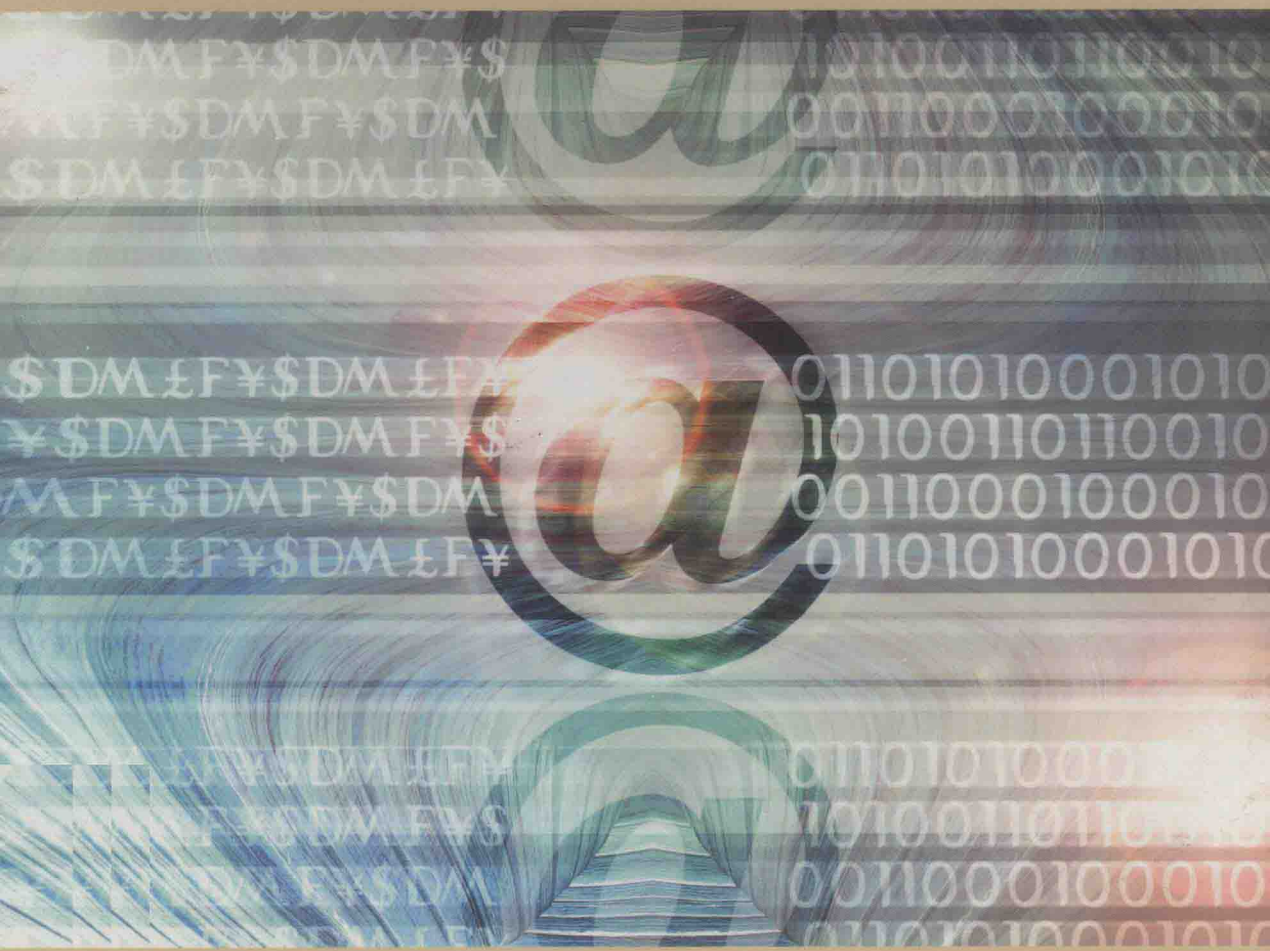
Integrated Approach to Web Performance Testing

A PRACTITIONER'S GUIDE



B. M. SUBRAYA

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A Practitioner's Guide

B. M. Subraya
Infosys Technologies Limited, Mysore, India

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Foreword

Globalization, aided by technology innovation and newer, faster communication channels are changing the basis of competition across industries today. To compete, firms must rapidly respond and adapt to a changing market and create responsive, flexible links across their value chains.

In this environment, the advent of *Web-based systems* has created a range of opportunities for organizations. Web-based systems and applications are enabling businesses to improve workflow costs and efficiencies across their supply chains, streamline and integrate their business processes, and collaborate with value-chain partners to deliver a strong value proposition to their customers.

Ensuring the robustness and reliability of Web-enabled systems has, therefore, become an increasingly critical function. *Integrated Approach to Web Performance Testing: A Practitioner's Guide* addresses the realities of performance testing in Web systems and provides an approach for integrating testing with the software development life cycle.

By offering a mix of theory and practical examples, Subraya provides the reader with a detailed understanding of performance testing issues in a Web environment. He offers an experience-based guidance of the testing process, detailing the approach from the definition of test requirements to design, simulation and

benchmarking, and building, executing and analyzing testing strategies and plans. The book also details key processes and issues involved in test automation, as well as performance monitoring and tuning for specific technologies.

The chapters are filled with real-life examples, as well as illustrative working code, to facilitate the reader's understanding of different facets of the testing process. The discussion of testing methodology is anchored by a running case study which helps illustrate the application of test plans, strategies, and techniques. The case study and examples help demonstrate various approaches in developing performance testing strategies, benchmark designs, operation profiles and workloads. By bringing an experiential understanding into aspects of Web performance testing, the author is able to offer useful tips to effectively plan and execute testing activity. In addition, the book offers various guidelines and checklists to help practitioners conduct and analyze results using the various testing tools available for Web based applications.

The book provides a highly systematic approach to performance testing and offers an expert's eye view of the testing and functionality of Web systems. Subraya is careful to provide broad, initial groundwork for the subject in his first three chapters, which makes this text accessible even to the beginner.

Integrated Approach to Web Performance Testing: A Practitioner's Guide will prove to be a valuable tool for testing professionals, as well as for students, academicians and researchers.

N. R. Narayana Murthy, Chairman and Chief Mentor
Infosys Technologies Ltd.

Preface

In the current scenario where Information and Communication Technology (ICT) integration has become affordable, most organizations are looking at every single application to be Web-enabled. The functional aspects of an application get reasonable treatment, and also abundant literature is available for the same, whereas no books or insufficient literature is available on the performance aspects of such applications. However, the requirement for developing or creating systems that perform well in the Web commerce scenario is uncontestable.

The proliferation of Internet applications in recent years is a testimony to the evolving demands of business on technology. However, software life cycle methodologies do not yet seem to consider application performance as a critical parameter until late in the developmental process. Often, this impacts cost and delivery schedules negatively, leading to extensive rework and also results in unsatisfactory application performance. In addition, the field of performance testing is still in its infancy, and the various activities involved do not seem to be well understood among practitioners.

Today, Web based software systems are both popular and pervasive across the world in most areas of business as well as in personal life. However, the software system development processes and the performance testing processes do not seem to be well integrated in terms of ensuring adequate match between required and actual performance, especially since the latter activity is usually carried out very late in the developmental life cycle. Further, for practitioners, it is critical to understand the intricacies of environments, platforms, and tech-

nologies and their impact on the application performance. Given the wide spectrum of technologies and tools employed in the implementation of systems for different platforms, and a variety of tools used for performance testing, it is important to understand which of the parameters associated with each one of these is significant in terms of their effect on the system performance.

This book fulfills this void and provides an integrated approach and guidelines to performance testing of Web based systems. Based upon a mix of theoretical and practical concepts, this work provides a detailed understanding of the various aspects of performance testing in relation to the different phases of the software development life cycle, using a rich mixture of examples, checklists, templates, and working code to illustrate the different facets of application performance. This book enables a practical approach to be adapted in making appropriate choices of tools, methodologies, and project management for performance testing.

The material presented in the book is substantially based on the experience gained by studying performance testing issues in more than 20 IT application development projects for leading global/fortune 500 clients at Infosys Technologies Limited (a leading CMM level-5 global company specializing in software consulting, www.infosys.com) since 2000. This has been further reinforced through the delivery of more than 10 international preconference tutorials and more than 18 internal workshops at Infosys. Research studies conducted in this area by me has led to eight publications in various national and international conferences. Feedback from participants in tutorials and workshops in addition to those from reviewers has been used extensively to continuously refine the concepts, examples, case studies, and so forth presented in the work to make it useful for designers and architects.

Using a running case study, this book elucidates the concept of performance life cycle for applications in relation to the development life cycle; this is subsequently specialized through an identification of performance related activities corresponding to each stage of the developmental life cycle. Performance test results from the case study are discussed in detail to illustrate various aspects of application performance in relation to hardware resources, network bandwidth, and the effects of layering in the application. Finally, guidelines, checklists, and tips are provided to help practitioners address, plan, schedule, conduct, and analyze performance test results using commonly available commercial performance testing tools for applications built with different technologies on different platforms, together with enabling them to identify and resolve bottlenecks in application performance.

This book is written primarily for technical architects, analysts, project managers, and software professionals who are involved in development and management of projects. By using various techniques described in this book, they can systematically improve the planning and execution of their performance testing

based projects. This book could also be used as a text in a software testing course or it can be introduced as an elective course for graduate level students. The book is targeted toward two types of readers: the novice and those who have been exposed to performance testing. The first three chapters are devoted mainly to a novice reader who needs a strong foundation with necessary ingredients on performance testing. The book provides many benefits to different categories of professionals.

The benefits from this book would include:

- A method to capture performance related data during requirement analysis;
- A process and method to plan and design for performance tests;
- A process and guidelines for analyzing and interpreting performance test data;
- Guidelines for identifying bottlenecks in application performance and remedial measures;
- Guidelines for optimal tuning of performance related parameters for applications developed using a sample set of different technologies.

Chapter 1 starts with an overview of software testing and explains the difference between Web application testing and client server testing, particularly performance testing, and sets the context for this book. This chapter also discusses the implications of poor performance and the need for performance testing and sets an abstract goal. Though the performance testing objective is to ensure the best field level performance of the application before deployment, it is better to set subgoals at each level of testing phases. To meet such goals, one needs to understand the basic definition of various types of performance testing like load testing, stress testing, and their differences. What type of testing is required to meet the goal or what kind of comprehensive performance testing is required to ensure an optimal result best understood by the LESS approach which is discussed in this chapter? Finally, the myths on performance testing which are always hogging around project managers while investing on tools and time required to complete the testing is removed in this chapter.

Once the importance of the performance of an application is known, it is necessary to understand how various factors affect the performance. The factors could be many and varied from different perspectives like technology, project management, scripting language, and so forth.

Chapter 2 discusses more on these factors that affect the performance. For instance, technical peculiarities like too many scripting languages, mushrooming of browsers, and Rapid Application Development approach affect the per-

formance of the application. Further, different environments like client server environment may affect the performance of the application. A firewall is one of the important components which is needed to secure the application, but it slows down the performance of the application. Likewise, all possible aspects affecting the performance are discussed in this chapter.

Performance testing is not to be construed as features testing even though it has a definite linkage with the latter. In fact, performance testing begins from where the feature testing ends, that is, once all the desired functional requirements expected from the system are fully met. Both features and performance testing are in one way or another impacted by the various technologies and languages.

Chapter 3 provides insight about the technology aspects, including the software languages necessary for Web development. Without understanding the technology, working on performance testing is difficult. Hence, the topic on reference technology will help readers to understand and to appreciate the performance testing discussed in later chapters. This chapter also discusses various issues like network performance, technology, and user's perception.

Once the basic building blocks on concepts about performance testing and its importance on Web application are ready, the reader is comfortable to dwell on the process of conducting the performance testing as a practitioner would.

Customarily, designers address performance issues close to the end of the project life cycle, when the system is available for testing in its entirety or in significantly large modular chunks. This, however, poses a difficult problem, since it exposes the project to a potentially large risk related to the effort involved in both identifying as well as rectifying possible problems in the system at a very late stage in the life cycle. A more balanced approach would tend to distribute such risks by addressing these issues at different levels of abstraction (intended to result in increased clarity with time), multiple times (leading to greater effectiveness and comprehensiveness in testing application performance), and at different stages during the life cycle. The very first component of activities related to preparation for such testing is in collecting and analyzing requirements related to the performance of the system alongside those related to its features and functions.

The main objectives of Chapter 4 is to define goals of performance testing, remove ambiguities in performance goals, determine the complexity involved in performance testing, define performance measurements and metrics, list risk factors, and define the strategy for performance testing.

Real performance testing depends on how accurately the testers simulate the production environment with respect to the application's behavior. To simulate the behavior of the Web site accurately, benchmarks are used. The benchmark is a standard representation of the applications expected behavior or the likely real world operating conditions. It is typically essential to estimate usage pat-

terns of the application before conducting the performance test. The behavior of the Web site varies with time, peak or normal, and hence the benchmarks do also. This means, there is no single metric possible. The benchmark should not be too general as it may not be useful in particular. The accuracy of the benchmark drives the effectiveness of the performance testing.

Chapter 5 highlights the complexity of identifying proper business benchmarks and deriving the operation pattern and workload from them. Types of workload and their complexities, number of workloads required and their design, sequencing various transactions within the workload and their importance, and required tools for creating the workload are some of the highlights of this chapter.

Design provides only the guidelines, but the build phase really implements the design so that execution of the test can be carried out later. Developing a good testing process guides the build phase properly.

Chapter 6 provides in-depth information on the build phase. The first activity in the build phase is to plan the various activities for testing. Preparing a test plan for performance testing is entirely a different ball game when compared to the functional test plan. A comprehensive test plan comprises test objectives, system profile, performance measurement criteria, usage model, test environment, testing process, and various constraints. However, building a comprehensive test plan addressing all the issues is as important as executing the test itself. The build phase also includes planning a test environment. Developing a test script involves identifying the tool, building proper logics, sequencing transactions, identifying the user groups, and optimizing the script code. Chapter 6 also drives the practitioners to prepare for the test execution. Once the preparation for test execution is ready, the system is ready for test execution.

Chapter 7 discusses more on practical aspects of test execution, wherein we address issues like, entry/exit criteria (not the same criteria as in functionality testing), scheduling problems, categorizing and setting performance parameters, and various risks involved. Practitioners can use this chapter as guidelines for their project during performance test execution.

Once the test execution is completed, the next task is to analyze the results. This is performed in post-test execution phase which is discussed in Chapter 8. The post-test execution phase is tedious and has multifaceted activity. Testers normally underestimate the complexity involved in this phase and face the uphill tasks while tuning the system for better performance. This chapter mainly discusses the revisit to the specific test execution through logs, defines a method/strategy for analysis, compares the results with standard benchmarks, and identifies the areas of improvement. Guidelines for performance tuning are also discussed here. The chapter mainly helps the practitioner who is keen on test execution and analysis of results.

By now, most practitioners understand the complexity of the performance testing and the inability to conduct such a test manually. Managing the performance

testing manually and handling performance issues are next to impossible. Automation is the only solution for any performance testing project, with the best tools available on the market. There is a need for automation and the automation process. Test automation is not just using some tools, and the common assumption is that the tool solves the performance problems. Testers are not aware of the complexities involved in test automation.

Chapter 9 is dedicated to set up a process for test automation and highlights various issues involved in test automation. Some of the strategies to succeed in test automation, based on the author's vast experience in performance testing, are also discussed in this chapter. Practitioners always face problems while selecting a proper automation tool. We present a set of characteristics of a good tool and a survey of available tools in the market. The chapter summarizes by presenting the guidelines for test automation.

Any application should be performance conscious; its performance must be monitored continuously. Monitoring of performance is a necessary part of the preventive maintenance of the application. By monitoring, we obtain performance data which are useful in diagnosing performance problems under operational conditions. This data could be used for tuning for optimal performance. Monitoring is an activity which is normally carried out specific to technology.

In Chapter 10, we highlight performance monitoring and tuning related to Java and .NET. The first nine chapters together described the performance testing from concept to reality whereas Chapter 10 highlights aspects of monitoring and tuning to specific technologies. This chapter provides an overview of monitoring and tuning applications with frameworks in Java and .Net technologies. Readers must have basic exposure to Java and .NET technology before understanding this chapter.

To help practitioners, a quick reference guide is provided. Appendix A discusses the performance tuning guidelines. Performance tuning guidelines for a Web server (Apache), a database (Oracle), and an object oriented technology (Java) are presented. Along with this, .NET coding guidelines and procedure to execute Microsoft's performance monitoring tool, PERFMON, are also discussed. Characteristics of a good performance testing tool and a comparative study of various tools are presented in Appendix B. Further, some templates on performance requirement and test plan are provided in Appendix C for easy reference.

Though guidelines on planning, execution, and result analysis are discussed in various chapters, they are better understood if discussed with a case study. Accordingly, a detailed case study on banking function is taken and discussed. Appendix D highlights various aspects of the case study and brings concepts to practices. A virtual bank is considered and simple routine business functions are considered. Here more emphasis is given on performance and thus only relevant business functions which impact performance are considered. This

case study provides the performance requirement document and basic design document on performance testing. Only a sample workload, one test run, and relevant results are presented and discussed. The case study will help practitioners validate their understanding from the book.

This book addresses only the performance testing aspects, not performance engineering like capacity planning.

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B. M. Subraya
Mysore, India
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