Microsoft®*Press*
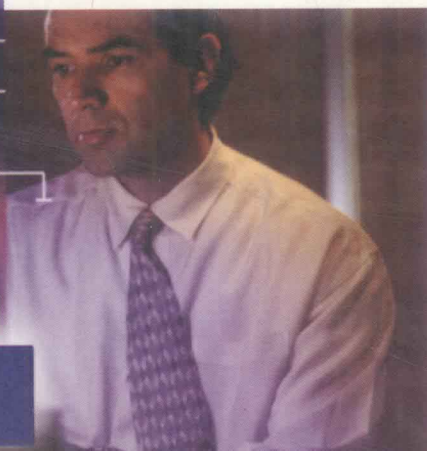
Windows

Microsoft®
Windows 2000
性能调试技术手册
（影印版）

Microsoft®
Windows 2000
Performance
Tuning
Technical
Reference

- 完备的操作技术手册
- Windows 2000 Server 性能优化的专业指南
- 适合各种规模机构中的系统管理人员

deploy

configure

optimize

［美］ John P. Mueller
Irfan Chaudhry 著

enhance

IT Professional

Microsoft Windows 2000
性能调试技术手册（影印版）

[美] John P. Mueller
Irfan Chaudhry 著

北京大学出版社

内 容 简 介

本书以各种实际操作技巧和关于最新调试工具的信息，向读者介绍 Windows 2000 的性能调试技术。具体内容有：进程、线程和内存管理对性能的影响，CPU、内存、磁盘等故障对网络性能的影响以及相应的诊断和解决方法，Active Directory 等高级特性在性能调试中的应用，如何利用最新的调试工具，如何将 Windows 2000 优化成一台 Internet 服务器。

本书适合中、高级技术人员阅读。

出 版 前 言

如果用一个成语来概括国内计算机图书市场的现状，当谓之"汗牛充栋"。然而，如果您是一位从事计算机应用系统开发或管理的中、高级专业人士，很可能发现这貌似种类齐全的计算机图书中，为您量身定做的并不多见。

依据多年从事计算机图书工作所积累的经验，以及与 IT 领域广泛而深入的接触所获取的信息，我们认识到，具有相当的专业深度和技术前沿性的图书，是计算机专业人员的迫切需要，当然，也是我们从事计算机图书工作、服务专业领域的一大着眼点。

基于这一点，2000 年元月，我们与微软出版社(Microsoft Press)达成合作协议，成立微软图书影印中心，独家代理微软出版社图书影印版在中国大陆的出版、发行，为 IT 业界提供及时的专业技术服务。选题和策划上的匠心独运，使得我们的影印书成为计算机图书中的标新立异者。这里，有四大特色值得读者朋友予以关注：

首先，这是微软出版社第一次授权在中国大陆影印、发行它的版权书。在选题上，可以说独辟蹊径。在内容上，立足技术广度和深度，系统推介微软产品。所有这些，都是目前国内一般计算机图书所无法比拟的。

其次，我们的理念是为国内计算机专业人员学习前沿性的微软技术提供服务。为此，我们不但与微软公司紧密协作与沟通，及时掌握微软最新技术动向，而且组织了精干的工作人员，倾力于微软影印书的出版和发行。

再者，微软影印书主要面向中、高级专业人员，印量有限。这类书的读者对象有较强的针对性，一般来说，包括 IT 决策人员，中、高级开发人员，以及中、高级系统管理人员。因而，我们将每套书的印数控制在 1000~2000 册之间。

最后，微软图书影印版几乎与原版书保持同步发行，最大限度地满足了国内读者跟踪微软最新技术的需求。软件升级越来越快，新软件令人目不暇接。作为技术载体之一的图书，只有迅速作出反应，把新软件介绍给读者，才能赢得他们的青睐。总之，兵贵神速，这是我们的目标。

正应验了前人的预言，21 世纪是一个信息时代。软件作为信息系统的神经，在我们生活的这个时代里发挥着举足轻重的作用，而微软公司和它推出的各种软件，更是令世人为之瞩目。我们将立足图书，继续并扩大与微软公司的合作，在中国信息产业的发展道路上留下自己的足迹。

出版者
2000 年 10 月

Dedication

This book is dedicated to our wives, Rebecca Mueller and Noreen Chaudhry, who have given up many hours of comfort for the reader's illumination.

Acknowledgments

Thanks to Rebecca Mueller for helping to complete this book. She researched and compiled some of the information that appears in this book (especially the Glossary). She also did a fine job of proofreading the first draft and page proofing the final result. Lynn Lunik, Robert Lyon, and Jack Beaudry deserve thanks for their technical edit of this book. They greatly added to the accuracy and depth of the material you see here. In addition, they worked very hard in researching some additions for the book. Matt Wagner, our agent, deserves credit for helping us get the contract in the first place and taking care of all the details that most authors don't really think about. We really appreciate the thoughtful and kind way that he dealt with some of the problems we had while writing this book. Certainly, he made our jobs much easier than they could have been under the circumstances.

The technical support staff at Microsoft deserves credit for answering the questions that helped fill in the blanks, especially when it came to finding some of the product features we talk about in this book. The vendor support staffs listed in Chapter 16 were also quite helpful. Likewise, we'd like to thank the people on the various Internet newsgroups we visited.

Finally, we would like to thank David Clark, Tracy Thomsic, Lynn Finnel, and the rest of the production staff for their assistance in bringing this book to print. It was a real joy working with all of them and both of us look forward to working with them on future projects.

Introduction

Everywhere you look in the trade press today, someone's talking about performance issues. It doesn't matter if the article is about local area networks (LANs), wide area networks (WANs), metro area networks (MANs), the Internet, an individual server, or even a single component within that server. Everyone wants to get the performance they paid for, and, if possible, get better performance than they expected. That's why performance tuning and optimization (PTO) is so important. Time is money, and everyone wants to reduce costs by reducing the time required to perform tasks on their network.

Okay, so management is thrilled that it takes half the time today to get a report out than it did yesterday. What's in PTO for you? If an administrator can tune a server to provide even a modicum of performance improvement, management is certain to take notice because of the savings in new equipment and user efficiency. In addition, users react favorably when they see that network tasks are completed in record time. In short, the techniques in this book will reduce your workload, enhance how management views your capabilities, and make you popular with the people using the network.

What You Learn

What can you expect to learn by reading this book? This book concentrates on PTO problems that occur in a variety of places. We begin by looking at the server (both hardware and software), and then move to the network, special devices like storage area networks (SANs), and even the user. Obviously, we mention relevant infrastructure problems that could cause poor Windows 2000 performance, but that isn't the main focus of the book. We also cover generic tuning topics like application performance and tuning.

Besides generic tuning topics, we look at some of the more important Windows 2000 Server-specific topics like Active Directory optimization. The book addresses issues regarding replication of Active Directory services across enterprise networks, multiple domains, and single domains in LAN or WAN networks. Since Active Directory services is a new technology, many administrators aren't certain how to proceed when it comes

to tuning this essential part of Windows 2000. Armed with the knowledge in this book, you'll be able to deal with most of the Active Directory PTO problems that can occur on a system.

Any book that wants to truly address the needs of today's administrator needs some material on working with the Internet. The Internet introduces a wealth of difficult-to-find, yet frustratingly widespread, tuning problems. The fact that network bandwidth of the Internet is at a premium doesn't help matters much. As part of the Internet coverage, we review Internet-specific applications. In addition to this, we explain new features that Windows 2000 has that allow the administrator to fine tune the operating system when hosting Web sites on the server.

Windows 2000 Server is an operating system that requires in-depth knowledge in order to gain the most from the product. This book helps you understand how to approach PTO for a Windows 2000 Server. You get a lot of hands-on techniques and pointers to other places where you can find additional information. This book contains both theoretical and real-world information about PTO in the world of Windows 2000 Server.

Who Should Use This Book?

Anyone who wants to know more about the benefits of Windows 2000 Server PTO is a potential candidate for reading this book. We tried very hard to make every procedure clear, every bit of theory easy to understand, and every real-world experience as simple as we could. However, there are limits to what authors can cover in one book. *Microsoft Windows 2000 Performance Tuning Technical Reference* targets the experienced Microsoft Windows NT or Windows 2000 administrator. If you're a novice who's never worked with Windows before, you're definitely going to have trouble figuring out the contents of this book.

There are certain assumptions that we make about your current capabilities and knowledge level. For example, we assume you're already familiar with the Windows 2000 operating system and don't need additional information to complete common tasks that administrators should be familiar with. We also expect you to have some knowledge of common computer terms, although the Glossary in the back of the book should help with any terms you're unfamiliar with. This isn't a book that helps novice readers discover how to work with Windows 2000, nor does it assist intermediate readers with the vagaries of security or application installation.

What You Won't Find Here

It's important you understand that this is a book about PTO. We definitely cover just about everything you can think of when it comes to the issue of performance and how to correct performance problems through the use of tuning and optimization. However, this isn't the book you want to buy to learn to set up your system. We assume you already have a server in place and have spent some time working with it. You should have some ideas on what performance problems your server has when you pick this book up. We make every effort to point out other pitfalls you need to know about.

This book also has very little in the way of troubleshooting information. If you can't figure out why your network interface card (NIC) no longer communicates with the network, this book isn't going to help you find an answer. We're assuming your hardware works, for the most part, and all you really need to do is tune it to get optimum performance.

Finally, you won't find specific answers for your particular piece of equipment. This book is generalized PTO. What this means to you, as a reader, is that you find lots of suggestions on how to fix a problem, but that you probably have to perform some amount of research to find the specific solution that works for your equipment. Consider this book a flashlight that casts light on the topic of PTO. Even though we can shine a light for you, you still need to interpret what the light makes visible.

How This Book Is Structured

This book is packed with a lot of useful information about PTO. The following paragraphs summarize the book's structure and help you understand how the book can help you. Each description provides an overview of the chapter in question, which means you can gain a better appreciation of what the book can do to help you by reading these few paragraphs.

Chapter 1 Introduction to Performance Tuning and Optimization

This chapter contains information you need to understand the importance of PTO and how it can affect the performance of the server. The main purpose of this chapter is to provide you with a good reason to optimize your system, other than the fact that the boss has asked you to do it. Any task becomes easier if you have a personal reason to care and the knowledge to understand why the task is important.

Chapter 2 The Microsoft Windows 2000 Kernel

Even though the subject of the operating system kernel can be found in books that cover Windows 2000 Server, we feel it's absolutely necessary for this particular text because you need to understand the architecture behind the processes that take place under Windows 2000 Server. Also, changes that have taken place at the kernel level of the Windows 2000 operating system should be discussed and described so you understand how those changes might help with PTO. We take a look at a variety of kernel topics in this chapter, including an in-depth look at the hardware abstraction layer (HAL), Windows 2000 subsystems, Windows 2000 managers, and Windows 2000 applications.

Chapter 3 Processes and Threads and Memory Management

This chapter goes into detail about the theory behind processes, threads, multiprocessing, and memory management under Windows 2000. We explore both symmetric multiprocessing (SMP), which is the most common type of multiprocessing in use today, and asymmetric multiprocessing (AMP).

The purpose of this chapter is to explain how the multiprocessing capabilities of Windows 2000 can help improve the efficiency of the server. However, the chapter's purpose isn't just to define these terms, but to explain how features such as single-threaded processes, multithreaded processes, and thread priorities can affect performance of the server. You need this information to understand how multiprocessing and multithreading can have a negative effect on the server if not correctly tuned or configured.

Part of understanding processes and threads is learning how to view and work with them. This chapter will show you how to use various tools to view, monitor, and tune the performance of processes and threads. We'll look at both common and developer tools as part of the discussion. This part of the chapter represents the most direct use of process and thread theory that you can achieve.

This is one of those chapters that will seem long on theory and short on practical use. However, theory is very important when it comes to PTO. We also use this information in later chapters. For example, in Chapter 5 we use the information in this chapter to help you understand how to avoid processor bottlenecks.

Chapter 4 Performance Monitoring in Microsoft Windows 2000

This chapter provides a detailed look at the built-in System Monitor tool in Windows 2000. (This tool is actually part of the Performance MMC snap-in, all of which we cover in this chapter.) System Monitor is a tool Windows 2000 administrators must understand if they're looking to do any form of performance optimization. You also have an opportunity to review changes made to the Performance Monitor tool under Windows 2000. The chapter goes into detail on how to monitor the hundreds of counters available to administrators for performance analysis, but more importantly, it explains how to record data so they have results that are truly useful when analyzing PTO issues.

Chapter 5 Diagnosing Processor Bottlenecks

Processor-bound applications—those that rely heavily on the processor to perform their task—are quite common on Windows 2000 Server because of Microsoft's COM focus. This chapter begins by telling you how to detect and diagnose processor bottlenecks. Once you know how to recognize processor bottleneck problems, we review ways of correcting this problem. In addition to looking at current processor technology, this chapter also explores upcoming processor technologies that will reduce or eliminate common processor bottlenecks.

Chapter 6 Diagnosing Memory Bottlenecks

Understanding the causes of memory bottlenecks in your system is critical to diagnosing many kinds of Windows 2000 Server performance issues. For example, memory fragmentation—the way applications are placed within memory—can reduce the efficiency of Windows 2000. Memory bottlenecks don't just affect the operating system.

Poorly written applications can cause a myriad of problems, including inefficient use of memory by processes or threads. You might find that an application won't run because the server lacks enough memory to do so, yet the application will report an unrelated error to the user. In addition, application memory leaks cause a slow degradation of the server over time.

Of course, there are hardware-related problems that affect the Windows 2000 Server as well. For example, using error-correcting code (ECC) memory can improve server reliability, but often at the expense of server performance.

This chapter provides a multistep process for you to check for various types of memory problems. You learn to determine if a memory bottleneck exists; whether the cause of the bottleneck is the operating system, application, or hardware; and how to correct the problem.

Chapter 7 Diagnosing Disk Bottlenecks

This chapter helps you understand the causes of and cures for disk activity-related bottlenecks on your server. While Component Object Model (COM) or a spreadsheet application loads the processor, database applications load the disk drive. In short, it pays to know what type of application the server will run so you can predict which part of the server architecture will become the bottleneck.

We begin by helping you learn what you need to do to detect disk bottleneck problems under Windows 2000. We then look at how an administrator can correct those problems using built-in tools found in Windows 2000.

Of course, there are some unique areas of discussion for disk drives. We explore disk technologies such as RAID-5, mirroring, and duplexing, and how these technologies can help increase the performance of the server—for example, how RAID-5 can affect read/write performance of the server. Finally, since the enterprise server is moving toward external disk units, we cover performance issues related to technologies like SANs.

Chapter 8 Network Problems

The whole reason to install a server is to share resources of all types on a network. That's why network tuning is such an important issue for this book. Of course, given the complexity of network setups, it pays to look at sources of problems on the individual server first, and then look at network tuning issues. That's why this important chapter appears after the individual server-tuning chapters in the book—we're looking at a progression of simple to complex.

As in the past two chapters, this chapter begins with the sources of network bottlenecks. This means looking at features such as network topologies since different topologies have different problems.

Once you know the problem is network-related, you can utilize the tools available to you such as System Monitor and Network Monitor to analyze the network problem. System Monitor is packed with several network-related counters. The chapter explains the differences between these counters and what counters are the most commonly used when detecting network problems.

The chapter then goes into changes you can make at the Windows 2000 Server to correct these network-related problems. For example, there are several TCP/IP settings you can adjust. Another approach is to modify registry settings to increase server response time, in particular when running an Internet-based application. In addition to operating system-specific solutions, we also look at the other environmental factors that affect server performance like the hardware used to create the network and the kinds of tasks users typically perform on the network.

Chapter 9 Microsoft Active Directory Services and Tuning

In this chapter, we explore issues relating to replication of Active Directory services. Since Active Directory services is a new feature of Windows 2000, this chapter does spend a little time explaining how Active Directory services affects you, especially when it comes to performance. We then look at how the administrator can optimize Windows 2000 to increase performance of Active Directory services. The chapter covers items the administrator should watch for like slow network connections. A large part of the discussion centers on methods that can help decrease the time it takes for Active Directory replication.

Chapter 10 New Tuning Features in Microsoft Windows 2000

Windows 2000 has several new features that increase the performance of applications running on a Windows 2000 Server. This chapter explores how you can use each one to performance tune Windows 2000. For example, we look at what you can do to make your Web site react faster, yet more consistently, to user requests through the user of CPU and bandwidth throttling. We review how you can use process accounting to verify the amount of resources that each process is using on your Web site. Finally, we explain the latest method to use less bandwidth—HTTP compression.

This chapter doesn't stop with new Internet features. Microsoft has improved multiprocessor support in Windows 2000, so we review how this affects PTO. There are also some new technologies covered in this chapter like quality of service (QoS), Resource Reservation Protocol (RSVP), and Network Load Balancing (NLB).

Chapter 11 Capacity Planning

Most people have a basic understanding of what capacity is about—it relates to the server's ability to handle a specific load level. If the server had the same load every day, it would be easy to predict the capacity required to support more users or another application. However, real

networks have shifting loads of various types. One application might load the server, while another could load the disk.

This chapter covers the topic of capacity planning and what exactly it is. We touch on how the administrator can use methods and tools already covered in the book to develop a plan that predicts capacity requirements in the future. This means explaining how the administrator can use these tools to analyze trends in server usage today and use historical context as a basis for predicting future needs. One of the more important, real-world topics in this chapter is the issue of what the vendor tells the administrator versus what the product actually supports.

In addition to these topics, we'll discuss some issues you may not have thought to add to your capacity planning strategy like the importance of planning for a reliable system, as well as one that can handle a larger load.

Chapter 12 Microsoft Windows 2000 and Its Versions

If Windows 2000 came in just one size, one set of tuning types could potentially cover many of the issues that administrators face, at least at a generic level. However, there are multiple versions of Windows 2000 to deal with and Microsoft has slated each one to cover a particular kind of environment, which means tuning tips for one version of Windows 2000 don't necessarily work for the other versions. Windows 2000 Server is offered in three versions:

- Standard Edition
- Advanced Server
- Datacenter Server

This chapter covers the key differences between each of these versions and when you want to deploy one over the other to help with PTO issues. This chapter explores how switching from one version to the other can be part of an organization's capacity planning. Finally, we take a real-world look at some of the tuning technique differences between one server version and another.

Chapter 13 Microsoft Windows 2000 and Clustering

One way to increase the performance of applications and file/print services on a Windows 2000 Server is to implement clustering. This chapter covers the new clustering features found in Advanced and Datacenter versions of Windows 2000. The chapter also reviews the Windows 2000 cluster technology and how you can install and deploy the service. Also

covered is the topic of cluster designs and what each solution has to offer in terms of performance, scalability, and redundancy.

Chapter 14 Microsoft Windows 2000 and the Internet

Many environments have deployed or will deploy Windows 2000 Server as their Internet server of choice. This leads to issues regarding performance of the server under the constant and heavy traffic over the Internet. Windows 2000 technologies such as Processor Quotas and Accounting are covered in detail in this chapter. The ability to assign quotas is new to Windows 2000 and specifically Web sites running on a Windows 2000 Server. The chapter has examples on how to set these quotas and then monitor them. The chapter also explores available Web technologies such as Active Server Pages (ASP) and how selecting the right technology can contribute to your performance-tuning needs.

Chapter 15 Microsoft Windows 2000 Resource Kit Performance Tools

This chapter provides an overview of performance monitoring and enhancing tools in the Windows 2000 Resource Kit. We definitely don't cover the whole resource kit since doing so would require a book in and of itself. Microsoft normally includes a wealth of tools in the resource kit that help the administrator locate problem areas on the server. These tools can also point out areas where the server needs to be tuned, which is how we approach the topic in this chapter.

You'll be surprised at the number of new tools found in this version of the Windows 2000 Resource Kit. We don't cover all the new tools, but we look at some new tuning options that you might not have known existed in the past. For example, we review the Clear Memory utility, which is designed to clear the server memory for you and prevent certain types of memory fragmentation problems. We also look at the Page Fault Monitor, a tool designed to help you see when a particular application uses excessive amounts of memory or to determine when it's time to perform a memory upgrade on your server.

Chapter 16 Third-Party Tuning Tools

This chapter provides you with an overview of third-party tuning tools. The intent of this chapter is to give you some idea of what's available out there and where to find it. Third-party tuning tools can help reduce the time required to perform certain types of server tuning or eliminate the need for manual tuning in the first place.

This chapter is divided into four software categories. The main category is shareware tools. Shareware is a relatively inexpensive way to experiment to see what tool features you need. Some shareware is of such high quality that it exceeds what you find in shrink-wrapped software in both performance and functionality.

We also look at three kinds of shrink-wrapped software. This chapter provides some ideas on the types of general administration, hardware-oriented, and network-specific tools available to you. As previously mentioned, however, there are a lot of tools out there and only a little space in which to cover them. This chapter is designed to provide you with ideas of what you might want to look for to complete your tuning toolbox.

Conventions Used in This Book

This book uses special icons to help you find information that you need faster or to highlight its importance. You'll also find that some icons are used to tell you about special operating system requirements or to warn you about dangers of using specific techniques. The following list tells you about each of these icons and how you should interpret them.

Note Notes tell you about interesting facts that don't necessarily affect your ability to use the other information in the book. We use Note boxes to give you bits of information that we've picked up while using Microsoft Windows 2000 or products like Microsoft Visual Studio.

Tip Everyone likes tips, because they tell you new ways of doing things that you might not have thought about before. Tip boxes also provide an alternative way of doing something that you might like better than the first approach we provided.

Caution This means watch out! Cautions almost always tell you about some kind of system or data damage that occurs if you perform a certain action (or fail to perform others). Make sure you understand a Caution thoroughly before you follow any instructions that come after it.

More Info   The Internet contains a wealth of information, but finding it can be difficult, to say the least. The More Info boxes help you find new sources of information on the Internet that you can use to improve the way you manage your network or learn new techniques. You'll also find newsgroup More Info boxes that tell where you can find other people to talk with about Windows 2000. Finally, More Info boxes help you find utility programs that make working with Windows 2000 faster and easier than before.

Planning   This is a special box that helps you understand the requirements you need to satisfy before you start to use a procedure or technique within the book. For example, if you want to install a new product on your server, you might need to perform some preinstallation steps first. In some cases, the preparation has nothing to do with the server. Perhaps you need to set up some paperwork before you perform a technique to ensure that all the results are properly recorded.

Real World

Sometimes you need to separate theory from practice. A technique might appear to work all the time in theory. Only when you spend some time performing the technique do you see the rather large pothole in the road. The Real World box is intended to help you see the pothole before you use a particular technique. It's intended to relate experiential knowledge based on someone else's experience.

Contents

PART I An Overview of Performance Tuning and Optimization