



Part of the five-volume  
Networking Services Developer's Reference Library  
微软网络编程与开发丛书

Microsoft® Press

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深入网络编程与开发  
IT企业和网络编程人员必备

The essential reference set for developing with  
Microsoft® Windows® networking technologies

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Series Editor  
[www.iseminger.com](http://www.iseminger.com)

# Networking Services

[美] Microsoft 公司 著

# Routing 路由

(影印版)

北京大学出版社  
<http://cbs.pku.edu.cn>

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微软网络编程与开发影印丛书

Routing

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## 内 容 简 介

本书是 NETWORKING SERVICES DEVELOPER'S REFERENCE LIBRARY (微软网络编程与开发影印丛书)中的一本,是路由和远程访问服务(RRAS)的参考书。RRAS是 Microsoft Windows NT Server 4.0 的外接式附件,也包含在 Microsoft Windows 2000 Server 中。有了 RRAS API,可以创建应用程序来管理路由和远程访问服务,实现自己的路由协议,甚至把计算机转换成一台全功能网络路由器。RRAS 可以运行许多流行的路由协议,并提供了在 Windows NT 4.0 或 Windows 2000 Server 上使用经济、高性能中距路由器的能力。

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北京市版权局著作权合同登记号:图字 01-2000-0287

图书在版编目(CIP)数据

路由.第5卷:英文/美国微软公司(Microsoft)著.一影印本.一北京:北京大学出版社, 2000.4

ISBN 7-301-02040-6

I. 路... II. 美... III. 路由选择-英文 IV. TP393.04

中国版本图书馆 CIP 数据核字(2000)第 07600 号

书 名:路由

责任著作者:Microsoft 公司 著

标准书号:ISBN 7-301-02040-6/TP·0169

出 版 者:北京大学出版社

地 址:北京市海淀区中关村北京大学校内 100871

网 址:<http://cbs.pku.edu.cn>

电 话:出版部 62752015 发行部 62765126 62754140 编辑室 62765127

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印 刷 者:中国科学院印刷厂

发 行 者:北京大学出版社

经 销 者:新华书店

787 毫米×1092 毫米 16 开本 37 印张 880.5 千字

2000 年 4 月第 1 版 2000 年 4 月第 1 次印刷

定 价:98.00 元

## 前 言

在我们的生活和工作越来越离不开网络的今天，网络的速度、性能以及如何充分利用现有网络的容量都是至关重要的问题。Windows 2000 的几乎每一个新特性和新组件都必须直接或间接地使用网络。为了帮助用户最大限度地利用 Windows 2000 的网络特性，我们组织影印了这套 5 卷本的丛书，《微软网络编程与开发影印丛书》。本丛书可为编程人员提供完整的、考虑周全的参考资料。本丛书将最广泛使用的、最重要的和最及时的 Windows 网络技术信息搜集整理成册，便于开发人员开发更好的、与网络紧密集成的、在 Windows 平台上运行的应用程序。

本丛书的每一卷都侧重于 Windows 网络技术的不同领域，并结合 Windows 程序员的实际需要，精心编排了完整的索引，便于阅读和查找信息。本丛书的精心设计还有助于程序员方便地找到 Microsoft 的其他参考资料，包括印刷资料和电子版资料。每一本书还包括一个对整套丛书的概述，一个关于编程要素的附录，以及关于所引用的 Microsoft 技术的索引。但本丛书的内容远不止这些。本丛书是关于 Windows 网络特性、协议和服务的最佳资源。

本丛书的主编 David Iseminger 是 Microsoft 的独立顾问，作为网络和路由器性能分析师、通信专家和性能工具开发者，自 Windows NT 3.5 以来，他就一直从事 Windows NT 和 Windows 2000 的研究与开发工作。最近，他作为程序员，正在与开发人员文档组(Developer Documentation Group)一道，创建和维护 MSDN 建立的和新兴的网络技术，包括服务质量(Quality of Service)。作为计算机图书作家，David 的著作颇丰，包括他最新创作、Microsoft 出版的《Active Directory Services for Microsoft Windows 2000 Technical Reference》。David 毕业于华盛顿大学，现居住在华盛顿州的 Puget Sound 城。欲详细了解 David 的工作以及本丛书的其他作品，请访问站点：[www.iseminger.com](http://www.iseminger.com)。

本丛书由以下 5 本书组成：

- 《Windows Sockets and QoS》(《Winsock 和 QoS》)
- 《Network Protocols and Interface》(《网络协议和接口》)
- 《RPC and Windows Networking》(《RPC 和 Windows 网络》)
- 《Remote Access Services》(《远程访问服务》)
- 《Routing》(《路由》)

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## CHAPTER 1

# Getting Around in the Networking Services Library

Networking is pervasive in this digital age in which we live. Information at your fingertips, distributed computing, name resolution, and indeed the entire Internet—the advent of which will be ascribed to our generation for centuries to come—imply and require networking. Everything that has become the buzz of our business and personal lives, including e-mail, cell phones, and Web surfing, is enabled by the fact that networking has been brought to the masses (and we've barely scraped the beginning of the trend). You, the network-enabled Windows application developer, need to know how to lasso this all-important networking services capability and make it a part of your application. You've come to the right place.

Networking isn't magic, but it can seem that way to those who aren't accustomed to it (or to the programmer who isn't familiar with the technologies or doesn't know how to make networking part of his or her application). That's why the *Networking Services Developer's Reference Library* isn't just a collection of programmatic reference information; it would be only half-complete if it were. Instead, the Networking Services Library is a collection of explanatory and reference information that combine to provide you with the complete set that you need to create today's network-enabled Windows application.

The Networking Services Library is *the* comprehensive reference guide to network-enabled application development. This library, like all libraries in the Windows Programming Reference Series (WPRS), is designed to deliver the most complete, authoritative, and accessible reference information available on a given subject of Windows network programming—without sacrificing focus. Each book in each library is dedicated to a logical group of technologies or development concerns; this approach has been taken specifically to enable you to find the information you need quickly, efficiently, and intuitively.

In addition to its networking services development information, the Networking Services Library contains tips designed to make your programming life easier. For example, a thorough explanation and detailed tour of MSDN Online is included, as is a section that helps you get the most out of your MSDN subscription. Just in case you don't have an MSDN subscription, or don't know why you should, I've included information about that too, including the differences between the three levels of MSDN subscription, what each level offers, and why you'd want a subscription when MSDN Online is available over the Internet.

To ensure that you don't get lost in all the information provided in the Networking Services Library, each volume's appendixes provide an all-encompassing programming directory to help you easily find the particular programming element you're looking for. This directory suite, which covers all the functions, structures, enumerations, and other programming elements found in network-enabled application development, gets you quickly to the volume and page you need, saving you hours of time and bucketsful of frustration.

## How the Networking Services Library Is Structured

The Networking Services Library consists of five volumes, each of which focuses on a particular aspect of network programming. These programming reference volumes have been divided into the following:

- Volume 1: Winsock and QOS
- Volume 2: Network Interfaces and Protocols
- Volume 3: RPC and WNet
- Volume 4: Remote Access Services
- Volume 5: Routing

Dividing the Networking Services Library into these categories enables you to quickly identify the Networking Services volume you need, based on your task, and facilitates your maintenance of focus for that task. This approach enables you to keep one reference book open and handy, or tucked under your arm while researching that aspect of Windows programming on sandy beaches, without risking back problems (from toting around all 3,000+ pages of the Networking Services Library) and without having to shuffle among multiple less-focused books.

Within the Networking Services Library—and in fact, in all WPRS Libraries—each volume has a deliberate structure. This per-volume structure has been created to further focus the reference material in a developer-friendly manner, to maintain consistency within each volume and each Library throughout the series, and to enable you to easily gather the information you need. To that end, each volume in the Networking Services Library contains the following parts:

- Part 1: Introduction and Overview
- Part 2: Guides, Examples, and Programmatic Reference
- Part 3: Intelligently Structured Indexes

Part 1 provides an introduction to the Networking Services Library and to the WPRS (what you're reading now), and a handful of chapters designed to help you get the most out of networking technologies, MSDN, and MSDN Online. MSDN and WPRS Libraries are your tools in the developer process; knowing how to use them to their fullest will enable you to be more efficient and effective (both of which are generally desirable traits). In certain volumes (where appropriate), I've also provided additional information that you'll need in your network-enabled development efforts, and included such information as concluding chapters in Part 1. For example, Volume 3 includes a chapter that explains terms used throughout the RPC development documentation; by putting it into Chapter 5 of that volume, you always know where to go when you have a question about an RPC term. Some of the other volumes in the Networking Services Library conclude their Part 1 with chapters that include information crucial to their volume's contents, but I've been very selective about including such information. Publishing constraints have limited the amount of information I can provide in each volume (and in the library as a whole), so I've focused on the priority: getting you the most useful information possible within the number of pages I have to work with.

Part 2 contains the networking reference material particular to its volume. You'll notice that each volume contains *much* more than simple collections of function and structure definitions. A comprehensive reference resource should include information about how to use a particular technology, as well as definitions of programming elements. Consequently, the information in Part 2 combines complete programming element definitions with instructional and explanatory material for each programming area.

Part 3 is a collection of intelligently arranged and created indexes. One of the biggest challenges of the IT professional is finding information in the sea of available resources and network programming is probably one of the most complex and involved of any development discipline. In order to help you get a handle on network programming references (and Microsoft technologies in general), Part 3 puts all such information into an understandable, manageable directory (in the form of indexes) that enables you to quickly find the information you need.

## How the Networking Services Library Is Designed

The Networking Services Library (and all libraries in the WPRS) is designed to deliver the most pertinent information in the most accessible way possible. The Networking Services Library is also designed to integrate seamlessly with MSDN and MSDN Online by providing a look and feel consistent with their electronic means of disseminating Microsoft reference information. In other words, the way a given function reference appears on the pages of this book has been designed specifically to emulate the way that MSDN and MSDN Online present their function reference pages.

The reason for maintaining such integration is simple: to make it easy for you to use the tools and get the ongoing information you need to create quality programs. Providing a "common interface" among reference resources allows your familiarity with the Networking Services Library reference material to be immediately applied to MSDN or MSDN Online, and vice-versa. In a word, it means *consistency*.

You'll find this philosophy of consistency and simplicity applied throughout WPRS publications. I've designed the series to go hand-in-hand with MSDN and MSDN Online resources. Such consistency lets you leverage your familiarity with electronic reference material, then apply that familiarity to enable you to get away from your computer if you'd like, take a book with you, and—in the absence of keyboards and e-mail and upright chairs—get your programming reading and research done. Of course, each of the Networking Services Library volumes fits nicely right next to your mouse pad as well, even when opened to a particular reference page.

With any job, the simpler and more consistent your tools are, the more time you can spend doing work rather than figuring out how to use your tools. The structure and design of the Networking Services Library provide you with a comprehensive, presharpener toolset to build compelling Windows applications.

## What's In This Volume?

Volume 5 of the *Networking Services Developer's Reference Library* is a complete treatment of the routing capabilities built into RRAS.

The routing components of RRAS make it possible for a computer running Windows NT Server 4.0 or Windows 2000 Server to function as a network router. (RRAS also provides the next generation of server functionality for the Remote Access Service (RAS) for Windows. See Volume 4 for more information about the remote access capabilities of RRAS.)

This volume also has information about how you can use development resources such as MSDN, MSDN Online, and developer support resources. This helpful information is found in various chapters in Part 1, and those chapters are common to all WPRS volumes. By including this information in each library and in each volume, a few goals of the WPRS are achieved:

- I don't presume you have bought, or expect you to have to buy another WPRS Library to get access to this information. Maybe your primary focus is network programming, and your budget doesn't allow for you to purchase the *Active Directory Developer's Reference Library*. Since I've included this information in this library, you don't have to...because that useful developer resource information is included in this library, as well.
- You can access this important and useful information regardless of which volume you have in your hand. You don't have to (nor *should* you have to) fumble with another physical book to refer to information about how to get the most out of MSDN, or where to get support for questions you have about a particular Windows development problem you're having.
- Each volume becomes more useful, more portable, and more complete in and of itself. This goal of the WPRS makes it easier for you to grab one of its libraries' volumes and take it with you, rather than feeling like you must bring multiple volumes with you to have access to the library's important overview and usability information.

These goals have steered this library's content and choices of included technologies; I hope you find its information is useful, portable, a good value, and as accessible as it can be.

Part 2 of this volume provides the following routing information.

## Router Administration

The router administration API enables developers to create applications that manage the router service on a computer running Microsoft Windows 2000 or running Microsoft Windows NT 4.0 with the RRAS add-on installed. (Note that not all API functions are supported on both of these platforms.) The following topics are covered in this volume, and provide detailed information about router administration:

- Components of the Router Architecture
- Router Initialization
- Router Management Functions
- Router Interface Functions
- Router Manager (**Transport**) Functions
- Router Manager Client (**InterfaceTransport**) Functions
- **MprInfo** Functions and Information Headers
- Managing Router Clients and Interfaces

## Message Information Base (MIB)

The routing capabilities built into RRAS include the Management Information Base (MIB) API, which makes it possible to query and set the values of MIB variables exported by one of the router managers or any of the routing protocols that the router managers service. By using this API, the router supports the Simple Network Management Protocol (SNMP).

## Packet Filtering

Packet Filtering enables the developer to create and manage input and output filters for IP packets. Each IP adapter interface can be associated with one or more filters. Filters can include source and destination addresses, address mask and port, and protocol identifiers.

## Routing Protocol Interface

This chapter that describes the Routing Protocol Interface and explains how the integration of third-party routing protocols into RRAS is possible. RRAS defines the interface between the router manager and the Dynamic-Link Library (DLL) for routing protocols, and exposes that interface through routing protocol interface programming capabilities.



## **Routing Table Manager (RTM) v1**

The Routing Table Manager (RTM) is a central repository of routing information for all routing protocols that operate under RRAS. The RTM provides routing information to all interested components, such as routing protocols, management agents, and monitoring agents. The RTM also determines the best route to each destination network known to the routing protocols. It determines this route based on routing protocol priorities and on metrics associated with the routes, then passes the best-route information on to the forwarders and back to the routing protocols.

## **Routing Table Manager (RTM) v2**

The Routing Table Manager Version 2 (RTMv2) API is a feature of Windows 2000 that you can use to write routing protocols that interact with the routing table managers. RTMv2 is not available for Windows NT 4.0. Additionally, RTMv2 cannot be used for IPX routing protocols that run on Windows NT 4.0 or Windows 2000. If you are using IPX or writing routing protocols for Windows NT 4.0, you must use the Routing Table Manager Version 1 (RTMv1) API.

## **Multicast Group Manager**

The Multicast Group Manager (MGM) API enables developers to use the multicast routing capabilities of Windows 2000 Server. Developers can write routing protocols that join and leave multicast groups, as well as administrative applications that track group membership. Routing protocol developers can use MGM to develop callback functions to communicate group membership information directly to the routing protocol.