Z BOOKS



(EXAM 640-404)

CCNP 学习指南:

# Cisco



(英文版)

# 局域网交换配置技术

(美) Syngress Media 公司 著



机械工业出版社 China Machine Press

OSBORNE 🛗

# Cisco专业技术丛书

# CCNP学习指南

Cisco局域网交换配置技术

(英文版)

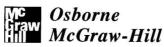
**CCNP Cisco LAN Switch** 

Configuration Study Guide

(EXAM 640-404)

(美) Syngress Media公司设置 草





Syngress Media, Inc.: CCNP Cisco LAN Switch Configuration Study Guide (EXAM 640-404).

Copyright (c)1999 by the McGraw-Hill companies, Inc. All rights reserved, jointly published by China Machine Press/McGraw-Hill. This edition may be sold in the People's Republic of China only. This book cannot be re-exported and is not for sale outside the People's Republic of China.

本书英文影印版由McGraw-Hill公司授权机械工业出版社在中国大陆境内独家出版发行,未经出版者许可,不得以任何方式抄袭、复制或节录本书中的任何部分。

版权所有,侵权必究。

Reprint ISBN 007-1169180

本书版权登记号: 01-1999-3112

#### 图书在版编目(CIP)数据

CCNP学习指南: Cisco局域网交换配置技术: 英文/美国西格瑞斯·梅地亚 (Syngress Media)公司著 - 北京: 机械工业出版社, 1999.12

(Cisco专业技术从书)

书名原文: CCNP Cisco LAN Switch Configuration Study Guide ISBN 7-111-07547-1

I.C… Ⅱ.美… Ⅲ.局部网络-信息交换-配置-技术-英文 IV.TP393.1

中国版本图书馆CIP数据核字(1999)第64191号

机械工业出版社(北京市西城区百万庄大街22号 邮政编码 100037)

责任编辑: 艾玉娟

北京牛山世兴印刷厂印刷·新华书店北京发行所发行

1999年12月第1版第1次印刷

787mm×1092mm 1/16·42印张

印数: 0 001-3 000册 定价: 100.00元(附光盘)

凡购本书,如有倒页、脱页、缺页,由本社发行部调换

#### **FOREWORD**

#### From Global Knowledge

At Global Knowledge we strive to support the multiplicity of learning styles required by our students to achieve success as technical professionals. In this series of books, it is our intention to offer the reader a valuable tool for successful completion of the CCNP Certification Exam.

As the world's largest IT training company, Global Knowledge is uniquely positioned to offer these books. The expertise gained each year from providing instructor-led training to hundreds of thousands of students worldwide has been captured in book form to enhance your learning experience. We hope that the quality of these books demonstrates our commitment to your lifelong learning success. Whether you choose to learn through the written word, computer-based training, Web delivery, or instructor-led training, Global Knowledge is committed to providing you the very best in each of those categories. For those of you who know Global Knowledge, or those of you who have just found us for the first time, our goal is to be your lifelong competency partner.

Thank you for the opportunity to serve you. We look forward to serving your needs again in the future.

Warmest regards,

Duncan Anderson

President and Chief Executive Officer, Global Knowledge

#### The Global Knowledge Advantage

Global Knowledge has a global delivery system for its products and services. The company has 28 subsidiaries, and offers its programs through a total of 60+ locations. No other vendor can provide consistent services across a geographic area this large. Global Knowledge is the largest independent information technology education provider, offering programs on a variety of platforms. This enables our multi-platform and multi-national customers to obtain all of their programs from a single vendor. The company has developed the unique CompetusTM Framework software tool and methodology which can quickly reconfigure courseware to the proficiency level of a student on an interactive basis. Combined with self-paced and on-line programs, this technology can reduce the time required for training by prescribing content in only the deficient skills areas. The company has fully automated every aspect of the education process, from registration and follow-up, to "just-in-time" production of courseware. Global Knowledge, through its Enterprise Services Consultancy, can customize programs and products to suit the needs of an individual customer.

#### Global Knowledge Classroom Education Programs

The backbone of our delivery options is classroom-based education. Our modern, well-equipped facilities staffed with the finest instructors offer programs in a wide variety of information technology topics, many of which lead to professional certifications.

#### **Custom Learning Solutions**

This delivery option has been created for companies and governments that value customized learning solutions. For them, our consultancy-based approach of developing targeted education solutions is most effective at helping them meet specific objectives.

#### **Self-Paced and Multimedia Products**

This delivery option offers self-paced program titles in interactive CD-ROM, videotape and audio tape programs. In addition, we offer custom development of interactive multimedia courseware to customers and partners. Call us at 1 (888) 427-4228.

#### **Electronic Delivery of Training**

Our network-based training service delivers efficient competency-based, interactive training via the World Wide Web and organizational intranets. This leading-edge delivery option provides a custom learning path and "just-in-time" training for maximum convenience to students.

#### **ARG**

American Research Group (ARG), a wholly-owned subsidiary of Global Knowledge, one of the largest worldwide training partners of Cisco Systems, offers a wide range of internetworking, LAN/WAN, Bay Networks, FORE Systems, IBM, and UNIX courses. ARG offers hands on network training in both instructor-led classes and self-paced PC-based training.

#### Global Knowledge Courses Available

#### **Network Fundamentals**

- Understanding Computer Networks
- Telecommunications Fundamentals I
- Telecommunications Fundamentals II
- Understanding Networking Fundamentals
- Implementing Computer Telephony Integration
- Introduction to Voice Over IP
- Introduction to Wide Area Networking
- Cabling Voice and Data Networks
- Introduction to LAN/WAN protocols
- Virtual Private Networks
- ATM Essentials

#### **Network Security & Management**

- Troubleshooting TCP/IP Networks
- Network Management
- Network Troubleshooting
- IP Address Management
- Network Security Administration
- Web Security
- Implementing UNIX Security
- Managing Cisco Network Security
- Windows NT 4.0 Security

#### **IT Professional Skills**

- Project Management for IT Professionals
- Advanced Project Management for IT Professionals
- Survival Skills for the New IT Manager
- Making IT Teams Work

#### LAN/WAN Internetworking

- Frame Relay Internetworking
- Implementing T1/T3 Services Understanding Digital Subscriber Line (xDSL)
- Internetworking with Routers and Switches
- Advanced Routing and Switching
- Multi-Layer Switching and Wire-Speed Routing Internetworking with TCP/IP
- ATM Internetworking
- OSPF Design and Configuration Border Gateway Protocol (BGP) Configuration

#### **Authorized Vendor Training**

#### Cisco Systems

- Introduction to Cisco Router Configuration
- Advanced Cisco Router Configuration
- Installation and Maintenance of Cisco Routers
- Cisco Internetwork Troubleshooting
- Cisco Internetwork Design
- Cisco Routers and LAN Switches
- Catalyst 5000 Series Configuration
- Cisco LAN Switch Configuration Managing Cisco Switched Internetworks
- Configuring, Monitoring, and Troubleshooting Dial-Up Services
- Cisco AS\$200 Installation and Configuration
- Cisco Campus ATM Solutions

#### **Bay Networks**

- Bay Networks Accelerated Router Configuration
- Bay Networks Advanced IP Routing
  - Bay Networks Hub Connectivity
  - Bay Networks Accelar 1xxx Installation and Basic Configuration
- Bay Networks Centillion Switching

#### **FORE Systems**

- FORE ATM Enterprise Core Products
- FORE ATM Enterprise Edge Products

- FORE ATM Theory
- FORE LAN Certification

#### Operating Systems & Programming

#### Microsoft

- Introduction to Windows NT
- Microsoft Networking Essentials
- Windows NT 4.0 Workstation
- Windows NT 4.0 Server
- Advanced Windows NT 4.0 Server
- Windows NT Networking with TCP/IP Introduction to Microsoft Web Tools
- Windows NT Troubleshooting
- Windows Registry Configuration

#### UNIX

- UNIX Level I
- UNIX Level II
- Essentials of UNIX and NT Integration

#### **Programming**

- Introduction to JavaScript
- Java Programming
  - PERL Programming
  - Advanced PERL with CGI for the Web

#### Web Site Management & Development

- Building a Web Site
- Web Site Management and Performance
- Web Development Fundamentals

#### **High Speed Networking**

- Essentials of Wide Area Networking
- Integrating ISDN
- Fiber Optic Network Design
- Fiber Optic Network Installation
- Migrating to High Performance Ethernet

#### **DIGITAL UNIX**

- UNIX Utilities and Commands
  - DIGITAL UNIX v4.0 System Administration
- DIGITAL UNIX v4.0 (TCP/IP) Network Management
- AdvFS, LSM, and RAID Configuration and Management
  - DIGITAL UNIX TruCluster Software Configuration and Management
- UNIX Shell Programming Featuring Kornshell
  - DIGITAL UNIX v4.0 Security Management
- DIGITAL UNIX v4.0 Performance Management

#### DIGITAL UNIX v4.0 Intervals Overview

OpenVMS Skills for Users

**DIGITAL OpenVMS** 

- OpenVMS System and Network Node Management I
- OpenVMS System and Network Node Management II
- OpenVMS System and Network Node Management III
- OpenVMS System and Network Node Operations
- OpenVMS for Programmers
- Open/MS System Troubleshooting for Systems Managers Configuring and Managing Complex VMScluster Systems Utilizing Open/MS Features from C

- OpenVMS Performance Management
- Managing DEC TCP/IP Services for OpenVMS
- Programming in C

#### **Hardware Courses**

- AlphaServer 1000/1000A Installation, Configuration and Maintenance
- AlphaServer 2100 Server Maintenance
- AlphaServer 4100, Troubleshooting Techniques and Problem Solving

#### **ABOUT THE CONTRIBUTORS**

#### About Syngress Media

Syngress Media creates books and software for Information Technology professionals seeking skill enhancement and career advancement. Its products are designed to comply with vendor and industry standard course curricula and are optimized for certification exam preparation. You can contact Syngress via the Web at http://www.syngress.com.

#### **About the Contributors**

Ryan Russell (CCNA, CCNP) has been employed in the networking field for more than 10 years, including more than five years working with Cisco equipment. He has held IT positions ranging from help desk support to network design, providing him with a good perspective on the challenges that face a network manager. Recently, Ryan has been doing mostly information security work involving network security and firewalls. He has completed his CCNP and holds a Bachelors of Science degree in Computer Science

Tony Costa (CCIE #4140, MCSE, CNE) started his career in networking in 1979 working extensively with IBM SNA and TCP/IP networks. He teaches the CLSC course to Cisco employees and the public through Chesapeake Computer Consultants, Inc. He also develops new courses for Cisco, recently contributing to the Interconnecting Cisco Network Devices (ICND) and the IP/TV 3.0 course. Tony lives near the "Silicon Mesa" in New Mexico with his wife Karen, their five children, and a rapidly growing number of pets. You can contact him at tcosta@msn.com.

Glenn Lepore is a Senior Network Engineer with Niche Networks, LLC a network services and training firm in Herndon, Virginia. He has more than 13 years of experience in LAN and WAN design, installation, and troubleshooting. His background includes Frame Relay, X.25, TCP/IP, IPX, and SNA. His experience includes Novell and Unix administration,

Web page design, and Internet Service Provider (ISP) network operations. He is working toward CCIE certification as well as MCSE.

John Dyer (CCIE) is a partner at Niche Networks, LLC, an Internetwork Consulting and Training firm in Herndon, Virginia. He has13 years of experience in systems integration and networking in the information technology industry, including design and installation of LAN/WAN infrastructures, network management and network security platforms. John is a Cisco Certified Instructor teaching Introduction to Cisco Router Configuration, Advanced Cisco Router Configuration, CiscoWorks, and Managing Cisco Switched Internetworks.

Stace Cunningham (CCNA, MCSE, CLSE, COS/2E, CLSI, COS/2I, CLSA, MCPS, A+) is a systems engineer with SDC Consulting in Biloxi, Mississippi. SDC Consulting specializes in the design, engineering, and installation of networks. Stace received his MCSE in October 1996, and is also certified as an IBM Certified LAN Server Engineer, IBM Certified OS/2 Engineer, IBM Certified LAN Server Administrator, Microsoft Certified Product Specialist, IBM Certified LAN Server Instructor, and IBM Certified OS/2 Instructor.

Stace has participated as a Technical Contributor for the IIS 3.0 exam, SMS 1.2 exam, Proxy Server 1.0 exam, Exchange Server 5.0 exam, Exchange Server 5.5 exam, Proxy Server 2.0 exam, IIS 4.0 exam, IEAK exam, and the revised Windows 95 exam. He recently was an instrumental force in the design and engineering of a 1,700-node Windows NT network that is located in more than 20 buildings at Keesler Air Force Base in Mississippi. Among his current projects is assisting in the design and implementation of a 10,000-node Windows NT network, also located at Keesler Air Force Base.

His wife Martha and daughter Marissa are very supportive of the time he spends on the computers located throughout his house.

#### **About the Series Editor**

Mark Buchmann (CCIE #3556, CCSI #95062) is a Cisco Certified Internetworking Expert and has been a Certified Cisco Systems Instructor since 1995. He is the owner of MAB Enterprises, Inc, a company providing

consulting, network support, training, and various other services. Mark is also a co-owner of www.CertaNet.com, a company providing online certification assistance for a variety of network career paths including all the various Cisco certifications. In his free time he enjoys spending time with his family and boating. He currently lives in Raleigh, North Carolina. Mark is Series Editor for Syngress Cisco books.

#### Technical Review and From the Classroom Sidebars by:

Neil Lovering (CCIE #1772, CCSI #95010) is a CCIE-certified network consultant and Cisco-certified instructor. He has helped with many large and small network design and optimization projects throughout the United States and Canada, specializing in OSPF configuration and migration. Neil has taught thousands of students over the last few years how to configure Cisco routers and switches, how to design and troubleshoot complex networks, and how to earn various Cisco network certifications. Neil has also authored the first in a series of Cisco-based computer-based training courses offered through Global Knowledge. He is currently working on some Web-based educational sites.

#### **Technical Review by:**

Richard D. Hornbaker (CCIE #3355, MCSE, MCNE) is a consultant with the Forté Consulting Group, based in Phoenix, Arizona. He specializes in large-scale routing and switching projects for Fortune 500 companies. Recent projects include a 12,000-node campus network using a combination of routing, switching, and ATM. Richard is currently designing the network for a major corporate merger.

Richard has more than 10 years of internetworking experience and holds several certifications. His skills are diverse, ranging from operating systems and software to telephony systems and data networks. Protocol analysis and troubleshooting are among his strong suits.

#### **ACKNOWLEDGMENTS**

 $\mathbf{W}^{\epsilon}$ 

e would like to thank the following people:

- Richard Kristof of Global Knowledge for championing the series and providing us access to some great people and information. And to Shelley Everett and Chuck Terrien for all their cooperation.
- Imran Qureshi and Tina Dupart at Cisco for their time and insight.
- To all the incredibly hard-working folks at Osborne/McGraw-Hill: Brandon Nordin, Scott Rogers, Gareth Hancock, Tara Davis, and Jody McKenzie for their help in launching a great series and being solid team players.

### **CONTENTS AT A GLANCE**

1	Introduction to Switching Concepts	1
2	VLANs	29
3	Placing Catalyst 5000 Series Switches in Your Network	63
4	Catalyst 5000 Series Switch Architecture	83
5	Catalyst 5000 Series Switch Hardware	119
6	Configuring the Catalyst 5000 Series Switches	161
7	Catalyst 5000 Series Switch Software	225
8	Managing the Catalyst 5000 Series Switches	281
9	Troubleshooting the Catalyst 5000	311
10	Catalyst 5000 Series Switch FDDI Module	351
11	ATM LANE	377
12	Catalyst 1900 Series and Catalyst 2820 Switches	433
13	Catalyst 3000 Series Switches	459
A	Self Test Answers	483
В	About the CD	541
С	About the Web Site	547
	Glossary	549
	Index	595

XV

# CONTENTS

	Foreword	ι
	About the Contributors	ix
	Acknowledgments	xiii
	Preface	xxvii
	Introduction	xxxı
j	Introduction to Switching Concepts	ī
	Collisions and Broadcast Domains	2
	Collisions	2
	Broadcast Domains	4
	LAN Segmentation · · · · · · · · · · · · · · · · · · ·	6
	LAN Segmentation Using a Router	6
	LAN Segmentation Using a Bridge	6
	LAN Segmentation Using a Switch	8
	LAN Switching	10
	Translational Switching	14
	Cut-Through vs. Store and Forward Switching	17
	Token Ring Switching	20
	Bridging Methods	22
	Certification Summary	23
	Two-Minute Drill	24
	Self Test	26
2	VLANs	29
	Broadcast Domains	30
	VLAN Characteristics	32
	Dynamic vs. Static VLANs	32
	VLANs Reduce Costs	33
	VLANs Increase Flexibility	36
	Network Security	37

#### XVIII CCNP Cisco LAN Switch Configuration Study Guide

	Frame Filtering Versus Frame Tagging · · · · · · · · · · · · · · · · · · ·	37
	VLAN Trunks · · · · · · · · · · · · · · · · · · ·	39
	Cisco Switch Trunk Capabilities	42
	ISL, 802.10, 802.1Q, and LANE	44
	ISL	44
	802.10	47
	802.1Q	49
	LANE	50
	Other Options	53
	Token Ring VLANs	54
	DRiP	56
	Certification Summary	57
	Two-Minute Drill	58
	Self Test	60
3	Placing Catalyst 5000 Series Switches in	
	Your Network	63
	Demand Nodes and Resource Nodes	64
	Local Resources and Remote Resources	67
	Local Resources	68
	Remote Resources	68
	Bottlenecks and Buffer Overflows · · · · · · · · · · · · · · · · · · ·	69
	Congestion Management	70
	Putting It All Together	71
	Number of Users	72
	Size and Layout of the Office or Campus	73
	Certification Summary	76
	Two-Minute Drill	77
	Self Test	79
4	Catalyst 5000 Series Switch Architecture	83
	Buffering and Congestion Control	84
	Per-Port Buffers	85
	Full vs. Half Duplex	80
	Priority Levels	87
	Additional Bandwidth	89

	Switching Components	90
	Catalyst 5000	91
	Frame Flow Through the Switch	95
	Catalyst 5500	96
	Network Management Components	101
	Remote Access	102
	Direct Console Access	103
	Telnet Access	105
	SNMP	106
	SLIP	107
	RMON	108
	SPAN	109
	Other Modules	109
	NAM	111
	Certification Summary	112
	Two-Minute Drill	113
	Self Test	116
5	Catalyst 5000 Series Switch Hardware	119
_		
	Catalyst 5000 Switch Hardware Description	121
	Catalyst 5002 Switch	121
	Catalyst 5000 Switch	123
	Catalyst 5505 Switch	124
	Catalyst 5509 Switch	125
	Catalyst 5500 Switch	127
	Supervisor Engine Module	130
	Redundant Supervisor Engine Operation	135
	Ethernet and Fast Ethernet Switching	138
	Ethernet Modules	140
	Fast Ethernet Modules	142
	Token Ring Modules	144
	FDDI and CDDI Modules	145
	ATM LANE Modules	147
	RSM	150
	Certification Summary	153
	Two-Minute Drill	155
	Self Test	158

6	Configuring the Catalyst 5000 Series Switches	161
	SET, SHOW, and CLEAR Commands	162
	Accessing the Command Line Interface	163
	The Configuration Process	164
	CLI Basics	172
	Administrative Commands	176
	The Catalyst IP Stack	177
	SNMP	179
	RMON	181
	Password Configuration	184
	Password Recovery	187
	SET INTERFACE Command	192
	SLIP	195
	Saving Configuration Files to and from a TFTP Server	198
	Saving Configuration Files to the TFTP Server	199
	Retrieving a Config File from a TFTP Server	201
	Downloading and Uploading Software Images · · · · · · · · · · · · · · · · · · ·	210
	Copying NMP Images to Supervisor I or Supervisor II	212
	Configuring Token Ring, Ethernet,	
	and Fast Ethernet Modules	215
	Port Configurations	215
	Certification Summary	218
	Two-Minute Drill	219
	Self Test	222
7	Catalyst 5000 Series Switch Software	225
	NMP Image Features	226
	Features of Release 2.x	226
	Features of Release 3.x	234
	Features of Release 4.x	236
	Multiple VLAN Configuration	238
	Creating VLANs	238
	VLAN Routing	246
	VLAN Trunking (ISL, 802.1Q, 802.10, and LANE)	257
	Frame Filtering	260
	Dynamic VLANs	260

	Fast EtherChannel · · · · · · · · · · · · · · · · · · ·	261
	Spanning-Tree Protocol and VLANs	263
	VLAN Load Sharing across Trunks	267
	VTP Pruning	270
	Multicast Services	270
	SPAN	272
	Certification Summary	274
	Two-Minute Drill	274
	Self Test	277
8	Managing the Catalyst 5000 Series Switches	281
	Management Options	282
	Command Line Interface	282
	Command Line Management Commands	284
	Embedded RMON · · · · · · · · · · · · · · · · · · ·	289
	SNMP	292
	CDP	296
	CWSI	298
	SPAN	300
	Certification Summary	304
	Two-Minute Drill	305
	Self Test	307
9	Troubleshooting the Catalyst 5000	311
	Catalyst 5000 Power-Up Sequence · · · · · · · · · · · · · · · · · · ·	312
	Troubleshooting the Power Subsystem	315
	Troubleshooting the Cooling Subsystem	316
	Troubleshooting the Processor	
	and Interface Subsystem	317
	Physical and Data Link Layers	319
	Troubleshooting at the Cabling Level	320
	Network Layer	338
	PING	341
	TRACEROUTE	342
	Certification Summary	343
	Two-Minute Drill	344
	Self Test	347

#### XXII CCNP Cisco LAN Switch Configuration Study Guide

10	Catalyst 5000 Series Switch FDDI Module	35 I
	FDDI/CDDI Review `	352
	Catalyst 5000 FDDI/CDDI Features	354
	APaRT Overview	354
	IP Features	355
	Spanning Tree Support	355
	Trunking Support Overview	355
	APaRT	356
	FDDICHECK · · · · · · · · · · · · · · · · · · ·	358
	FDDI VLANs and 802.10	359
	Mapping Ethernet and FDDI VLANs Together · · · · · · · · · · · · · · · · · · ·	362
	Configuring the FDDI/CDDI Module	365
	Naming FDDI Ports	365
	Turning Off APaRT	365
	Turning On FDDICHECK	366
	Multiswitch VLAN without Trunking	366
	Configuring FDDI VLANs	367
	Turning On Trunking	368
	Creating FDDI VLANs	368
	Mapping Ethernet VLANs to FDDI VLANs	369
	Certification Summary	370
	Two-Minute Drill	371
	Self Test	374
П	ATM LANE	377
	ATM Boot Camp · · · · · · · · · · · · · · · · · · ·	381
	SAR	381
	ATM Addressing	386
	ILMI	389
	ATM Signaling	389
	LANE Components	390
	ELAN	390
	LAN Emulation Client	391
	LAN Emulation Server	393
	Broadcast and Unknown Server	394
	LAN Emulation Configuration Server	394
	LANE Internetworking	396