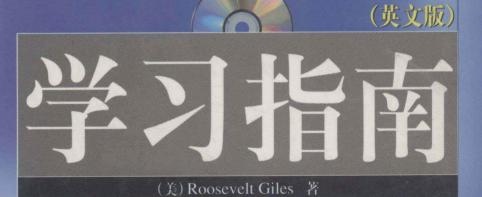
Cisco CCIE Study Guide

COID



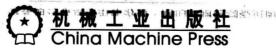
Cisco专业技术丛书

CCIE学习指南

(英文版)

CISCO CCIE Study Guide

(美) Rooseve 工业学院图书馆 工术工业学院图书馆 藏书章





Roosevelt Giles: CISCO CCIE Study Guide.

Copyright © 1998 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。

RISBN: 007-116314X

本书版权登记号: 图字: 01-1999-2597

图书在版编目(CIP)数据

CCIE学习指南: 英文版 / (美) 吉尔斯 (Giles, R.) 著.-北京: 机械工业出版社, 1999.10

(Cisco专业技术丛书)

ISBN 7-111-07460-2

I.C… Ⅱ.吉… Ⅲ.计算机网络-路由选择-应用程序 IV.TP393

中国版本图书馆CIP数据核字(1999)第39549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) 北京第二外国语学院印刷厂印刷·新华书店北京发行所发行 1999年10月第1版第1次印刷 787mm×1092mm 1/16·66印张

707 mm × 1072mm 1710 000p

印数: 0001-2000册

定价: 150.00元 (附光盘)

凡购本书,如有缺页、倒页、脱页,由本社发行部调换

ABOUT THE AUTHOR

Roosevelt Giles, CCI, CNE, MCSE, MCT, and CNX, is president of information Management Systems (IMS), a technology integration company in Atlanta, Georgia that specializes in providing complete CCIE training and support. He is a CISCO Certified Instructor with the following courses: ICWC, ACRC, ATM, C5SC, CLSE, CID, CIT, SNAM, SNAS, CMTD, ICRC, CISCO Design Specialist, CISCO CIP Specialist, Bay Networks, ATM Instructor and Router Specialist, 3Com, and an ATM Certified Instructor. Giles is a frequent speaker at COMDEX, ICA, Computer Measurements Group, and INTEROP, and has authored articles on Internet security, UNIX integration, ATM integration, and electronic commerce for *Network VAR* magazine.

Cisco专业技术丛书:

《Cisco路由器OSPF设计与实现》

《Cisco TCP/IP路由技术专业参考》

《CCIE学习指南(英文版)》

《CCNP学习指南: Cisco 路由器高级配置技术 (英文版)》

《CCNP学习指南: Cisco 网络互连故障排除(英文版)》

《CCNA学习指南(英文版)》

《ISDN与Cisco路由器配置》

《Cisco IOS技术基础》

《Cisco安全体系结构》

《Cisco与IP寻址》

《CCNP学习指南: Cisco路由器高级配置技术》

《CCNP学习指南: Cisco网络互连故障排除》

《CCNA学习指南》

Acknowledgments

It is difficult to thank all the individuals who have been instrumental in the completion of this project. First, I would like to give honor to God, the creator, without whom nothing I have achieved would be possible.

I would like to thank my wife, Sharon W. Giles, who has been my rock and partner and who has provided unconditional love and support. Sharon, thank you for always being there for the family and me. You bring balance, joy, and love to me always. I place this work with respect and humility at your feet. To my children Nakisha, Bradford, and Justin, thank you for your gift of love and understanding about all the time I spent away from home. You make a father proud. Bradford and Justin, thank you for being patient during this project. I love

you all and appreciate the sacrifices you have endured.

I would like to dedicate this book to my mother, Lake Giles, and Father, the late Enourmas Giles, whose love and support has sustained me through all these years. Mother, you and Father made me reach higher than I ever would have; thank you. I would like to thank my sisters Gertrude Good, Shirley Good, Vera Jean Dogan, Dorothy Ngongane, Emily Land, Sandra Mcbeth, Mary Watkins, Ruthie Mae Holland, and Vergie Mae Glenn for all the love, support, and encouragement. A special thanks to my brother, James Giles, who sacrificed himself for us during the lean times. James, thanks for providing the framework of knowledge you taught me about business; I am forever indebted to you. Thank you from the bottom of my heart, and I will always be there when you need me. Mildred Giles, my sister-in-law, is the best, always willing to assist where needed; thanks. My in-laws, Fred and Margaret Watts, without your support and love, I would be nowhere. I don't think that anyone could have in-laws as thoughtful and supporting as you; many thanks.

I would like to thank the village who assisted in shaping me as a individual. First, thanks go to all the students who have attended courses at Information Management Systems, Inc., over the years. Thank you for trusting us in your learning process. We are forever grateful. The Emanuel Chapel Baptist Church membership—thanks for the encouragement. The late Leo and Ila Thomas; Dr. Julia Long, professor of Mathematics at the University of South Carolina, nature has removed the braids; Dr. John Donovan of MIT; and Rick Strasser of Milliken and Company, who saw the positive and gave me a chance. Thanks for the vote of confidence and for being my mentor, Rick. Gus Allen, thanks for the opportunity. Nelson Smith, thanks for the words of encouragement during my tenure in LaGrange. Jessie Johnson, thanks for the promotion, and a special thanks goes to Mr. Roger Milliken, Chairman of the Board of Milliken & Company, who gave me the opportunity to work for one of the best-run companies in the world. Thanks to James Mcbeth and Tony Steward for guiding me through the difficult times in learning my new job at Milliken & Company. Thank you, Becky Sanders and Betty Joe, for helping me hone my typing skills and for being such good friends. Thanks to the late Mr. and Mrs. Emzie Smith, Mrs. Willie Mae Smith,

xxii Acknowledgments

the late Mr. Bennie Smith, Aunt Deara Washington, and my late grandmother Beulah Copeland for all the support during my upbringing.

The encouragement and support of friends like Dr. Moses & Rita Jones; Dr. Cameron Alexander; Marvin Anderson; Alvin and Janice Johnson; James P. Cavanagh; Curtis Crawford, President of AT&T Micro-Electronics; and Edward Menifee made the time special.

Special thanks to Dave Brambert, who as a friend and business partner, was always willing to encourage and listen. Thanks also for making my writing better with your comments.

Information Management Systems, Inc., Personnel

I am one of the luckiest individuals in the world to have such a dedicated staff of Support and Systems Engineers. I would like to thank the following Systems Engineers for their hard work putting this book together. These individuals deserve special recognition: Curtis Watts and Kenneth Jones who labored very hard and long with this project and were there all the way. Thanks, guys, for keeping the fire alive. Special thanks to Palaniappan Alagan in addition to CCIE for your steadfast devotion: Larry Mobley, J.C Fang, Johnny Bass, Richard Deal, and Patrick Delio. The support staff of Cheryl Johnson, Jackie Derico, Carol Cook, Hanifah McClendon, and Sandra Jones, thanks for putting up with me during this project.

I would like to dedicate this book to my wife, Suh-Jiuan, my son, Yi-Feng, and my daughter, Xin-Hui, for their understanding and caring.

—Jeh-Chuan Fang

I would like to dedicate this book to my beloved parents and sister, Vignes, for all the fond memories.

—Palaniappan Alagan CCIE #1922

I would like to dedicate this book to my father, A.G. Watts, mother, the late Willie Pearl Watts, and the rest of my family who have supported me through all my endeavors. Mom, I will always take you with me, wherever I go. Special thanks go to my Aunt Lonnie Green, who has been a second mother to me and a best friend, and to my partner, Sheryl Jackson, for putting up with me. (Baby, it is all going to be worth it.) To my friends Shelton, Tunji, and Kenny for keeping me motivated. I would like to thank the Rev. R.L. White for his words of inspiration in times of need.

-Curtis Watts

I would like to dedicate this book to my mother, Rosetta M. Jones, for all the love and support that she has given to me; to my brothers for helping me keep it real; to my fraternity, Kappa Alpha Psi Spring 86 Mu Gamma Chapter, for grooming me for life; and to my daughter, Kiesha, and son, Kentrell, who motivate me. I also would like to thank Samella C. Walker for all of her love and support and Rhonda Blassingame for being a true friend.

-Kenneth A. Jones

Vendor Support

Putting together a book of this magnitude requires assistance beyond the author's scope and resources. I would like to thank Imran Qureshi of Cisco for the outstanding support given during this project; Network Associates for the Sniffer Tools used in the frame captures; Laura M. Ellertson of Novell; Prem Kaliappan of Proteon LAN Development Group; and Jay Guillette of Banyan Corporation.

This book would not have come to fruition without the patience and diligence of the staff at McGraw-Hill. I would like to thank Steve Elliot for his unwavering support and guidance during this project. Thanks, Steve, for the encouragement when I felt down and out. Also, special thanks for all the behind-the-scenes support personnel at McGraw-Hill and Douglas & Gayle Ltd. Alan, thank you and the others at Douglas & Gayle—Kelly, Denny, and Laura—for a great job.

Recommendation

Roosevelt Giles builds the concepts based on internetworking fundamentals. Each chapter is written keeping in mind the importance of the internetworking standards and the Cisco IOS Feature Set. The challenging 2,000 sample test questions provide the in-depth understanding of the protocols required to pass internetworking certification.

I recommend this book as a self-study guide for any internetworking certification.

Imran Qureshi CCIE #1030 Cisco Certified Internetworking Expert (CCIE) Program Manager

Contents

Chapter 1	Getting Started	1
	Congratulations!	1
	CCIE: An Overview	2
	What Background Do I Need to Become a CCIE?	3
	Steps in Becoming a CCIE	3
	CCIE Routing and Switching Expert	4
	The Tests for CCIE Routing and Switching Expert	5
	CCIE WAN Switching Expert	6
	The Tests for CCIE WAN Switching Expert	7
	CCIE ISP Dial Expert	8
	The Tests for CCIE ISP Dial Expert	9
	Recertification for CCIEs	9
	Gaining the Necessary Cisco Training	9
	Getting the Most from Your Training by Developing Good Study Habits	12
	What's Behind Certification Requirements?	15
	Registering for the Exam	17
	Tips for Taking the Exams	17
	Standard Testing Technique	18
	What to Do if You Fail	19
	Conclusion	20
Chapter 2	Data Link Layer—MAC Layer Issues	21
	Data Link Layer Addressing	21
	Data Link Frames	22
	MAC Addressing	24
	FDDI Addressing	25
	Bit Order Transmission	25
	Ethernet Architecture	26
	Ethernet Definition	26
	Ethernet Transmission	28
	Ethernet Reception	30
	Full-Duplex Ethernet	34
	, IEEE 802.2 Data Link Service	35
	Summary of Ethernet Frame Formations and Descriptions	37
	IEEE 802.3 Frame Format	37
	IEEE 802.3 SNAP Frame Format	37
	802.3 Raw Novell Proprietary Frame Format	38
	802.2 LLC Header	39
	Addressing Schemes	40

vi .	Contents	
		Fast Ethernet
		Media Access Control Layer
		Media Independent Interface Layer
		100BASE-TX Physical Layer
	*	100BASE-T4 Physical Layer
		100BASE-FX Physical Layer
		Wiring Standard
		Network Diameter
		Repeater Classes
		Ethernet Vendor Addresses
		Token Ring Architecture
		Token Ring Operation
		Token Ring Frame Definitions
		Token Format
		Token Ring Addressing
		Token Ring Functions

Token Ring Initialization

Frame Transmission

Normal Repeat Mode

Early Token Release

Basic FDDI Characteristics

Connection Establishment

FDDI Timers and Frame Formats

Token Ring Architecture Summary

FDDI Architecture Summary

Logical Link Control Layer Issues

Sequencing of Data (LLC2)

Details of LLC Type 2 Operation

Data Link Layer Study Questions

Frame Reception

Ring Initialization

Normal Operation

FDDI Management

Address Summary

MAC and LLC Layers

LLC Type 2 Operation

Frame Formats

SAP Addressing

Timer Functions

Operation

FDDI Architecture

Summary

Chapter 3

Starting the Ring: The Token Claim Process

Fault Isolation and Software Error Reporting

Neighbor Notification and Duplicate Address Check

Connection-Oriented LLC2—Asynchronous Balance Mode

Connection-Oriented Services of the IEEE 802.2 Protocol

Token Ring Monitors: Maintaining the Ring

57

58

58

60

61

61

62

62

64

82

85

87

90

91

92

93

94

96

96

97

97

98

139

139

142

142

142

144

147

149

150

151

			Contents	vii
	LLC2 Frame Reception			152
	A Live Connection			154
	LLC Type 1 Operation			159
	Information Transfer			159
	SNAP			160
	Logical Link Control Layer Study Questions			162
Chapter 4	Bridging and LAN Switching			167
	Bridging Advantages			168
	How Bridges Work			168
	MAC Bridge Frame Formats			168
	Transparent Bridging			170
	Spanning Tree Algorithm			173
	How STB Works			175
	Shaping the Spanning Tree			177
	Cisco Transparent Bridging Features			180
	Source-Route Bridging (SRB)			181
	How Source Routing Works			182
	Source Route Traffic Overhead			198
	Parallel Bridges and Load Balancing			199
	Route Determination			202
	Cisco Source Route Bridging		e 2	202
	Source Route Bridging Features	n		202
	Remote Source-Route Bridging			203
	DLSw+			204
	SRB Summary			204
	Source Route Transparent			205
	The SRT Solution			205 206
	SRT BRIDGING			207
	About SRT			207
	Source-Route Transparent Bridging Features			210
	Translational and Encapsulation Bridging			210
	Translational Bridging			211
	Encapsulation Bridging			211
	Translation from Token Ring Frames to Ethernet Translation from Ethernet Frames to Token Ring			211
	Bridging Study Questions			212
	Transparent Bridging			212
	Source-Routing Bridging			214
	Source Route Transparent			219
	Other Reference Materials			222
Chapter 5	NetBIOS Architecture			223
	NetBIOS Names			224
	What Are NetBIOS Services?			225
	NetBIOS General Service Commands			225
	Naming Services			225

viii	Cont	-
VIII	Cont	enus

	What is a NetBIOS Session?	. 22	28
	NetBIOS Datagram Services	23	
	NBF and Sessions	23	
	NetBEUI and the OSI Model	23	-
	LLC Sublayer	23	-
	Connectionless Traffic	23	
	Connection-Oriented Traffic	23	
	Adaptive Sliding Window Protocol	23	1000
	Link Timers	23	
	NetBIOS Session Timers	23	9
	NetBEUI on a Multisegmented Token Ring LAN	24	0
	Cisco NetBIOS support	24	0
	NetBIOS Name Caching	24	1
	NetBIOS Broadcast Throttling	24	1
	NetBIOS Broadcast Damping	24	2
	NetBIOS Datagram Broadcast Handling	24:	2
	Broadcast Reduction	243	2
	Name Caching	245	3
	NetBIOS Cache Aging	243	3
	Statically Configured NetBIOS Names	243	3
	NetBIOS Study Questions	244	1
Chapter 6	Working with AppleTalk	249	•
	Cisco Systems AppleTalk Routing	240	
	Data Link and Physical Layers	249 250	
	Link-Access Protocols	250	
Si .	Data Links	251	
	AppleTalk Address Resolution Protocol (AARP)	251	
	AppleTalk AARP Addressing	252	
	Network Layer	254	-
	DDP Protocol Packet Layout	256	
	What is an AppleTalk Network Number?	258	6
	AppleTalk Phase 1 Architecture	259	58
	AppleTalk Phase 2 Architecture	259	
	Integrating AppleTalk Phase 1 and 2	259	
	Transport Layer	260	
	Routing Table Maintenance Protocol	261	
	AppleTalk Update-Based Routing Protocol	265	į.
	Name Binding Protocol Header Descriptions	267	C.
	What is an AppleTalk Zone?	271	
	Zone Information Protocol	271	
	ASP Session Protocol	274	10
	Printer Access Protocol (PAP)	274	8
	Presentation Layer Protocols	275	
	AppleTalk Filing Protocol	275	
	Cisco Enhancements to Standard AppleTalk Services	276	
	Security	277	
985	AppleTalk CCIE Study Questions	277	

	•	Contents	ix
Chapter 7	Working With Novell NetWare	2	89
	Building the Directory Framework	2	89
	Directory Logical Structure	2	91
	MAC	2	91
	ATM		91
	MAC Header		92
	Data Link Frames and Frame Types		92
	FDDI SNAP		92
	NetWare Layer 3 Support		95
	IPX Addressing		95
	Host Number	-	97
	Network Number		97
	Socket Number		97
	Checksum		98
	Length	in the second se	98
	Transport Control		98
	Packet Type		98
	Destination Network	_	98
	Destination Host Node		99
	Destination Socket		99
	Source Network		99
	Source Node	larer	00
	Source Socket	3	00
	Novell IPX Routing Information Protocol (RIP)	3	00
	Distance-Vector Algorithms	<u>.</u>	00
	Cisco IOS IPX Routing Table	30	01
	Client and Router Interaction	30	04
	IPX RIP Interval	30	05
	Multiple Routes	30	05
	IPX and Split Horizon	30	06
	IPX Static Routing	30	06
	Configurable RIP Timers	30	06
	Novell Burst Mode Architecture	30	07
	Novell Burst Mode Sequence Number	30	07
	NLSP: A Link-State Routing Protocol	30	09
	Link-State Databases	3.	12
	NLSP Addressing	31	14
	NLSP Advantages	31	15
	Level 1 LSP	31	18
	NLSP Management Information	32	20
	Link-State Information	32	21
	Services Information	32	23
	External Routes Header	32	25
	IPX Level 1 Hello Packet	32	28
	CSNP Header	33	30
	Service Advertising Protocol	33	
	SAP Header Format and Fields		32
	Cisco Static SAP Tables	33	34
	Cisco Configurable SAP Timers		34

X	Contents
	Colineurs

	Service Advertising Protocol	334
	IPX SAP Interval	334
	SPX Architecture	334
	Large Packets	335
	SPX Packet Format	335
	SPX Header Description	335
	SPX Acknowledgment Packets	337
	SPX Connection Management Packets	337
	Connection Management	337
	Session Termination	337
	SPX Watchdog Algorithm	337
	Session Watchdog during Connection Establishment	338
	Windowing Algorithm	338
	Managing Sequence and Acknowledge Numbers	338
	Acknowledgments	338
	Extensive Error-Recovery Mechanisms	338
	Data Packet Timeout	339
	Window Size	339
	Congestion Control Algorithm	339
	NetWare Core Protocol	339
	NCP Header Descriptions	341
	NCP Function Codes	341
	NetBIOS over IPX	342
	IPX Version 1.0	342
	Connection Establishment	344
	The Shell Program	345
	IPX Protocol Design Worksheet	348
	Novell IPX PROTOCOL WORKSHEET	349
	Novell IPX RIP WORKSHEET	350
	Novell SAP WORKSHEET	351
	Novell IPX WAN DESIGN WORKSHEET	352
	NOVELL NLSP DESIGN WORKSHEET	353
	Novell CCIE Study Questions	354
Chapter 8	TCP/IP Architecture Overview	369
	Internet Protocol (IP)	369
	Internet Protocol (IP) IP Datagrams	371
	IP Addresses	371
	Address Classes	
	Summary of IP Address Classes	375 376
	Classless InterDomain Routing (CIDR)	376
	Subnetting	
	Variable Length Subnet Masks (VLSM)	377 377
	IP Addressing and Subnetting Exercises	
	ARP Architecture	378
	ARP: Frame Encapsulation	383 383
	ARP: Header Format	383 384
	Proxy ARP	384 384
	LIVAY ARE	304

	Contents	xi
Reverse ARP	10	384
ARP Features		385
DHCP Protocol Architecture		386
DHCP Scopes		386
DHCP Relay		386
Configuration Parameters		388
Network Address Allocation		389
Client-Server Protocol		389
Constructing and Sending DHCP Messages		397
DHCP Server Controls		399
DHCP Server Behavior		399
DHCP Client Behavior		405
Applications and Benefits		409
Managing DNS		409
DHCP in a Switched Network		409
TCP/IP Networks Easier to Configure		410
Internet Control Message Protocol (ICMP)		410
ICMP Encapsulation		411
ICMP Header Format		411
Echo Request (Type 8) or Echo Reply Message (Type 0)		411
IP Fields		412
Destination Unreachable Message		413
Source Quench Message		415
ICMP Fields	160	415
Redirect Message		416
IP Fields		416
ICMP Fields		416 417
Time Exceeded Message		417
IP Fields		417
ICMP Fields		417
Parameter Problem Message		418
IP Fields		418
ICMP Fields		419
Timestamp Request or Timestamp Reply Message		420
IP Fields ICMP Fields		420
Information Request or Information Reply Message		420
IP Fields	*	420
ICMP Fields		420
Address Mask Request or Address Mask Reply Message		421
TCP Protocol Overview		422
Full-Duplex Operation		423
Sequence Numbers		423
Window Size and Buffering		423
Round-Trip Time Estimation		424
Header Format		424
Sequence Numbers		427
Initial Sequence Number Selection		428
Establishing a connection		428
The Communication of Urgent Information		432

kii Conte	nts	
	Managing the Window	432
	User Datagram Protocol (UDP)	433
	UDP and the ISO Model	433
	UDP Header Encapsulation	435
	NetBIOS over TCP/IP	435
	Interface to Application Programs	436
	NetBIOS Scope	438
	NetBIOS End-Nodes	438
	NetBIOS Support Servers	440
	NetBIOS Name Server (NBNS) Nodes	440
	Relationship of NetBIOS Support Servers and B Nodes	441
	Topologies	441
	Retransmission of Requests	442
	Requests without Responses: Demands	442
	Transaction ID	443
	TCP and UDP Foundations	443
	Representation of NetBIOS Names	443
	First Level Encoding	443
	Second Level Encoding	444
	NetBIOS Name Service	444
	Name Registration (Claim)	444
	Name Query (Discovery)	445
	Name Release	445
•	Explicit Release	445
	NetBIOS Session Service	445
	Overview of NetBIOS Session Service	445
	Session Establishment Phase Overview	446
	NetBIOS Datagram Service	447
	NetBIOS Datagrams by B Nodes	447
	NetBIOS Datagrams by P and M Nodes	448
	Cisco's TCP/IP Options	449
	Access Restrictions	449
97.9	Multivendor Tunneling	450
	IP Multicast Support	450
	Routing Protocol Update Suppression	450
	Administrative Distance	450
	Routing Protocol Redistribution	450
	Serverless Network Support	451
	Network Monitoring and Debugging	451
	Summary	452
	TCP/IP CCIE Study Questions	452
Chapter 9	Routing Information Protocol (RIP)	487
	RIP Limitations	488
	Split Horizon	490
	Triggered Updates	490
	Route States	491
	UP	491
	GARRAGE COLLECTION	491