

Covers  
**IOS 15**

TODD LAMMLE'S

# CCNA/CCENT **IOS** COMMANDS

## SURVIVAL GUIDE

EXAMS 100-101, 200-101, AND 200-120

o/r 0x2142 media-typ  
Service password encryption  
network-number  
no cdp sh vlan enable  
ppp authentication  
chap 1 ppp authentication pap  
ip route  
media-type no ip domain-lookup  
logging synchronous

**Todd Lammle**

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# Todd Lammle's CCNA®/CCENT® IOS Commands Survival Guide



Todd Lammle



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Cover Designer: Ryan Sneed  
Cover Image: © Wiley

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Published simultaneously in Canada

ISBN: 978-1-118-82004-9

ISBN: 978-1-118-81978-4 (ebk.)

ISBN: 978-1-118-82007-0 (ebk.)

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**Library of Congress Control Number:** 2013954097

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Best regards,

A handwritten signature in black ink, appearing to read "Chris Webb". The signature is fluid and cursive, with a large initial "C" and "W".

Chris Webb  
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# Acknowledgments

Kudos to Jeff Kellum for coming up with the original idea for this book. This is one of my favorite books that I have written, and I am glad that I had the opportunity to write this new second edition.

Thanks to my developmental editor Pete Gaughan for his patience and gentle but effective direction and also thanks to my production editor Eric Charbonneau for helping me organize and keep my thoughts going in one direction—which is no easy task! Also, thanks to Troy McMillan and Dax Mickelson for their technical expertise. Finally, thanks to proofreader Rebecca Rider and compositor Craig Woods. All of these people helped create this fantastic title.

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## About the Author

**Todd Lammle** is the authority on Cisco Certification and internetworking. He is a world-renowned author, speaker, trainer, and consultant. Todd has three decades of experience working with LANs, WANs, and large licensed and unlicensed wireless networks, and lately he has been implementing large Cisco data centers worldwide. His three decades of real world experience is prevalent in his writing; he is not just an author but an experienced networking engineer with very practical experience working on the largest networks in the world. Todd has published over 60 books, including the very popular *CCNA: Cisco Certified Network Associate Study Guide*, *CCNA Wireless Study Guide*, and *CCNA Data Center Study Guide*, all from Sybex. He runs an international training and consulting company based in Colorado, Texas, and San Francisco.

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# Introduction

I know it's kind of wrong to say this type of stuff about your own stuff, but I'm just going to do it—this is a really good book! It might even be the most interesting book I've written so far. A big reason for this is that its scope allowed me to go above and beyond covering the usual CCNA study guide material and I got to really detail the commands I used in the guide, plus a lot of additional commands that just happen to be some of my personal favorites.

Do remember that, although very cool indeed, this volume isn't intended to be a one-stop shop for passing the CCNA exams. Think of it and use it as a supplement to other study material—like, well, my Sybex CCNA study guide! But seriously, I want you to know that this book will complement anything, no matter what you have stashed in your personal arsenal to pass the exams—it's that good, and yes, I said it myself. By the way, know that lots of other people (who I didn't pay) think so too!

## How to Use This Book

If you want a solid foundation for the serious and I hope successful goal of effectively preparing for the Cisco Certified Network Associate (CCNA) suite of exams—including the ICND1, ICND2, and the CCNA composite 200-120—then this is your baby! I've spent hundreds of hours putting together this book with the sole objective of helping you to pass the whole group of CCNA exams while actually learning how to configure Cisco routers, switches, and tons of other things too.

So, yes, this book is loaded with lots of valuable information, and you will get the most out of all that and your studying time if you understand how I put the book together.

To maximize your benefit from this book, I recommend the following study method:

1. My recommendation is to read the full Sybex *CCNA Study Guide* and then just start reading this book from Chapter 1 and don't stop until you're all the way through Chapter 11. This study method will really help you concentrate on the commands needed to cover the many CCENT/CCNA objectives.
2. Study each chapter carefully, making sure you fully understand the command covered in each chapter. Pay extra-close attention to any chapter that includes material covered that you struggled with when reading the full study guide.
3. Check out [www.lammle.com](http://www.lammle.com) for more Cisco exam prep questions and updates to this book and other Cisco books I have written. The questions found at [www.lammle.com](http://www.lammle.com) will be updated at least monthly, if not weekly or even daily! Before you take your test, be sure to visit my website for questions, videos, audios, and other useful information.

To learn every bit of the material covered in this book, you'll have to apply yourself regularly and with discipline. Try to set aside the same time period every day to study, and select a comfortable and quiet place to do so. If you work hard, you will be surprised at how quickly you learn this material.

## What Does This Book Cover?

This book covers everything you need to know in order to understand the CCNA exam objective commands. However, taking the time to study and practice with routers or a router simulator is the real key to success.

You will learn the following information in this book:

- Chapter 1 introduces you to the Cisco Internetwork Operating System (IOS) and command-line interface (CLI). In this chapter you will learn how to turn on a router and configure the basics of the IOS, including setting passwords, banners, and more.
- Chapter 2 provides you with the management skills needed to run a Cisco IOS network. Backing up and restoring the IOS, as well as router configuration, are covered, as are the troubleshooting command tools necessary to keep a network up and running.
- Chapter 3 teaches you about IP routing. This is an important chapter, because you will learn how to build a network, add IP addresses, and route data between routers. You will also learn about static, default, and dynamic routing using RIP.
- Chapter 4 dives into more complex dynamic routing with Enhanced IGRP and OSPF routing.
- Chapter 5 gives you a background on layer-2 switching and how switches perform address learning and make forwarding and filtering decisions. Network loops and how to avoid them with the Spanning Tree Protocol (STP) will be discussed, as well as the 802.1w STP version.
- Chapter 6 covers virtual LANs and how you can use them in your internetwork. This chapter also covers the nitty-gritty of VLANs and the different concepts and protocols used with VLANs, as well as troubleshooting.
- Chapter 7 covers security and access lists, which are created on routers to filter the network. IP standard, extended, and named access lists are covered in detail.
- Chapter 8 covers Network Address Translation (NAT). Information and all the configuration commands, troubleshooting, and verification commands needed to understand the NAT CCNA objectives are covered in this chapter.
- Chapter 9 covers IPv6. This is a very fun chapter and has some great information. IPv6 is not the big, bad, scary monster that most people think it is. IPv6 is an objective on this new exam, so study this chapter carefully. This chapter is more technology based then configuration based to cover the current CCNA objectives. Keep an eye out at [www.lammle.com](http://www.lammle.com) for up-to-the-minute updates.
- Chapter 10 concentrates on Cisco wide area network (WAN) protocols. This chapter covers HDLC, PPP, and Frame Relay in depth. You must be proficient in all these protocols to be successful on the CCNA exam.
- Chapter 11 covers Cisco IP Services, which are the newest exam objectives added to the latest CCNA exam.



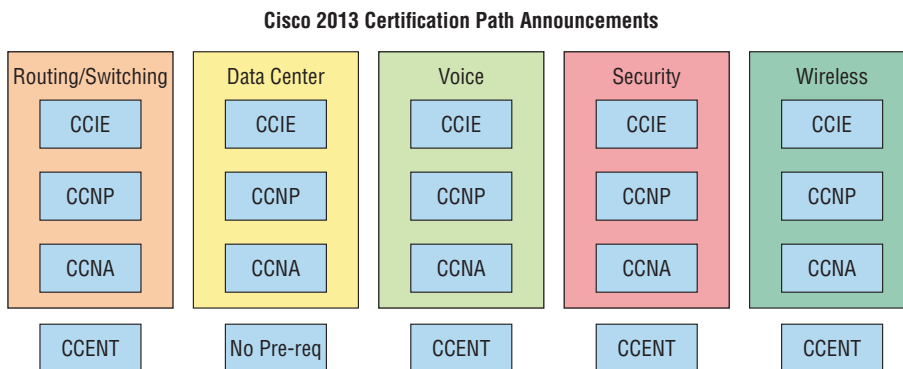
For up-to-the-minute updates covering additions or modifications to the CCNA certification exams, as well as additional study tools and review questions, be sure to visit the Todd Lammle forum and website at [www.lammle.com](http://www.lammle.com) or [www.lammle.com/forum](http://www.lammle.com/forum).

## Cisco's Network Certifications

It used to be that to secure the holy grail of Cisco certifications—the CCIE—you passed only one written test before being faced with a grueling, formidable hands-on lab. This intensely daunting, all-or-nothing approach made it nearly impossible to succeed and predictably didn't work out too well for most people. Cisco responded to this issue by creating a series of new certifications, which not only made it easier to eventually win the highly coveted CCIE prize, it gave employers a way to accurately rate and measure the skill levels of prospective and current employees. This exciting paradigm shift in Cisco's certification path truly opened doors that few were allowed through before!

Beginning in 1998, obtaining the Cisco Certified Network Associate (CCNA) certification was the first milestone in the Cisco certification climb as well as the unofficial prerequisite to each of the more advanced levels. But that changed when Cisco announced the Cisco Certified Entry Network Technician (CCENT) certification. And then in March 2013, Cisco once again proclaimed that all-new tests would be required beginning in October of the same year; now the Cisco certification process looks like Figure I.1.

**FIGURE I.1** The Cisco Certification Path





I have included only the most popular tracks in Figure I.1. In addition to the ones in this image, there are also tracks for Design, Service Provider, Service Provider Operations, and Video. Also note that the CCIE Voice certification has been retired as of February 2014.

The Cisco Routing and Switching (R/S) path is by far the most popular and could very well remain so, but soon you'll see the Data Center path become more and more of a focus as companies migrate to data center technologies. The Voice track also actually does provide a good job opportunity. Still, understanding the foundation of R/S before attempting any other certification track is something I highly recommend.

Even so, and as the figure shows, you only need your CCENT certification to get underway for most of the tracks. Also, note that there are a few other certification tracks you can go down that are not shown in the figure, although they're not as popular as the ones shown. You can find information on all Cisco certification tracks at [www.cisco.com](http://www.cisco.com).

## Cisco Certified Entry Network Technician (CCENT)

Don't be fooled by the oh-so-misleading name of this first certification because it absolutely isn't entry-level! Okay—maybe it's entry level for Cisco's certification path, but definitely not for someone without experience trying to break into the highly lucrative yet challenging IT job market! For the uninitiated, the CompTIA A+ and Network+ certifications aren't official prerequisites, but know that Cisco does expect you to have that type and level of experience before embarking on your Cisco certification journey.

All of this gets us to 2013, when the climb to Cisco supremacy just got much harder again. The innocuous-sounding siren's call of the CCENT can lure you to some serious trouble if you're not prepared, because it's actually much harder than the old CCNA ever was. This will rapidly become apparent once you start studying, but be encouraged! The fact that the certification process is getting harder really works better for you in the long run, because that which is harder to obtain only becomes that much more valuable when you finally do get it, right? Yes, indeed!

Another important factor to keep in mind is that the CCENT 100-101 exam, which is the exam this book was written for, costs \$150 per attempt and it's anything but easy to pass! The good news is that this book will guide you step-by-step in building a strong foundation in routing and switching technologies. You really need to build on a strong technical foundation and stay away from exam cram type books, suspicious online material, and the like. They can help somewhat, but understand that you'll pass the Cisco certification exams only if you have a strong foundation and that you'll get that solid foundation only by reading as much as you can, performing the written labs and review questions in this book, and practicing lots and lots of hands-on labs. Additional practice exam questions, videos, and labs are offered on my website, and what seems like a million other sites offer additional material that can help you study.

However, there is one way to skip the CCENT exam and still meet the prerequisite required before moving on to any other certification track, and that path is through the



CCNA R/S composite exam. First, I'll discuss the Interconnecting Cisco Network Devices 2 (ICND2) exam, and then I'll tell you about the composite CCNA exam, which will provide you, when successful, with both the CCENT and the CCNA R/S certification.

## Cisco Certified Network Associate Routing and Switching (CCNA R/S)

Once you have achieved your CCENT certification, you can take the ICND2 (200-101) exam in order to achieve your CCNA R/S certification. This is now the most popular certification Cisco has by far because it's the most sought-after certification of all employers.

As with the CCENT, this exam is also \$150 per attempt—although thinking you can just skim a book and pass any of these exams would probably be a really expensive mistake! The CCENT/CCNA exams are extremely hard and cover a lot of material, so you have to really know your stuff. Taking a Cisco class or spending months with hands-on experience is definitely a requirement to succeed when faced with this monster!

And once you have your CCNA, you don't have to stop there—you can choose to continue and achieve an even higher certification, called the Cisco Certified Network Professional (CCNP). There are various ones as shown in Figure I.1. The CCNP R/S is still the most popular, with Voice certifications coming in at a close second. And I've got to tell you that the Data Center certification will be catching up fast. Also good to know is that anyone with a CCNP has all the skills and knowledge needed to attempt the notoriously dreaded but coveted CCIE lab. But just becoming a CCENT/CCNA can land you that job you've dreamed about and that's what this book is all about: helping you to get and keep a great job!

Still, why take two exams to get your CCNA if you don't have to? Cisco still has the composite exam called CCNA 200-120 that, if passed, will land you with your CCENT and your CCNA R/S via only one test priced accordingly at \$300. Some people like the one test approach, some people like the two-test approach, but this book will help you with either path you choose.

## Why Become a CCENT and CCNA R/S?

Cisco, like Microsoft and other vendors that provide certification, has created the certification process to give administrators a set of skills and to equip prospective employers with a way to measure those skills or match certain criteria. And as you probably know, becoming a CCNA R/S is certainly the initial, key step on a successful journey toward a new, highly rewarding, and sustainable networking career.

The CCNA program was created to provide a solid introduction not only to the Cisco Internetwork Operating System (IOS) and Cisco hardware but also to internetworking in general, making it helpful to you in areas that are not exclusively Cisco's. And regarding today's certification process, it's not unrealistic that network managers—even those without Cisco equipment—require Cisco certifications for their job applicants.

Rest assured that if you make it through the CCNA and are still interested in Cisco and internetworking, you're headed down a path to certain success!

## What Skills Do You Need to Become a CCENT?

This exam tests a candidate for the knowledge and skills required to successfully install, operate, and troubleshoot a small branch office network.

The exam includes topics on the operation of IP data networks, LAN switching technologies, IPv6, IP routing technologies, IP services (DHCP, NAT, ACLs), network device security, and basic troubleshooting.

## What Skills Do You Need to Become a CCNA R/S?

The ICND2 exam (exam 200-101) tests a candidate for the knowledge and skills required to successfully install, operate, and troubleshoot a small to medium-size enterprise branch network. The exam includes topics on LAN switching technologies, IP routing technologies, IP services (FHRP, syslog, SNMP v2 and v3), troubleshooting, and WAN technologies.

Another test you can take instead of taking both of the ICND1 and ICND2 is the composite CCNA v2.0 exam, number 200-120.

## How Do You Become a CCNA R/S with Just One Test?

The way to become a CCNA R/S is to pass one little test (CCNA Composite exam 200-120) without having to take the CCENT exam. Then—poof!—you’re a CCNA R/S. Oh, but don’t you wish it were that easy? True, it’s just one test, but it’s a whopper, and to pass it you must possess enough knowledge to understand what the test writers are saying.

Good to know is that Cisco offers the two-step process I discussed earlier in this introduction that you can follow to become a CCNA. It’s easier than taking that one ginormous exam, but don’t think the two-test method is easy. It takes work! However, it can be done; you just need to stick with your studies.

The two-test method involves passing the following:

**Exam 100-101:** Interconnecting Cisco Networking Devices 1 (ICND1)

**Exam 200-101:** Introduction to Cisco Networking Devices 2 (ICND2)

I can’t stress this point enough: It’s critical that you have some hands-on experience with Cisco routers. If you can get ahold of some basic routers and switches, you’re set; but if you can’t, I’ve worked hard to provide hundreds of configuration examples throughout this book to help network administrators, or people who want to become network administrators, learn the skills they need to pass the CCENT and CCNA exams.



For Cisco certification hands-on training with Todd Lammle, please see [www.lammle.com](http://www.lammle.com). Each student will get hands-on experience by configuring at least three routers and two switches—no sharing of equipment!

# Where Do You Take the Exams?

You may take the CCENT or any Cisco exam at any of the Pearson VUE authorized testing centers ([www.vue.com](http://www.vue.com)) or call 877-404-EXAM (3926).

To register for a Cisco exam, follow these steps:

1. Determine the number of the exam you want to take.
2. Register with the nearest Pearson VUE testing center. At this point, you will be asked to pay in advance for the exam. At the time of this writing, the CCENT and ICND2 exams are \$125 and must be taken within one year of payment. You can schedule exams up to six weeks in advance or as late as the day you want to take it—but if you fail a Cisco exam, you must wait six days before you will be allowed to retake it. If something comes up and you need to cancel or reschedule your exam appointment, contact Pearson VUE at least 24 hours in advance.
3. When you schedule the exam, you'll get instructions regarding all appointment and cancellation procedures, the ID requirements, and information about the testing-center location.

## Tips for Taking Your CCNA Exams

The CCNA exams contains about 55 questions and must be completed in 75 to 90 minutes or less. This information can change per exam. You must get a score of about 80 to 85 percent to pass this exam, but again, each exam can be different.

Many questions on the exam have answer choices that at first glance look identical—especially the syntax questions! Remember to read through the choices carefully because close doesn't cut it. If you get commands in the wrong order or forget one measly character, you'll get the question wrong.

Also, never forget that the right answer is the Cisco answer. In many cases, more than one appropriate answer is presented, but the *correct* answer is the one that Cisco recommends. On the exam, you're always instructed to pick one, two, or three, never "choose all that apply." The latest CCNA exams may include the following test formats:

- Multiple-choice single answer
- Multiple-choice multiple answer
- Drag-and-drop
- Fill-in-the-blank
- Router simulations

In addition to multiple choice and fill-in response questions, Cisco Career Certifications exams may include performance simulation exam items. They do allow partial command responses. For example, `show running-config`, or `sh run` would be acceptable.

Here are some general tips for exam success:

- Arrive early at the exam center so you can relax and review your study materials.
- Read the questions *carefully*. Don't jump to conclusions. Make sure you're clear about *exactly* what each question asks.
- When answering multiple-choice questions that you're not sure about, use the process of elimination to get rid of the obviously incorrect answers first. Doing this greatly improves your odds if you need to make an educated guess.
- You can no longer move forward and backward through the Cisco exams, so double-check your answer before clicking Next since you can't change your mind.

After you complete an exam, you'll get immediate, online notification of your pass or fail status, a printed Examination Score Report that indicates your pass or fail status, and your exam results by section. (The test administrator will give you the printed score report.) Test scores are automatically forwarded to Cisco within five working days after you take the test, so you don't need to send your score to them. If you pass the exam, you'll receive confirmation from Cisco, typically within two to four weeks, sometimes longer.



This book covers everything CCNA related. For up-to-date information on Todd Lammle Cisco Authorized CCNA CCNP and CCIE boot camps, please see [www.lammle.com](http://www.lammle.com).

## How to Contact the Author

You can reach Todd Lammle through GlobalNet Training Solutions, Inc. ([www.globalnettc.com](http://www.globalnettc.com)), his training and systems integration company; or through his forum at [www.lammle.com/forum](http://www.lammle.com/forum).

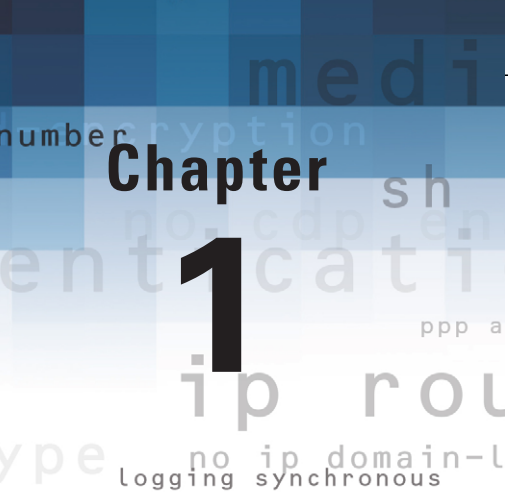
Chapter

1

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# Basic IOS Commands

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This book starts by introducing you to the Cisco Internetwork Operating System (IOS). The IOS is what runs Cisco routers as well as some Cisco switches, and it's what allows you to configure the devices. You use the command-line interface (CLI) to configure a router, and that is what I'll show you in this chapter.

The Cisco router IOS software is responsible for the following important tasks:

- Carrying network protocols and functions
- Connecting high-speed traffic between devices
- Adding security to control access and stop unauthorized network use
- Providing scalability for ease of network growth and redundancy
- Supplying network reliability for connecting to network resources

You can access the Cisco IOS through the console port of a router, from a modem into the auxiliary (or aux) port, or even through Telnet and Secure Shell (SSH). Access to the IOS command line is called an *exec session*.

Once you have attached your console cable (this is a rolled cable, sometimes referred to as a *rollover cable*) to the router and have started your terminal software, you will be ready to power on the router. Assuming that this is a new router, it will have no configuration and thus will need to have, well, everything set up. In this chapter, first I'll cover the power-on process of the router, and then I'll introduce the setup script.



For up-to-the minute updates for this chapter, please see [www.lammle.com](http://www.lammle.com).

## Booting the Router

The following messages appear when you first boot or reload a router:

```
System Bootstrap, Version 15.1(4)M6, RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 2006 by cisco Systems, Inc.
Initializing memory for ECC
c2811 platform with 262144 Kbytes of main memory
```

```

Main memory is configured to 64 bit mode with ECC enabled
Upgrade ROMMON initialized
program load complete, entry point: 0x8000f000, size: 0xcb80
program load complete, entry point: 0x8000f000, size: 0xcb80
program load complete, entry point: 0x8000f000, size: 0x14b45f8
Self decompressing the image :
#####
##### [OK]
[some output cut]

```

```

Cisco IOS Software, 2800 Software (C2800NM-ADVSECURITYK9-M), Version
 15.1(4)M6,RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2006 by Cisco Systems, Inc.
Compiled Fri 17-Nov-06 12:02 by prod_rel_team
Image text-base: 0x40093160, data-base: 0x41AA0000

```

[some output cut]

```

Cisco 2811 (revision 49.46) with 249856K/12288K bytes of memory.
Processor board ID FTX1049A1AB
2 FastEthernet interfaces
4 Serial(sync/async) interfaces
1 Virtual Private Network (VPN) Module
DRAM configuration is 64 bits wide with parity enabled.
239K bytes of non-volatile configuration memory.
62720K bytes of ATA CompactFlash (Read/Write)

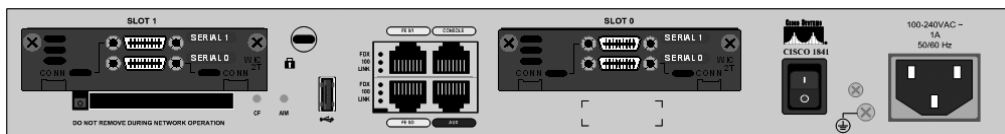
```

Notice the following in the previous messages:

- The type of router (2811) and the amount of memory (262,144KB)
- The version of software the router is running (15.1(4)M6)
- The interfaces on the router (two Fast Ethernet and four serial)

Figure 1.1 shows a picture of an 1841 router, which is what is called an *integrated services router* (ISR), just like the 2811 router output shown earlier.

**FIGURE 1.1** A Cisco 1841 router



An 1841 router holds most of the same interfaces as a 2800 router, but it's smaller and less expensive.

## Setup Mode

If the router has no initial configuration, you will be prompted to use setup mode to establish an initial configuration. You can also enter setup mode at any time from the command line by typing the command **setup** from something called *privileged mode*. Setup mode covers only some global commands and is generally just not helpful. Here is an example:

```
Would you like to enter the initial configuration dialog? [yes/no]: y
```

At any point you may enter a question mark '?' for help.  
Use ctrl-c to abort configuration dialog at any prompt.  
Default settings are in square brackets '[]'.

Basic management setup configures only enough connectivity for management of the system, extended setup will ask you to configure each interface on the system

```
Would you like to enter basic management setup? [yes/no]: y
Configuring global parameters:
```

```
Enter host name [Router]:Ctrl+C
Configuration aborted, no changes made.
```



You can exit setup mode at any time by pressing Ctrl+C.

## Router Configuration Modes

One key to navigating the CLI is to always be aware of which router configuration mode you are currently in (see Table 1.1). You can tell which configuration mode you are in by watching the CLI prompt.

**TABLE 1.1** Router Configuration Modes

Mode	Definition	Example
User EXEC mode	Limited to basic monitoring commands	Router>



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sample content of Todd Lammle's CCNA/CCENT IOS Commands Survival Guide: Exams 100-101, 200-101, and 200-120

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