

CCENT Study Guide 3

Section 9.3 Troubleshooting Layer 3 IP Addressing Issues

As you work through this troubleshooting section, you can review the material necessary to prepare you to obtain a CCENT certification. To obtain a CCENT certification, you must pass the 640-822 ICND1 examination. These study guides provide a method to organize your review based on the ICND1 exam objectives.

IP Addressing and Subnetting

Objective: Describe the need and role of addressing in a network

Discovery 1 Review Chapters:

Connecting to the Network: Both MAC addresses and IP addresses are discussed in this chapter. Pay close attention to the differences between physical and logical addressing. It is necessary to understand how communication on a local Ethernet network relies on the MAC address of the NIC card to identify the source and destination hosts. Internetwork communications rely on the logical, Layer 3 addresses. In most modern networks, this is the IP address. Review the topics *Physical Addressing* and *Logical Addressing* in the *Communicating on a Local Wired Network* section.

Network Addressing: The first two sections of this chapter, *IP Addresses and Subnet Masks* and *Types of IP Addresses*, contain information critical to your understanding of the role IP addressing plays in a network. They also provide the basis for understanding how hosts and routers use IP addressing to direct packets along the best path to their destinations. Pay close attention to the animations in the topics *IP Address Structure* and *How IP Addresses and Subnet Masks Interact*. It is very important to understand how to convert a binary IP address to dotted decimal notation, and how to convert dotted decimal notation to a binary address. Be able to describe how a host uses its own configured subnet mask to determine whether or not a destination is local or remote.

Discovery 2 Review Chapters:

Planning the Addressing Structure: The section *Review of IP Addresses* contains information about the various classes of IP addresses, the hierarchical nature of IP addressing schemes, and introduces the concept of subnets.

Objective: Create and apply an addressing scheme to a network

Objective: Assign and verify valid IP addresses to hosts, servers, and networking devices in a LAN environment

These two objectives are closely related. The first refers to the ability to design an IP addressing scheme, including creating subnetworks. The second objective involves the skill of applying the addresses to various types of devices, including routers, switches, and PCs. Note: For the certification examination, private addressing is most frequently used in the tasks.

Discovery 1 Review Chapters:

Connecting to the Network: An important concept to remember when creating and applying an IP addressing scheme to a network is the designation of a default gateway. The function of a default gateway is described in the *Default Gateway* topic within the *Building the Distribution Layer of the Network* section. Packet Tracer is

introduced in this section. The section **Plan and Connect a Local Network** provides an introduction to designing, prototyping and actually building a simple local network, including the assignment of IP addresses.

Discovery 2 Review Chapters:

Planning a Network Upgrade: The topic **Design Considerations** in the section **Purchasing and Maintaining Equipment** contains information about the types of devices that need to have IP addresses assigned.

Planning the Addressing Structure: IP addressing and subnetting are critical skills tested on the ICND1 exam. Pay close attention to how devices use subnet masks to determine which destination devices are on the same network and which destinations are on remote networks. Subnetting and configuring the correct IP address/subnet mask combination on devices and hosts is one of the most important tasks networkers perform. Errors in assigning subnets account for a large percentage of configuration errors. Review the section **IP Addressing in the LAN** carefully and ensure you fully understand how to calculate subnets to meet networking requirements. Be able to describe the advantages of VLSM over classful subnetting.

Configuring Network Devices: Once an IP addressing scheme is designed, assigning the IP addresses to various device types is the next step in network configuration. It is important to understand which types of devices need IP addresses and which commands to use to configure addresses on hosts, Cisco router interfaces and the management interface of Cisco switches. SDM, SDM Express, and the CLI can be used to configure Cisco router interfaces. The section **Using SDM Express and SDM** describes how to use SDM to configure an interface IP address. Within the **Configuring a Router Using IOS CLI**, the topic **Configuring an Interface** contains the necessary commands to configure and verify IP address information on a Cisco router. The topic **Initial Switch Configuration** describes the process to configure and verify the management interface on a Cisco switch.

Practice Activities:

1. Use ping and nslookup to determine the IP addresses of your favorite websites. Identify the address class of each IP address. Determine the default subnet mask associated with the address.
2. Randomly pick IP address and subnet mask combinations. For each combination, determine the network address, the broadcast address, and how many host addresses are available on the network. For example:

IP Address	Subnet Mask	Network Address	Broadcast Address	Number of Available Host Addresses
172.16.10.5/22	255.255.252.0	172.16.8.0	172.16.11.255	1022
10.14.8.131/27	255.255.255.224	10.14.8.128	10.14.8.159	30

3. Use Packet Tracer to create routed networks that include Cisco routers, switches, servers and hosts. Make a note of how many IP addresses are used for router interfaces and switch management interfaces. Remember to include these requirements when designing address schemes. Assign various IP addressing schemes to hosts on each individual local network. Use ping, ipconfig, traceroute (tracert), and various show commands to practice interpreting the output.
4. Create hypothetical network requirements. Determine what private address space can be used to support the requirements, and what classless subnetting schemes would work to meet the requirements with the minimum number of wasted IP addresses. Use Packet Tracer to configure your networks and verify that they work as you expect.

Requirement: 3 Networks, one with 10 hosts, one with 40 hosts and one with 100 hosts.

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Working at a Small-to-Medium Business or ISP

Network: 192.168.1.0/24 Subnet Mask 255.255.255.0

Subnet Address	Subnet Mask	Number of Hosts	Broadcast Address
192.168.1.0/25	255.255.255.128	126	192.168.1.127
192.168.1.128/26	255.255.255.192	62	192.168.1.191
192.168.1.192/28	255.255.255.240	14	192.168.1.207

Private IP Addressing and NAT

Objective: Describe the operation and benefits of using private and public IP addressing

Discovery 1 Review Chapters:

Network Addressing: The section *Types of IP Addresses* describes the different classes of IP addresses, as well as the ranges that are reserved for private IP networks. The activity in this section provides practice recognizing public and private addresses.

Discovery 2 Review Chapters:

Planning the Addressing Structure: A review of the private IP addressing ranges, and a chart containing the ranges is contained in the *Review of IP Addresses* topic.

Objective: Explain the basic uses and operation of NAT in a small network connecting to one ISP

Discovery 1 Review Chapters:

Network Addressing: The section *Address Management* includes the topic *Network Address Translation*. Within this topic, the term Network Address Translation (NAT) is defined, and the process that occurs to enable networks using private IP addresses to access the Internet is shown in an animation. Although this section uses the Linksys device to perform NAT, the function is the same when applied to a Cisco router serving as the NAT device. The Packet Tracer activity associated with this topic illustrates the functionality of DHCP and NAT.

Discovery 2 Review Chapters:

Planning the Addressing Structure: The section *NAT and PAT* describes different methods to perform Network Address Translation using Cisco routers. Be sure that you understand the terminology associated with NAT and PAT, and fully understand the process in which an internal private IP address is assigned to a public IP address for transmission through the Internet. Pay close attention to the animations contained within this section.

Objective: Enable NAT for a small network with a single ISP and connection using SDM and verify operation using CLI and ping

Discovery 1 Review Chapters: none

Discovery 2 Review Chapters:

Configuring Network Devices: The topics *Configuring NAT using Cisco SDM* and *Configuring Static NAT using Cisco IOS CLI* explain how to configure a Cisco router to provide address translation for the local privately addressed LAN. Review the difference between static NAT translations and dynamic address pool assignment.

Troubleshooting: The topic *DHCP and NAT issues* in the *Troubleshooting Layer 3 Address Issues* section describes how to identify NAT translation problems using the Cisco IOS CLI. It is important to understand what information can be gathered from the output of the various IOS commands.

Practice Activities:

1. Create a chart of each of the important NAT terms and list the definition of each term.
2. Review the NAT animations in the curriculum and identify the source and destination IP addresses at various points within the networks.
3. Configure a small network with private IP addresses. Configure a Cisco router to provide different types of NAT translations: static, dynamic pool addresses, and overload PAT translations. Use the various show commands to verify the translations are occurring as expected.

DHCP and DNS

Objective: Implement static and dynamic addressing services for hosts in a LAN environment

Discovery 1 Review Chapters:

Operating Systems: Configuring a host with a static IP address or to receive the IP information dynamically is introduced in the *Configuring a Computer for the Network* topic.

Network Addressing: In the topic *Static and Dynamic Address Assignment*, the function of DHCP is explained. Within the *Address Management* section, the topic *Address Assignment* describes how an integrated router acts as a DHCP server.

Discovery 2 Review Chapters:

Configuring Network Devices: The topics *SDM Express Configuration Options* and *Configuring DHCP Services* provide step-by-step procedures to configure a Cisco router to be a DHCP server.

Objective: Configure, verify and troubleshoot DHCP and DNS operation on a router (including: CLI/SDM)

Discovery 1 Review Chapters:

Network Addressing: The section *How IP Addresses are Obtained* describes the various ways a host can obtain an IP addresses and includes information on how to configure a Linksys device to be a DHCP server. The lab in this section enables you to practice the configuration skill.

Network Services: The function of the Domain Name System (DNS) and the Domain Name Service running on a server are introduced in the topic *Domain Name Service* in the *Application Protocols and Services* section.

Troubleshoot Your Network: The section *Troubleshooting Issues* explains how to use utilities such as ipconfig, tracert, ping, and nslookup to troubleshoot and identify IP addressing, DHCP and DNS problems.

Discovery 2 Review Chapters:

Help Desk: The *Troubleshooting the OSI Model* topic within the *OSI Model* section provides a review of how to use PC utilities to troubleshoot DHCP and DNS errors. The *Troubleshooting Scenarios* topic within the *ISP Troubleshooting* section describes common client configuration errors.

Configuring Network Devices: The topics *SDM Express Configuration Options* and *Configuring DHCP Services* provide step-by-step procedures to configure a Cisco router to be a DHCP server. The Packet Tracer activity and lab in the *Configuring DHCP Services* topic are important activities to review.

ISP Services: The section *Domain Name System* provides in-depth information on how DNS works that can provide valuable troubleshooting information.

Troubleshooting: Common symptoms associated with DHCP issues are described in the topic *DHCP and NAT Issues* in the *Troubleshooting Layer 3 IP Addressing Issues* section.

Practice Activities:

1. Create a small routed network and configure a Cisco router to provide DHCP services to hosts on the network. Use both the SDM Express configuration utilities and the CLI configuration commands. Use CLI commands to verify that DHCP is working as expected.
2. Use the PC ipconfig command to verify that DHCP is providing the correct IP address, subnet mask, default gateway and DNS server addresses.
3. Create a diagram showing the process a PC client uses to obtain a DHCP address from a server.

Troubleshooting IP Issues

Objective: Identify and correct IP addressing issues

Discovery 1 Review Chapters: none

Discovery 2 Review Chapters:

Help Desk: The topic *Troubleshooting the OSI Model* in the *ISP Troubleshooting* section explains how to use various utilities to identify Layer 3 addressing issues. A common IP addressing problem is the failure of a host to obtain an IP address through DHCP. This can be caused by various issues. The topic *Help Desk Troubleshooting Scenarios* describes the link local address that is automatically assigned to Windows PCs when a DHCP server is not available.

Troubleshooting: The section *Troubleshooting Layer 3 Addressing Issues* is dedicated to providing information on how to troubleshoot and correct IP addressing problems in a LAN or WAN. The topics *IP Design and Configuration Issues* and *IP Address Planning and Allocation Issues* explain the symptoms that occur when overlapping or inadequate subnets are configured.

Practice Activities:

1. Practice using ipconfig and IOS show commands to view IP address assignments.
2. Randomly pick two addresses from the same private address space. Using various different subnet masks, determine if both addresses are on the same local network, or whether a router would be needed in order for the hosts to communicate with each other. This practice will enable you to quickly spot errors in overlapping subnet masks or incorrect host range assignments.

Example: Host 172.16.12.4 and Host 172.16.14.150

Subnet Mask	Prefix Length	On Same Network?	Need Router?
255.255.255.224	/27	No	Yes
255.255.255.0	/24	No	Yes
255.255.252.0	/22	Yes	No
255.255.0.0	/16	Yes	No