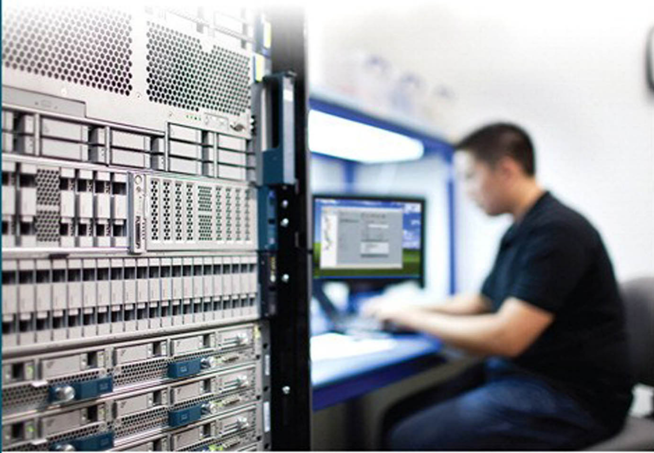
Troubleshooting and Maintaining Cisco IP Networks (TSHOOT)

Foundation Learning Guide



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Cisco Press

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Amir Ranjbar

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Dedication

I dedicate this book to my father, Mr. Kavos Ranjbar, whom I lost on January 2, 2013. I wish we could all be so loving, helpful, and generous, yet humble, peaceful, and gentle, just like my dad.

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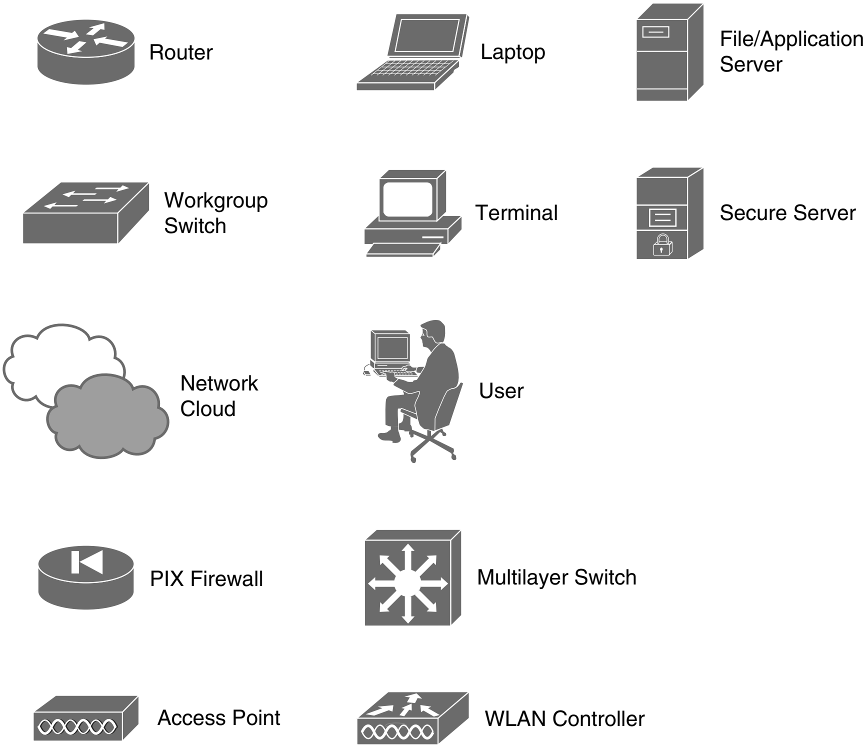

Command Syntax Conventions

The conventions used to present command syntax in this book are the same conventions used in the IOS Command Reference. The Command Reference describes these conventions as follows:

- **Boldface** indicates commands and keywords that are entered literally as shown. In actual configuration examples and output (not general command syntax), boldface indicates commands that are manually input by the user (such as a **show** command).
- *Italic* indicates arguments for which you supply actual values.
- Vertical bars (|) separate alternative, mutually exclusive elements.
- Square brackets ([ ]) indicate an optional element.
- Braces ({ }) indicate a required choice.
- Braces within brackets ([{ }]) indicate a required choice within an optional element.

Introduction

This book is based on the Cisco Systems TSHOOT course, which was recently introduced as part of the CCNP curriculum. It provides troubleshooting and maintenance information and examples that relate to Cisco routing and switching. It is assumed that readers know and understand as much Cisco routing and switching background as covered in the Cisco ROUTE and SWITCH courses. The book is enough to prepare you for the TSHOOT exam, too.

Teaching troubleshooting is not an easy task. This book introduces you to many troubleshooting methodologies and identifies the benefits of different techniques. Technical routing and switching topics are briefly reviewed, but the emphasis is on troubleshooting commands, and most important, this book presents many troubleshooting examples. Chapter review questions will help you evaluate how well you absorbed material within each chapter. The questions are also an excellent supplement for exam preparation.

Who Should Read This Book?

Those individuals who want to learn about modern troubleshooting methodologies and techniques and want to see several relevant examples will find this book very useful. This book is most suitable for those who have some prior routing and switching knowledge but would like to learn more or otherwise enhance their troubleshooting skill set. Readers who want to pass the Cisco TSHOOT exam can find all the content they need to successfully do so in this book. The Cisco Networking Academy CCNP TSHOOT course students will use this book as their official textbook.

Cisco Certifications and Exams

Cisco offers four levels of routing and switching certification, each with an increasing level of proficiency: Entry, Associate, Professional, and Expert. These are commonly known by their acronyms CCENT (Cisco Certified Entry Networking Technician), CCNA (Cisco Certified Network Associate), CCNP (Cisco Certified Network Professional), and CCIE (Cisco Certified Internetworking Expert). There are others, too, but this book focuses on the certifications for enterprise networks.

For the CCNP certification, you must pass exams on a series of CCNP topics, including the SWITCH, ROUTE, and TSHOOT exams. For most exams, Cisco does not publish the scores needed for passing. You need to take the exam to find that out for yourself.

To see the most current requirements for the CCNP certification, go to Cisco.com and click **Training and Events**. There you can find out other exam details such as exam topics and how to register for an exam.

The strategy you use to prepare for the TSHOOT exam might differ slightly from strategies used by other readers, mainly based on the skills, knowledge, and experience you have already obtained. For instance, if you have attended the TSHOOT course, you might take a different approach than someone who learned troubleshooting through on-the-job training. Regardless of the strategy you use or the background you have, this book is designed to help you get to the point where you can pass the exam with the least amount of time required.

How This Book Is Organized

Although this book can be read cover to cover, it is designed to be flexible and allow you to easily move between chapters to cover only the material for which you might need additional remediation. The chapters can be covered in any order, although some chapters are related to and build upon each other. If you do intend to read them all, the order in the book is an excellent sequence to follow.

Each core chapter covers a subset of the topics on the CCNP TSHOOT exam. The chapters cover the following topics:

- Chapter 1 introduces the troubleshooting principles and discusses the most common troubleshooting approaches.
- Chapter 2 defines structured troubleshooting and analyzes all the subprocesses of structured troubleshooting.
- Chapter 3 introduces structured network maintenance and discusses network maintenance processes and procedures. Network maintenance services and tools, along with how you can integrate troubleshooting into the network maintenance process, are also presented in this chapter.
- Chapter 4 reviews the Layer 2 switching and Layer 3 routing processes and shows how to do selective information gathering using the IOS **show** command, **debug** command, ping, and Telnet.
- Chapter 5 discusses troubleshooting tools: traffic-capturing features and tools, information gathering with SNMP, information gathering with NetFlow, and network event notification with EEM.
- Chapters 6 through 10 are all troubleshooting cases. Each chapter is about a different network with many different problems. Each problem is dealt with in the form of a real-life trouble ticket, and it is fixed following the structured troubleshooting methodology using the appropriate approach. All stages of troubleshooting, including fact gathering, are presented with output from Cisco IOS routers and switches. The network diagrams for Chapters 6 through 10 appear at the beginning and end of each chapter. For easier reference, a PDF of these network diagrams is available to download and print out or read on your e-device. Go to ciscopress.com/title/9781587204555 and click on the Downloads tab.

There is also an appendix that has answers to the review questions found at the end of each chapter.

Chapter 1

Troubleshooting Methods

This chapter covers the following topics:

- Troubleshooting principles
- Common troubleshooting approaches
- Troubleshooting example using six different approaches

Most modern enterprises depend heavily on the smooth operation of their network infrastructure. Network downtime usually translates to loss of productivity, revenue, and reputation. Network troubleshooting is therefore one of the essential responsibilities of the network support group. The more efficiently and effectively the network support personnel diagnose and resolve problems, the lower impact and damages will be to business. In complex environments, troubleshooting can be a daunting task, and the recommended way to diagnose and resolve problems quickly and effectively is by following a structured approach. Structured network troubleshooting requires well-defined and documented troubleshooting procedures.

This chapter defines troubleshooting and troubleshooting principles. Next, six different troubleshooting approaches are described. The third section of this chapter presents a troubleshooting example based on each of the six troubleshooting approaches.

Troubleshooting Principles

Troubleshooting is the process that leads to the diagnosis and, if possible, resolution of a problem. Troubleshooting is usually triggered when a person reports a problem. In modern and sophisticated environments that deploy proactive network monitoring tools and techniques, a failure/problem may be discovered and even fixed/resolved before end users notice or business applications get affected by it.

Some people say that a problem does not exist until it is noticed, perceived as a problem, and reported as a problem. This implies that you need to differentiate between a problem, as experienced by the user, and the actual cause of that problem. The time a problem is reported is not necessarily the same time at which the event causing the problem happened. Also, the reporting user generally equates the problem to the symptoms, whereas the troubleshooter often equates the problem to the root cause. For example, if the Internet connection fails on Saturday in a small company, it is usually not a problem, but you can be sure that it will turn into a problem on Monday morning if it is not fixed before then. Although this distinction between symptoms and cause of a problem might seem philosophical, you need to be aware of the potential communication issues that might arise from it.

Generally, reporting of a problem triggers the troubleshooting process. Troubleshooting starts by defining the problem. The second step is diagnosing the problem, during which information is gathered, the problem definition is refined, and possible causes for the problem are proposed. Eventually, this process should lead to a hypothesis for the root cause of the problem. At this time, possible solutions need to be proposed and evaluated. Next, the best solution is selected and implemented. Figure 1-1 illustrates the main elements of a structured troubleshooting approach and the transition possibilities from one step to the next.

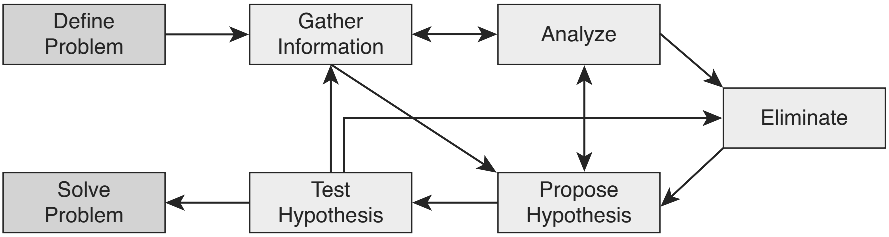

Figure 1-1 *Flow Chart of a Structured Troubleshooting Approach*

Note It is noteworthy, however, that the solution to a network problem cannot always be readily implemented and an interim workaround might have to be proposed. The difference between a solution and a workaround is that a solution resolves the root cause of the problem, whereas a workaround only alleviates the symptoms of the problem.

Although problem reporting and resolution are definitely essential elements of the troubleshooting process, most of the time is spent in the diagnostic phase. One might even believe that diagnosis is all troubleshooting is about. Nevertheless, within the context of network maintenance, problem reporting and resolution are indeed essential parts of troubleshooting. Diagnosis is the process of identifying the nature and cause of a problem. The main elements of this process are as follows:

- **Gathering information:** Gathering information happens after the problem has been reported by the user (or anyone). This might include interviewing all parties (user) involved, plus any other means to gather relevant information. Usually, the problem report does not contain enough information to formulate a good hypothesis without first gathering more information. Information and symptoms can be gathered directly, by observing processes, or indirectly, by executing tests.

- **Analyzing information:** After the gathered information has been analyzed, the troubleshooter compares the symptoms against his knowledge of the system, processes, and baselines to separate normal behavior from abnormal behavior.
- **Eliminating possible causes:** By comparing the observed behavior against expected behavior, some of the possible problem causes are eliminated.
- **Formulating/proposing a hypothesis:** After gathering and analyzing information and eliminating the possible causes, one or more potential problem causes remain. The probability of each of these causes will have to be assessed and the most likely cause proposed as the hypothetical cause of the problem.
- **Testing the hypothesis:** The hypothesis must be tested to confirm or deny that it is the actual cause of the problem. The simplest way to do this is by proposing a solution based on this hypothesis, implementing that solution, and verifying whether this solved the problem. If this method is impossible or disruptive, the hypothesis can be strengthened or invalidated by gathering and analyzing more information.

All troubleshooting methods include the elements of gathering and analyzing information, eliminating possible causes, and formulating and testing hypotheses. Each of these steps has its merits and requires some time and effort; how and when one moves from one step to the next is a key factor in the success level of a troubleshooting exercise. In a scenario where you are troubleshooting a complex problem, you might go back and forth between different stages of troubleshooting: Gather some information, analyze the information, eliminate some of the possibilities, gather more information, analyze again, formulate a hypothesis, test it, reject it, eliminate some more possibilities, gather more information, and so on.

If you do not take a structured approach to troubleshooting and do troubleshooting in an ad hoc fashion, you might eventually find the solution; however, the process in general will be very inefficient. Another drawback of ad hoc troubleshooting is that handing the job over to someone else is very hard to do; the progress results are mainly lost. This can happen even if the troubleshooter wants to resume his own task after he has stopped for a while, perhaps to take care of another matter. A structured approach to troubleshooting, regardless of the exact method adopted, yields more predictable results in the long run. It also makes it easier to pick up where you left off or hand the job over to someone else without losing any effort or results.

A troubleshooting approach that is commonly deployed both by inexperienced and experienced troubleshooters is called shoot-from-the-hip. After a very short period of gathering information, taking this approach, the troubleshooter quickly makes a change to see if it solves the problem. Even though it may seem like random troubleshooting on the surface, it is not. The reason is that the guiding principle for this method is prior and usually vast knowledge of common symptoms and their corresponding causes, or simply extensive relevant experience in a particular environment or application. This technique might be quite effective for the experienced troubleshooter most times, but it usually does not yield the same results for the inexperienced troubleshooter. Figure 1-2 shows how the "shoot-from-the-hip" approach goes about solving a problem, spending almost no effort in analyzing the gathered information and eliminating possibilities.

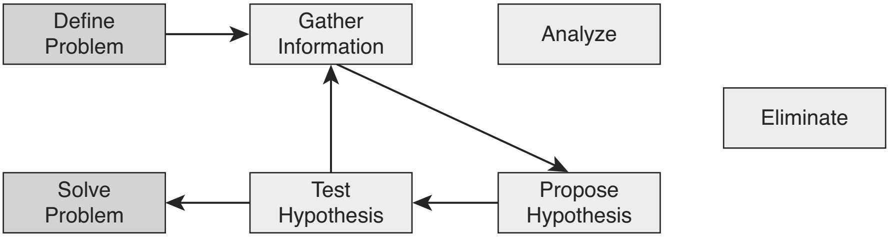

Figure 1-2 *Shoot-from-the-Hip*

Assume that a user reports a LAN performance problem and in 90 percent of the past cases with similar symptoms, the problem has been caused by duplex mismatch between users' workstations (PC or laptop) and the corresponding access switch port. The solution has been to configure the switch port for 100-Mbps full duplex. Therefore, it sounds reasonable to quickly verify the duplex setting of the switch port to which the user connects and change it to 100-Mbps full duplex to see whether that fixes the problem. When it works, this method can be very effective because it takes very little time. Unfortunately, the downside of this method is that if it does not work, you have not come any closer to a possible solution, you have wasted some time (both yours and users'), and you might possibly have caused a bit of frustration. Experienced troubleshooters use this method to great effect. The key factor in using this method effectively is knowing when to stop and switch to a more methodical (structured) approach.

Structured Troubleshooting Approaches

Troubleshooting is not an exact science, and a particular problem can be diagnosed and sometimes even solved in many different ways. However, when you perform structured troubleshooting, you make continuous progress, and usually solve the problem faster than it would take using an ad hoc approach. There are many different structured troubleshooting approaches. For some problems, one method might work better, whereas for others, another method might be more suitable. Therefore, it is beneficial for the troubleshooter to be familiar with a variety of structured approaches and select the best method or combination of methods to solve a particular problem.

A structured troubleshooting method is used as a guideline through a troubleshooting process. The key to all structured troubleshooting methods is systematic elimination of hypothetical causes and narrowing down on the possible causes. By systematically eliminating possible problem causes, you can reduce the scope of the problem until you manage to isolate and solve the problem. If at some point you decide to seek help or hand the task over to someone else, your findings can be of help to that person and your efforts are not wasted. Commonly used troubleshooting approaches include the following:

- **The top-down approach:** Using this approach, you work from the Open Systems Interconnection (OSI) model's application layer down to the physical layer. The OSI seven-layer networking model and TCP/IP four-layer model are shown side by side in Figure 1-3 for your reference.

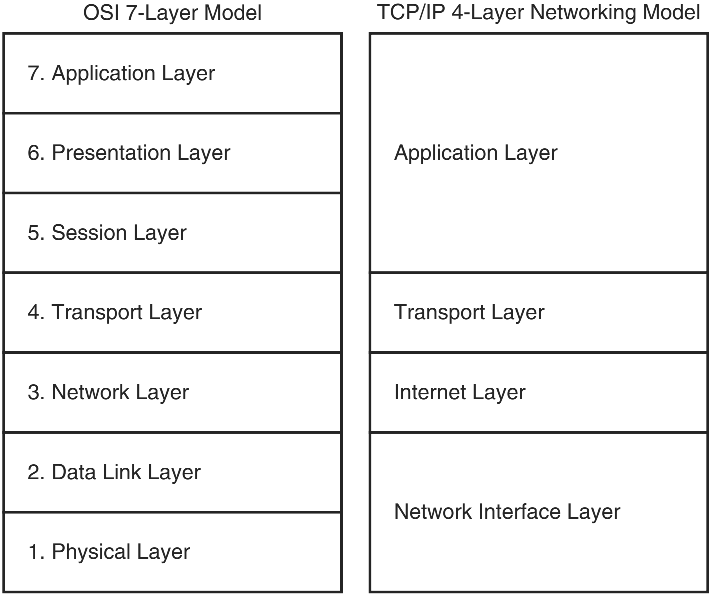

Figure 1-3 *The OSI and TCP/IP Networking Models*

- **The bottom-up approach:** This approach starts from the OSI model's physical layer and moves up toward the application layer.
- **The divide-and-conquer approach:** Using this approach, you start in the middle of the OSI model's stack (usually the network layer), and then, based on your findings, you move up or down the OSI stack.
- **The follow-the-path approach:** This approach is based on the path that packets take through the network from source to destination.
- **The spot-the-differences approach:** As the name implies, this approach compares network devices or processes that are operating correctly to devices or processes that are not operating as expected and gathers clues by spotting significant differences. In case the problem occurred after a change on a single device was implemented, the spot-the differences approach can pinpoint the problem cause by focusing on the difference between the device configurations, before and after the problem was reported.
- **The move-the-problem approach:** The strategy of this troubleshooting approach is to physically move components and observe whether the problem moves with the moved components.

The sections that follow describe each of these methods in more detail.

The Top-Down Troubleshooting Approach

The top-down troubleshooting method uses the OSI model as a guiding principle. One of the most important characteristics of the OSI model is that each layer depends on the underlying layers for its operation. This implies that if you find a layer to be operational, you can safely assume that all underlying layers are fully operational as well.

Let's assume that you are researching a problem of a user that cannot browse a particular website and you find that you can establish a TCP connection on port 80 from this host to the server and get a response from the server (see Figure 1-4). In this situation, it is reasonable to conclude that the transport layer and all layers below must be fully functional between the client and the server and that this is most likely a client or server problem (most likely at application, presentation, or session layer) and not a network problem. Be aware that in this example it is reasonable to conclude that Layers 1 through 4 must be fully operational, but it does not definitively prove this. For instance, nonfragmented packets might be routed correctly, whereas fragmented packets are dropped. The TCP connection to port 80 might not uncover such a problem.

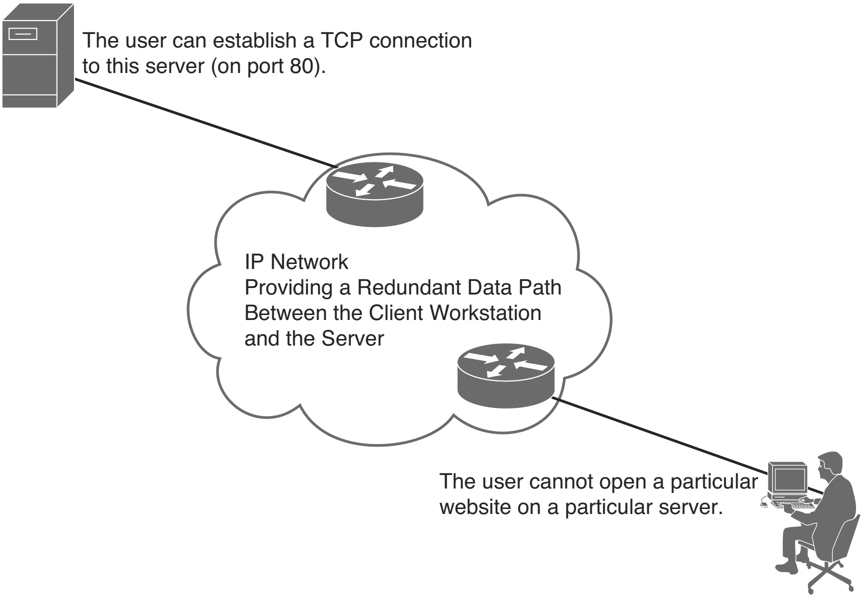
The user can establish a TCP connection to this server (on port 80).
IP Network
Providing a Redundant Data Path
Between the Client Workstation
and the Server
The user cannot open a particular website on a particular server.

Figure 1-4 *Application Layer Failure*

Essentially, the goal of the top-down approach is to find the highest OSI layer that is still working. All devices and processes that work on that layer or layers below are then eliminated from the scope of the troubleshooting. It might be clear that this approach is most effective if the problem is on one of the higher OSI layers. It is also one of the most straightforward troubleshooting approaches, because problems reported by users are typically defined as application layer problems, so starting the troubleshooting process at that layer is a natural thing to do. A drawback or impediment to this approach is that you need to have access to the client's application layer software to initiate the troubleshooting process, and if the software is only installed on a small number of machines, your troubleshooting options might be limited.

The Bottom-Up Troubleshooting Approach

The bottom-up troubleshooting approach also uses the OSI model as its guiding principle with the physical layer (bottom layer of the OSI seven-layer network model) as the starting point. In this approach, you work your way layer by layer up toward the application layer and verify that relevant network elements are operating correctly. You try to eliminate more and more potential problem causes so that you can narrow down the scope of the potential problems.

Let's assume that you are researching a problem of a user that cannot browse a particular website and while you are verifying the problem, you find that the user's workstation is not even able to obtain an IP address through the DHCP process (see Figure 1-5). In this situation it is reasonable to suspect lower layers of the OSI model and take a bottom-up troubleshooting approach.

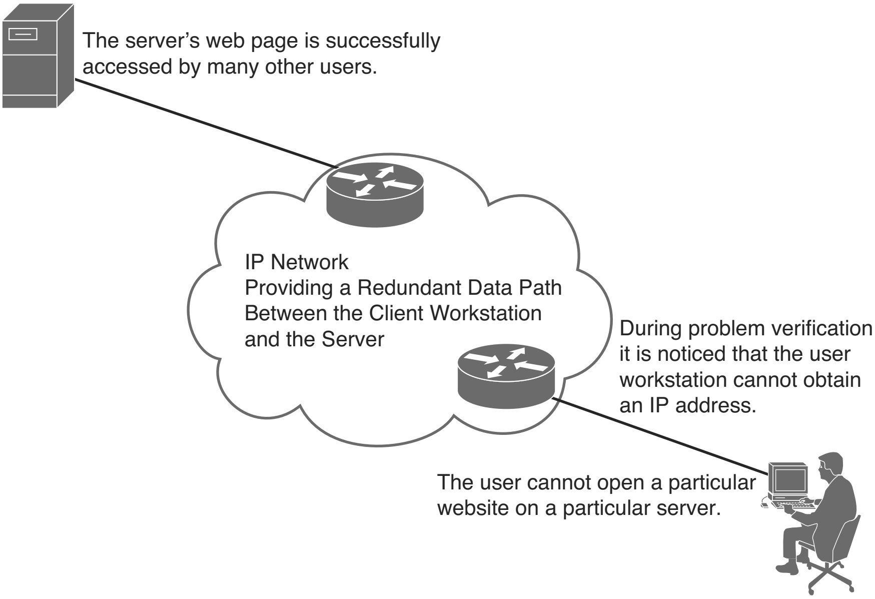
The server's web page is successfully accessed by many other users.
IP Network
Providing a Redundant Data Path
Between the Client Workstation
and the Server
During problem verification it is noticed that the user workstation cannot obtain an IP address.
The user cannot open a particular website on a particular server.

Figure 1-5 *Failure at Lower OSI Layers*

A benefit of the bottom-up approach is that all the initial troubleshooting takes place on the network, so access to clients, servers, or applications is not necessary until a very late stage in the troubleshooting process. In certain environments, especially those where many old and outdated devices and technologies are still in use, many network problems are hardware related. The bottom-up approach is very effective under those circumstances. A disadvantage of this method is that, in large networks, it can be a time-consuming process because a lot of effort will be spent on gathering and analyzing data and you always start from the bottom layer. The best bottom-up approach is to first reduce the scope of the problem using a different strategy and then switch to the bottom-up approach for clearly bounded parts of the network topology.

The Divide-and-Conquer Troubleshooting Approach

The divide-and-conquer troubleshooting approach strikes a balance between the top-down and bottom-up troubleshooting approaches. If it is not clear which of the top-down or bottom-up approaches will be more effective for a particular problem, an alternative is to start in the middle (usually from the network layer) and perform some tests such as ping and trace. Ping is an excellent connectivity testing tool. If the test is successful, you can assume that all lower layers are functional, and so you can start a bottom-up troubleshooting starting from the network layer. However, if the test fails, you can start a top-down troubleshooting starting from the network layer.

Let's assume that you are researching a problem of a user who cannot browse a particular website and that while you are verifying the problem you find that the user's workstation can successfully ping the server's IP address (see Figure 1-6). In this situation, it is reasonable to assume that the physical, data link, and network layers of the OSI model are in good working condition, and so you examine the upper layers, starting from the transport layer in a bottom-up approach.

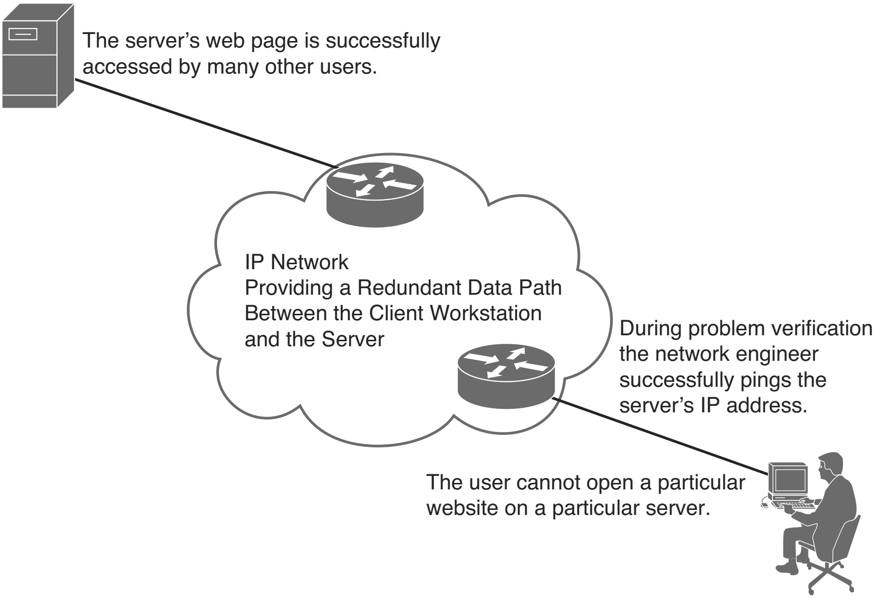
The server's web page is successfully accessed by many other users.
IP Network
Providing a Redundant Data Path
Between the Client Workstation
and the Server
During problem verification the network engineer successfully pings the server's IP address.
The user cannot open a particular website on a particular server.

Figure 1-6 *Successful Ping Shifts the Focus to Upper OSI Layers (Divide-and-Conquer Approach)*

Whether the result of the initial test is positive or negative, the divide-and-conquer approach usually results in a faster elimination of potential problems than what you would achieve by implementing a full top-down or bottom-up approach. Therefore, the divide-and-conquer method is considered highly effective and possibly the most popular troubleshooting approach.

The Follow-the-Path Troubleshooting Approach

The follow-the-path approach is one of the most basic troubleshooting techniques, and it usually complements one of the other troubleshooting methods such as the top-down or the bottom-up approach. The follow-the-path approach first discovers the actual traffic path all the way from source to destination. Next, the scope of troubleshooting is reduced to just the links and devices that are actually in the forwarding path. The principle of this approach is to eliminate the links and devices that are irrelevant to the troubleshooting task at hand.

Let's assume that you are researching a problem of a user who cannot browse a particular website and that while you are verifying the problem you find that a trace (tracert) from the user's PC command prompt to the server's IP address succeeds only as far as the first hop, which is the L3 Switch v (Layer 3 or Multilayer Switch v) in Figure 1-7. Based on your understanding of the network link bandwidths and the routing protocol used on this network, you mark the links on the best path between the user workstation and the server on the diagram with numbers 1 through 7, as shown in Figure 1-7.

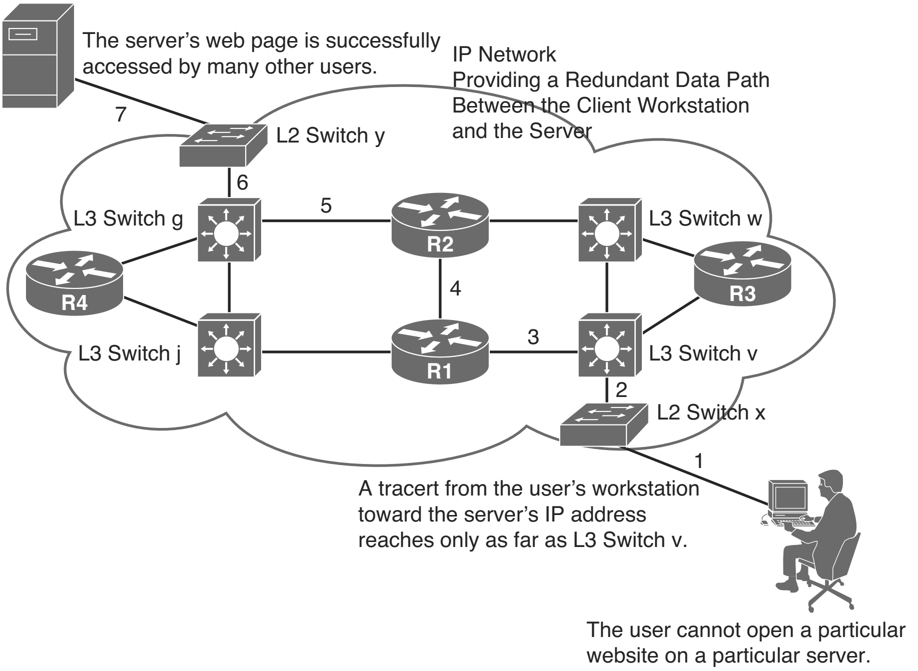
The server's web page is successfully accessed by many other users.
IP Network
Providing a Redundant Data Path
Between the Client Workstation
and the Server
7
L2 Switch y
6
L3 Switch g
5
R2
L3 Switch w
R3
R4
4
L3 Switch j
R1
3
L3 Switch v
2
L2 Switch x
1
A tracert from the user's workstation toward the server's IP address reaches only as far as L3 Switch v.
The user cannot open a particular website on a particular server.

Figure 1-7 *The Follow-the-Path Approach Shifts the Focus to Link 3 and Beyond Toward the Server*

In this situation it is reasonable to shift your troubleshooting approach to the L3 Switch v and the segments beyond, toward the server along the best path. The follow-the-path approach can quickly lead you to the problem area. You can then try and pinpoint the problem to a device, and ultimately to a particular physical or logical component that is either broken, misconfigured, or has a bug.

The Compare-Configurations Troubleshooting Approach

Another common troubleshooting approach is called the compare-configurations approach, also referred to as the spotting-the-differences approach. By comparing configurations, software versions, hardware, or other device properties between working and nonworking situations and spotting significant differences between them, this approach attempts to resolve the problem by changing the nonoperational elements to be consistent with the working ones. The weakness of this method is that it might lead to a working situation, without clearly revealing the root cause of the problem. In some cases, you are not sure whether you have implemented a solution or a workaround.

Example 1-1 shows two routing tables; one belongs to Branch2's edge router, experiencing problems, and the other belongs to Branch1's edge router, with no problems. If you compare the content of these routing tables, as per the compare-configurations (spotting-the-differences) approach, a natural deduction is that the branch with problems is missing a static entry. The static entry can be added to see whether it solves the problem.

Example 1-1 *Spot-the-Differences: One Malfunctioning and One Working Router*

```
------------- Branch1 is in good working order ----------
Branch1# show ip route
<...output omitted...>
10.0.0.0/24 is subnetted, 1 subnets
C   10.132.125.0 is directly connected, FastEthernet4
C   192.168.36.0/24 is directly connected, BVI1
S*  0.0.0.0/0 [254/0] via 10.132.125.1
------------- Branch2 has connectivity problems ----------
Branch2# show ip route
<...output omitted...>
10.0.0.0/24 is subnetted, 1 subnets
C 10.132.126.0 is directly connected, FastEthernet4
C 192.168.37.0/24 is directly connected, BVI1
```

The compare-configurations approach (spotting-the-differences) is not a complete approach; it is, however, a good technique to use undertaking other approaches. One benefit of this approach is that it can easily be used by less-experienced troubleshooting staff to at least shed more light on the case. When you have an up-to-date and accessible set of baseline configurations, diagrams, and so on, spotting the difference between the current configuration and the baseline might help you solve the problem faster than any other approach.

The Swap-Components Troubleshooting Approach

Also called move-the-problem, the swap-components approach is a very elementary troubleshooting technique that you can use for problem isolation: You physically swap components and observe whether the problem stays in place, moves with the component, or disappears entirely. Figure 1-8 shows two PCs and three laptops connected to a LAN switch, among which laptop B has connectivity problems. Assuming that hardware failure is suspected, you must discover whether the problem is on the switch, the cable, or the laptop. One approach is to start gathering data by checking the settings on the laptop with problems, examining the settings on the switch, comparing the settings of all the laptops, and the switch ports, and so on. However, you might not have the required administrative passwords for the PCs, laptops, and the switch. The only data that you can gather is the status of the link LEDs on the switch and the laptops and PCs. What you can do is obviously limited. A common way to at least isolate the problem (if it is not solved outright) is cable or port swapping. Swap the cable between a working device and laptop B (the one that is having problems). Move the laptop from one port to another using a cable that you know for sure is good. Based on these simple moves, you can isolate whether the problem is cable, switch, or laptop related.

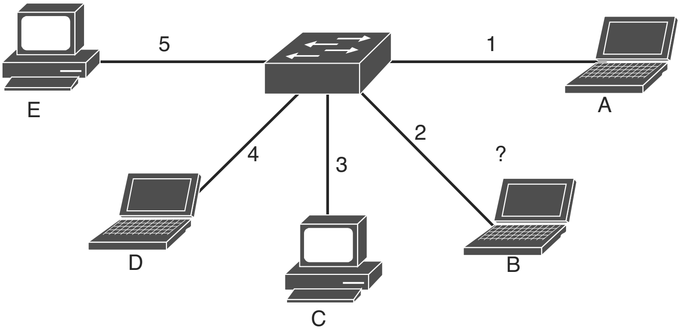

Figure 1-8 *Swap-the-Component: Laptop B Is Having Network Problems*

Just by executing simple tests in a methodical way, the swap-components approach enables you to isolate the problem even if the information that you can gather is minimal. Even if you do not solve the problem, you have scoped it to a single element, and you can now focus further troubleshooting on that element. Note that in the previous example if you determine that the problem is cable related, it is unnecessary to obtain the administrative password for the switch, PCs, and laptops. The drawbacks of this method are that you are isolating the problem to only a limited set of physical elements and not gaining any real insight into what is happening, because you are gathering only very limited indirect information. This method assumes that the problem is with a single component. If the problem lies within multiple devices, you might not be able to isolate the problem correctly.

Troubleshooting Example Using Six Different Approaches

An external financial consultant has come in to help your company's controller with an accounting problem. He needs access to the finance server. An account has been created for him on the server, and the client software has been installed on the consultant's laptop. You happen to walk past the controller's office and are called in and told that the consultant can't connect to the finance server. You are a network support engineer and have access to all network devices, but not to the servers. Think about how you would handle this problem, what your troubleshooting plan would be, and which method or combination of methods you would use.

What possible approaches can you take for this troubleshooting task? This case lends itself to many different approaches, but some specific characteristics can help you decide an appropriate approach:

- You have access to the network devices, but not to the server. This implies that you will likely be able to handle Layer 1–4 problems by yourself; however, for Layer 5–7, you will probably have to escalate to a different person.
- You have access to the client device, so it is possible to start your troubleshooting from it.
- The controller has the same software and access rights on his machine, so it is possible to compare between the two devices.

What are the benefits and drawbacks of each possible troubleshooting approach for this case?

- **Top-down:** You have the opportunity to start testing at the application layer. It is good troubleshooting practice to confirm the reported problem, so starting from the application layer is an obvious choice. The only possible drawback is that you will not discover simple problems, such as the cable being plugged in to a wrong outlet, until later in the process.
- **Bottom-up:** A full bottom-up check of the whole network is not a very useful approach because it will take too much time and at this point, there is no reason to assume that the network beyond the first access switch would be causing the issue. You could consider starting with a bottom-up approach for the first stretch of the network, from the consultant's laptop to the access switch, to uncover potential cabling problems.
- **Divide-and-conquer:** This is a viable approach. You can ping from the consultant's laptop to the finance server. If that succeeds, the problem is most likely at upper layers. For example, a firewall or access control list could be the culprit. If the ping fails, assuming that ping is not blocked in the network, it is safe to assume that the problem is at network or lower layers and you are responsible for fixing it. The advantage of this method is that you can quickly decide on the scope of the problem and whether escalation is necessary.

- **Follow-the-path:** Similar to the bottom-up approach, a full follow-the-path approach is not efficient under the circumstances, but tracing the cabling to the first switch can be a good start if it turns out that the link LED is off on the consultant's PC. This method might come into play after other techniques have been used to narrow the scope of the problem.
- **Compare-configurations:** You have access to both the controller's PC and the consultant's laptop; therefore, compare-configurations is a possible strategy. However, because these machines are not under the control of a single IT department, you might find many differences, and it might therefore be hard to spot the significant and relevant differences. The compare-configurations approach might prove useful later, after it has been determined that the problem is likely to be on the client.
- **Swap-components:** Using this approach alone is not likely to be enough to solve the problem, but if following any of the other methods indicates a potential hardware issue between the consultant's PC and the access switch, this method might come into play. However, merely as a first step, you could consider swapping the cable and the jack connected to the consultant's laptop and the controller's PC, in turn, to see whether the problem is cable, PC, or switch related.

Many combinations of these different methods could be considered here. The most promising methods are top-down or divide-and-conquer. You will possibly switch to follow-the-path or compare-configurations approach after the scope of the problem has been properly reduced. As an initial step in any approach, the swap-components method could be used to quickly separate client-related issues from network-related issues. The bottom-up approach could be used as the first step to verify the first stretch of cabling.

Summary

The fundamental elements of a troubleshooting process are as follows:

- Defining the problem
- Gathering information
- Analyzing information
- Eliminating possible causes
- Formulating a hypothesis
- Testing the hypothesis
- Solving the problem

Some commonly used troubleshooting approaches are as follows:

- Top-down
- Bottom-up

- Divide-and-conquer
- Follow-the-path
- Compare-configurations
- Swap-components

Review Questions

1. Which *three* of the following processes are subprocesses or phases of a troubleshooting process?

a. Solve the problem
b. Eliminate
c. Compile
d. Report the problem
e. Define the problem

2. Which *three* of the following approaches are valid troubleshooting methods?

a. Swap-components
b. Ad Hoc
c. Compare-configurations
d. Follow-the-path
e. Hierarchical

3. Which *three* of the following troubleshooting approaches use the OSI reference model as a guiding principle?

a. Top-down
b. Bottom-up
c. Divide-and-conquer
d. Compare-configurations
e. Swap-components

4. Which of the following troubleshooting methods would be most effective when the problem is with the Ethernet cable connecting a workstation to the wall RJ-45 jack?

a. Top-down
b. Divide-and-conquer
c. Compare-configurations
d. Swap-components
e. Follow-the-path

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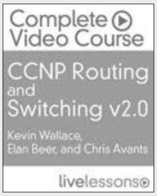

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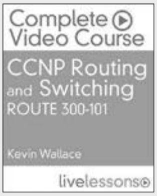

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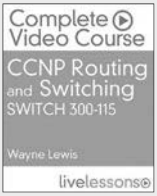

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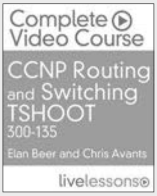

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