Chapter 10:
Review and Preparation for Troubleshooting Complex Enterprise Networks

CCNP TSHOOT: Maintaining and Troubleshooting IP Networks

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Chapter 10 Objectives

- Review key maintenance and troubleshooting concepts and tools.
- Apply maintenance and troubleshooting concepts and tools.

Review of Key Maintenance and Troubleshooting Concepts and Tools

Section Overview

- Today's networks incorporate many different technologies, protocols, devices, and features.

- To maintain and troubleshoot these complex, integrated enterprise networks efficiently and effectively, requires broad knowledge and a wide range of skills:

  - Understanding of how various components interact and depend on each other

  - Knowledge of methods used to isolate problems to a particular device, protocol, or feature

  - Ability to plan a troubleshooting process and adjust the plan based on the results

  - Knowledge of how to find documentation for technologies, protocols and features

  - Familiarity with the tools that are available to support network maintenance and troubleshooting processes and knowledge of how to use those tools

  - Ability to plan, communicate, document, and execute structured network maintenance and troubleshooting processes

- Practicing these skills in a noncritical environment is an important tool to assess whether you have understood and incorporated your acquired knowledge, and to further improve your troubleshooting expertise.

Review of Key Topics: Chapter 1

Chapter 1: Planning Maintenance for Complex Networks

- Advantages of structured network maintenance over interrupt-driven network maintenance

- Structured network maintenance methodologies

- Network maintenance planning includes:

  - Scheduling maintenance

  - Change-control procedures

  - Network documentation

  - Effective communication

  - Defining templates/procedures/conventions, and disaster recovery.

Review of Key Topics: Chapter 2

Chapter 2: Troubleshooting Processes for Complex Enterprise Networks

- Fundamental elements of a troubleshooting process:

  - Gathering information and symptoms

  - Analyzing information

  - Eliminating possible causes

  - Formulating a hypothesis

  - Testing the hypothesis

- Commonly used troubleshooting approaches are top down, bottom up, divide and conquer, follow the path, spot the differences, and move the problem.

- Communication is an essential part of the troubleshooting process, and it happens in all stages of troubleshooting:

  Step 1. Reporting the problem

  Step 2. Gathering information

  Step 3. Analyzing and eliminating

  Step 4. Proposing and testing a hypothesis

  Step 5. Solving the problem.

Review of Key Topics: Chapter 3

Chapter 3: Using Maintenance and Troubleshooting Tools and Applications

- Use of Cisco IOS commands to selectively gather information in support of basic diagnostic processes

- Introduction to tools commonly used for specific maintenance and troubleshooting processes and preparing the infrastructure for their use

Review of Key Topics: Chapter 4

Chapter 4: Maintaining and Troubleshooting Campus Switched Solutions

- Important LAN switching concepts

- Presentation of useful skills and commands to troubleshoot VLANs, Spanning Tree Protocol, inter-VLAN routing, and first-hop redundancy protocols

Review of Key Topics: Chapter 5

Chapter 5: Maintaining and Troubleshooting Routing Solutions

- Network layer connectivity and in-depth troubleshooting of:
  - Enhanced Interior Gateway Protocol (EIGRP)
  - Open Shortest Path First (OSPF) Protocol
  - Border Gateway Protocol (BGP)
  - Route redistribution

Review of Key Topics: Chapter 6

Chapter 6: Troubleshooting Addressing Services

- Common IPv4 addressing issues related to:
  - Address translation (NAT)
  - Dynamic Host Configuration Protocol (DHCP)
- Common IPv6 routing issues

Review of Key Topics: Chapter 7

Chapter 7: Troubleshooting Network Performance Issues

- The main categories of application services are:
  - Network classification
  - Application scalability
  - Application networking
  - Application acceleration
  - WAN acceleration
  - Application optimization
- Application optimization is a four-step cycle:
  - **Step 1.** Baseline application traffic
  - **Step 2.** Optimize the network
  - **Step 3.** Measure, adjust, and verify
  - **Step 4.** Deploy new applications
- Troubleshooting of network applications services, switch performance issues, and router performance issues

Review of Key Topics: Chapter 8

Chapter 8: Troubleshooting Converged Networks - Wireless

- Common wireless integration issues including:

  - Problems at the wireless to wired boundary

  - Filters that might be blocking traffic

  - Wireless quality of service (QoS) and wired QoS mapping might be incorrect

  - Power over Ethernet (PoE) issues

  - Trunk issues

Review of Key Topics: Chapter 8 – Cont.

Chapter 8: Troubleshooting Converged Networks – VoIP

- Design and troubleshooting considerations of integrating unified communications (VoIP and IP Telephony) into a campus LAN are:

  - **QoS** (bandwidth, delay, jitter, packet loss, network QoS readiness, trust boundaries)

  - **High availability** (STP/RSTP, HSRP/GLBP/VRRP)

  - **Security** (traffic segregation, firewalling/filtering)

  - **Availability and correct provisioning of other services** (PoE, DHCP, TFTP, NTP, CDP, trunking and VLANs)

Review of Key Topics: Chapter 8 – Cont.

Chapter 8: Troubleshooting Converged Networks – Video

- Common video integration issues:

  - Excessive bandwidth utilization

  - Lack of control

  - Poor quality (lack of QoS)

  - Security issues (filtering of key protocols, and stateful requirements)

  - Multicast issues

Review of Key Topics: Chapter 9

Chapter 9: Maintaining and Troubleshooting Network Security Implementations – Management Plane

- The three main functional planes of a router or switch are:
    - Management plane
    - Control plane
    - Data plane
- The management functions of a router or switch are commonly accessed using three methods:
    - Cisco IOS CLI
    - Web-based device management
    - A network management platform that is based on SNMP
- These methods must be used in the most secure way, based on device type, IOS, and organizational security policies.
- Two common techniques to secure management access to network devices are:
    - Restrict access to the management plane using packet or session filters
    - Authenticate the user that is attempting to access the device

Review of Key Topics: Chapter 9 – Cont.

Chapter 9: Maintaining and Troubleshooting Network Security Implementations – Control Plane

- Misconfiguration of any of the following can lead to control plane failures:

  - Routing protocol or first-hop redundancy protocol authentication
  - STP options such as BPDU Guard, BPDU filter, Root Guard, and Loop Guard
  - DHCP snooping
  - Dynamic ARP inspection
  - Control plane policing or protection

Review of Key Topics: Chapter 9 – Cont.

Chapter 9: Maintaining and Troubleshooting Network Security Implementations – Data Plane

- Data plane security is accomplished using a variety of router and switch options such as:
  - Unicast Reverse Path Forwarding (Unicast RPF)
  - IPsec
  - Network Admission Control
  - 802.1x port authentication

# Applying Maintenance and Troubleshooting Concepts and Tools

Section Overview

- In complex integrated networks, a combination of many different protocols and technologies deliver network services that support the enterprise applications.

- These protocols and technologies interact as follows:
  - Some processes merely interact with each other
  - Some depend on other processes
  - Other processes perform their functions in parallel

- If one of the elements fails or does not perform as expected, it impacts the system as a whole.

- At some point, symptoms will become noticeable at the application level, and a user will report a problem.

- A diagnostic process starts to find the elements that are causing the problem and eliminates the problem by implementing a solution or workaround.

Network Element and Protocol Relationships

- Network elements are interrelated, dependent on each other or run in parallel. The diagram shows element and protocol interaction relative to the OSI model.
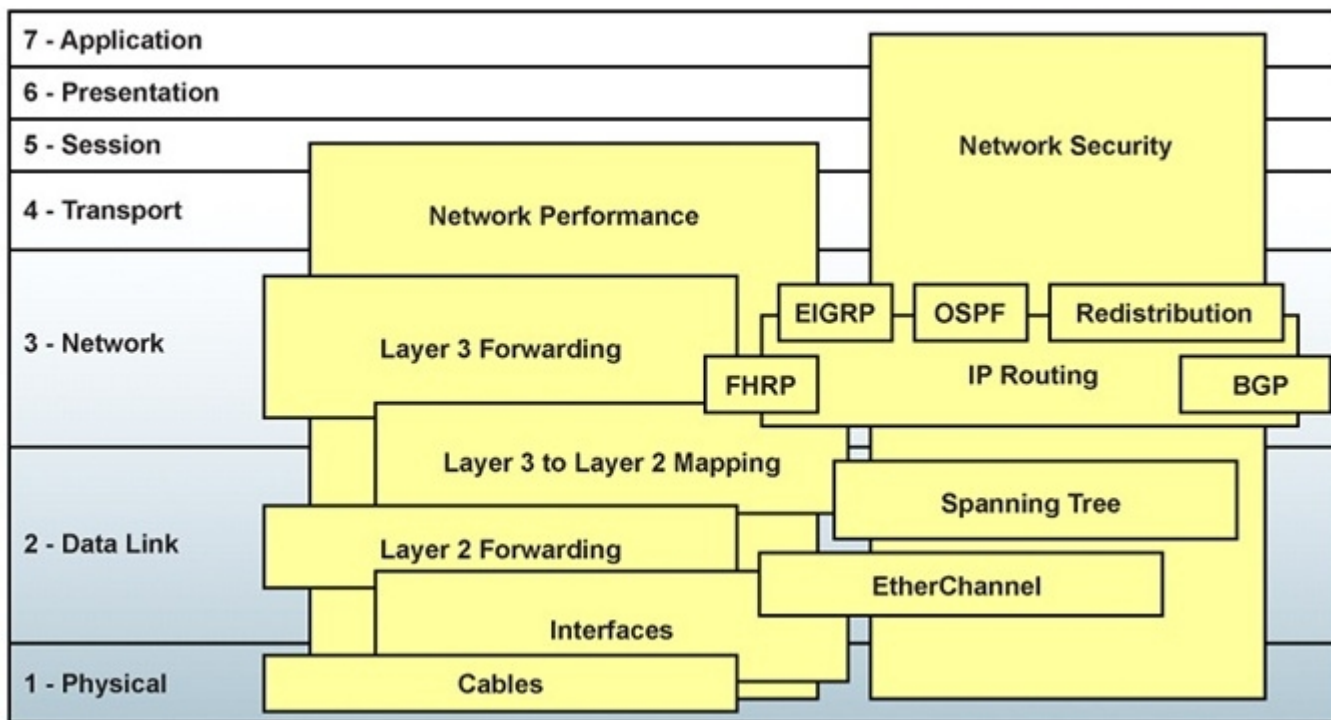
Troubleshooting Tips and Suggestions

To be able to troubleshoot a complex network in an effective and efficient manner, consider the following recommendations:

- Develop an understanding of the individual technologies, protocols, and features used in your network.

  - Try to gain at least a high-level overview of each one.

  - It is not necessary to have specialist knowledge about every one.

  - Identify sources of expert support in your organization.

  - Maintain a daily log with your own documentation and notes.

- Develop an understanding of the interactions and dependencies between the different technologies, protocols, and features in your network.

  - A problem symptom in an element does not necessarily mean the root cause is in that element.

  - The cause might be another element, upon which this element depends or interacts.

  - Seek to identify root causes. A patch or workaround that masks the root cause does not solve the real problem.

  - For example, a routing protocol failure might be caused by an underlying Layer 2 problem.

Troubleshooting Tips and Suggestions – Cont.

- Develop an understanding of the way control plane processes influence data plane processes.

  - Problem symptoms are usually noticed and reported on the data plane.

  - The root cause in many cases is in the control plane, where the solutions or workarounds must be implemented.

  - Knowing how control plane data structures are used in data plane forwarding, and knowing how these data structures are populated, is essential for successful diagnosis and resolution of network problems.

- Develop a good working knowledge of and experience with the tools available to gather information about the operation of various technologies, protocols, features, and processes.

- This includes both specialized troubleshooting tools and tools used in support of regular maintenance processes.

- Examples of such tools are those that support change control processes, baseline collection, communication, and documentation.
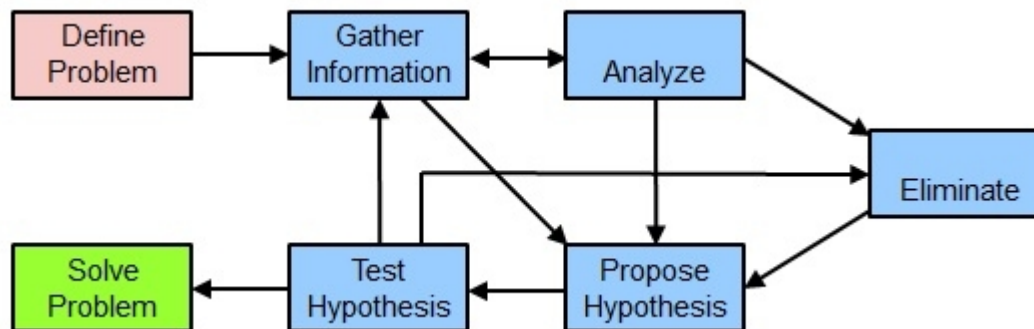
Troubleshooting Tips and Suggestions – Cont.

- Before you start troubleshooting, perform the following preliminary tasks:

- Document the network (devices, connections, protocols, addresses, routing protocols, VLANs).
  - Use IOS commands and other tools to support this effort.
  - Create physical and logical topologies.
  - Ensure that the documentation you are using is current.

- Back up all current configurations.

- Review the security policy.

- Document the security implementations in the network.

# Troubleshooting Tips and Suggestions – Cont.

- As you troubleshoot different cases, keep in mind that different approaches might suit different cases.

- Depending on the case, the approach you take might be top down, bottom up, follow the path, or a hybrid method.

- The key is to have an approach and follow through, documenting all discoveries or changes.

- No matter which method is used, the basic elements should include those shown in the following workflow.

Troubleshooting Tips and Suggestions – Cont.

- **Step 1.** Define the problem.

- **Step 2.** Gather information. Document any issues.

- **Step 3.** Analyze the information.

- **Step 4.** Eliminate possible causes.

- **Step 5.** Formulate and propose a hypothesis. Document possible solutions.

- **Step 6.** Implement and test hypothesis. Always circle back to the security policy to ensure any changes meet the policy requirements.

- **Step 7.** Solve problem and document changes.
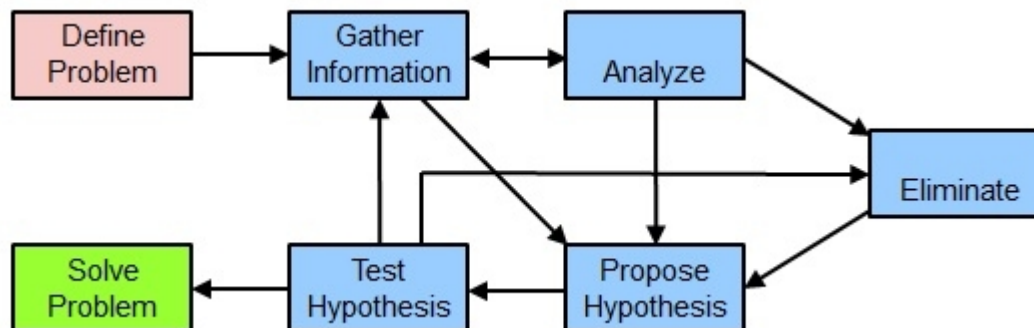
Chapter 10 Summary

- Previous chapters reviewed many of the individual technologies commonly used in complex, integrated enterprise networks.

- These chapters demonstrated the use of tools and structured methods with troubleshooting examples, important lessons and best practices derived from these experiences.

- To master network troubleshooting, you must gain considerable hands-on experience with the networking devices.

- This can be accomplished using:

  - An in-house lab of your employer

  - Rental of remote labs

  - Your own small lab

  - Network simulators such as Packet Tracer.

- The Cisco Networking Academy and Cisco Learning Partners offer Cisco official curriculum courses, most of which include extensive hands-on labs.

- To become a CCNP, consider other books to help prepare you for the troubleshooting examination, such as the Cisco Press CCNP Troubleshooting Exam Certification Guide.

Chapter 10 Labs

- **10-1 Troubleshooting Complex Environments**