CCNP Optimizing Converged Networks (ONT 642-845)

Lab Portfolio

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Introduction

My first motivation for writing this book was to serve the needs of CCNP instructors and students in the Cisco Networking Academy. For the past four years, I (David) have had the privilege of serving on the National Advisory Council for the Cisco Networking Academy, representing four-year colleges and universities. Also on that Council are a number of two-year community colleges. Inevitably at Council meetings, we would discuss both CCNP curricula and labs. As I spoke with a number of my CCNP instructor peers, a common theme emerged. Instructors felt that the labs needed to be rewritten to be more comprehensive. Labs in the past have lacked complexity. When I realized that I was rewriting the Academy CCNP labs, and that my peers were rewriting the same labs, the thought occurred to me that perhaps an engineering school like RPI was up to the task of writing these labs in a way that would better serve the needs of the community. It is not that the previous labs were inappropriate. Rather I think it is that the Cisco Networking Academy has grown up. Having just celebrated its tenth birthday, the Academy is ready for bigger challenges. I hope that these labs will fill that role.

My second motivation for writing these labs was to help network professionals who are trying to upgrade their skill set to the CCNP level. As a former hiring manager at a Tier 1 ISP, I have a strong sense of what industry is looking for when it hires someone with CCNP credentials. A number of hiring managers from Fortune 500 companies contact me each year about hiring my students. I know the level of expertise they expect from a CCNP. These labs reflect the convictions those managers have shared with me.

My third motivation for writing these labs was to see how much of a challenge a university undergraduate could rise to if the student were asked to do a big job. My coauthors, Josh Moorhouse and Ross Wolfson, were both undergraduates when they authored these labs. I gave them a huge task and they responded with skill and grace. I firmly believe that we frequently do not ask enough of our students. If we ask for greatness, sometimes we will get it. If we settle for the normal, we are more assured of success, but we may miss the opportunity to see our students soar to heights undreamed of. Whether an instructor or student, I hope that your technical knowledge will soar to new heights with these labs.

Goals and Methods

The most important goal of this book is to help you master the technologies necessary to configure quality of service in a production network. After all, what is the point of getting certified and getting that dream job or promotion, if you cannot perform after you are there. While it is impossible to simulate a network of hundreds of routers, we have added loopback interfaces to simulate additional networks and to increase complexity.

A secondary goal of this book is to help people pass the ONT certification exam. For two years, I was on the CCNP Assessment authoring team. After all those years of complaining, “What were they thinking when they put *that* question on the exam?” suddenly the questions I was writing were the subject of someone else’s complaint. I know how important it is both to students and network professionals to pass certifications. Frequently prestige, promotion, and money are all at stake. While all the core configurations on the certification exam are covered in this book, no static document like a book can keep up with the dynamic way in which the certification exam is constantly being upgraded.

Who Should Read This Book

Cisco Networking Academy instructors and students who want a written copy of the electronic labs will find this book of great use. In addition to all the official labs that are part of the Academy curriculum, additional Challenge and Troubleshooting labs have been added to test your mastery.

Network professionals, either in formal classes or studying alone, will also find great value in this book.

What You Need to Configure the Labs

These labs were written on four Cisco 2811 routers using the following IOS image: c2800nm-advipservicesk9-mz.124-10.bin.

You should be able to configure the labs on any Cisco router that is using a 12.4 advanced IP services image of the IOS.

Classes and individuals using older Cisco devices or less robust versions of IOS will find that many commands are not supported.

Academy students have access to the Pagent traffic generation software that is used extensively throughout these labs. Pagent is an internal Cisco tool that is used to test multimillion-dollar networks before they are deployed. Network professionals doing these labs should use their favorite search engine to find an alternative traffic generation tool. While it is possible to do the labs without testing them with traffic generation, your learning will increase dramatically by being able to see the effects of what you are configuring.

How This Book Is Organized

Those preparing for the ONT certification exam should work through this book from cover to cover. Network professionals needing help or a refresher on a particular topic can skip right to the area in which they need assistance.

The chapters cover the following topics:

Chapter 1, "Describing Campus Network Requirements": Knowing how expensive equipment is, we have tried to keep costs down by using only four routers. The challenge of trying to simulate a large network with this much equipment is that we had to create some pretty complex logical scenarios. This chapter lays out the physical and logical topologies that are used throughout the rest of the book.

Chapter 2, "Cisco VoIP Implementations": Softphones, or software-based phones that can be run on a laptop, are increasingly popular, especially with people engaged in business travel. In this chapter, you learn to install and configure Cisco IP Communicator. This lab uses the newest version of Cisco Unified Call Manager Express at the time of this writing (CME 4.0(2)). This was tested using Cisco IOS Software Release 12.4(9)T1 running on a Cisco 2800 series router. The IP Voice image is required in order to be able to manipulate codecs.

Chapter 3, "Introduction to IP QoS": Imagine a network where the traffic involved in downloading a large digital movie was given the same priority as a phone call. The call would be constantly interrupted. Voice packets must be prioritized over data traffic. This is the purpose of quality of service. The same network that routes voice, data, and multimedia must also be secure. In this chapter, we use Security Device Manager (SDM) to configure basic QoS.

Chapter 4, "DiffServ QoS Model": Depending on time and expertise, many network engineers are going to rely on tools like SDM, AutoQoS, and NBAR to configure QoS. However, intermediate-level engineers are going to want to understand and/or tweak the configurations that are automatically generated. This chapter gives you a good start on understanding the complex and diverse world of QoS options.

Chapter 5, "AutoQoS": AutoQoS is an IOS feature that observes traffic patterns on an interface through Network-Based Application Recognition (NBAR) and generates appropriate class-based QoS policies based on observed traffic patterns. This chapter shows you how to set this up.

Chapter 6, "Wireless Scalability": Unlike in the previous version of the CCNP curriculum, Cisco has not prescribed any order in which the courses must be taken. Students who have already taken the BCMSN course can skip or quickly review the first three wireless labs. Those who have not already taken the BCMSN course will need to work through all five labs.

Chapter 7, "Case Study": With very little direction, students are asked to set up QoS on both LAN and WAN links. The ability to successfully complete this lab indicates a significant mastery of the ONT concepts and configurations.

NETLAB+® Compatibility

NDG has worked closely with the Cisco Networking Academy CCNP lab team to develop ONT labs that are compatible with the installed base of NETLAB AE router pods. For current information on labs compatible with NETLAB+® go to http://www.netdevgroup.com/ae/labs.htm.

CHAPTER 5

AutoQoS

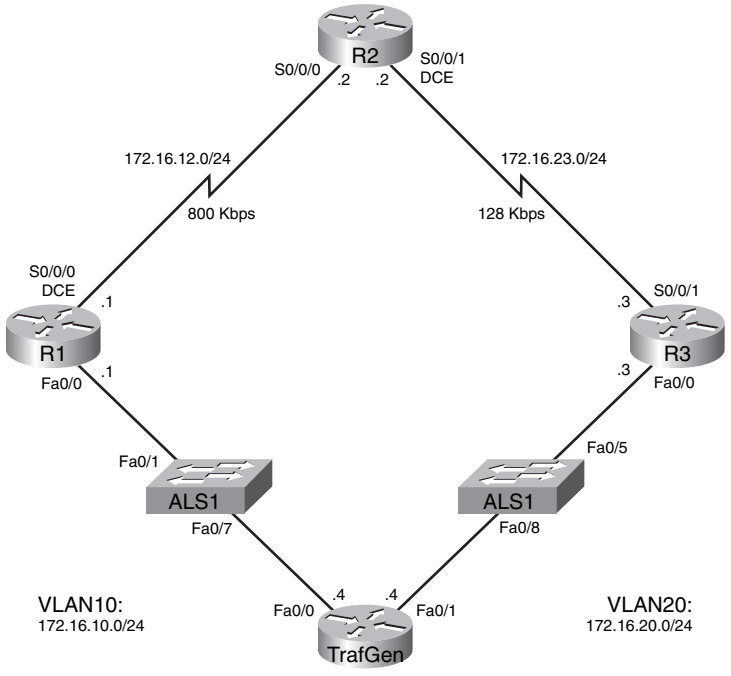
Lab 5-1: AutoQoS (5.3.1)

In this lab, you will learn how to do the following:

- Configure AutoQoS Discovery
- Configure AutoQoS
- Verify AutoQoS behavior

Refer to the topology diagram in Figure 5-1 for this lab.

Figure 5-1 Topology Diagram



Scenario

In this lab, you will configure AutoQoS, a Cisco QoS solution for simple, scalable quality of service (QoS) deployments. For this lab, you are required to use a Pagent IOS image on TrafGen to generate lab traffic.

Preparation

This lab uses the Basic Pagent Configuration for TrafGen and the switch to generate and facilitate lab traffic in a stream from TrafGen to R1 to R2. Prior to beginning this lab, configure TrafGen (R4) and the switch according to the Basic Pagent Configuration in Lab 3.1: Preparing for QoS. You can simply accomplish this on R4 by loading the *basic-ios.cfg* file from flash memory into NVRAM and reloading.

```
TrafGen# copy flash:basic-ios.cfg startup-config

Destination filename [startup-config]?
[OK]
2875 bytes copied in 1.456 secs (1975 bytes/sec)
TrafGen# reload

Proceed with reload? [confirm]
```

Next, instruct TGN to load the *basic-tgn.cfg* file and to start generating traffic.

```
TrafGen> enable
TrafGen# tgn load-config
TrafGen# tgn start
```

On the switch, load the basic.cfg file into NVRAM and reload the device.

```
ALS1# copy flash:basic.cfg startup-config

Destination filename [startup-config]?
[OK]
2875 bytes copied in 1.456 secs (1975 bytes/sec)
ALS1# reload

Proceed with reload? [confirm]
```

In addition, add the Fast Ethernet 0/5 interface on the switch to VLAN 20 because R3 will be the exit point from the network topology in this lab.

```
ALS1# configure terminal
ALS1(config)# interface fastethernet 0/5
ALS1(config-if)# switchport access vlan 20
ALS1(config-if)# switchport mode access
```

Step 1: Configure the Physical Interfaces

Configure all the physical interfaces shown in the topology diagram. Set the clock rate on the serial link between R1 and R2 to 800 kbps and the clock rate of the serial link between R2 and R3 to 128 kbps; use the **no shutdown** command on all interfaces. Set the informational bandwidth parameter appropriately on the serial interfaces.

```
R1(config)# interface fastethernet 0/0
R1(config-if)# ip address 172.16.10.1 255.255.255.0
R1(config-if)# no shutdown
R1(config-if)# interface serial 0/0/0
R1(config-if)# bandwidth 800
R1(config-if)# ip address 172.16.12.1 255.255.255.0
R1(config-if)# clock rate 800000
R1(config-if)# no shutdown
```

```
R2(config)# interface serial 0/0/0
R2(config-if)# bandwidth 800
R2(config-if)# ip address 172.16.12.2 255.255.255.0
R2(config-if)# no shutdown
R2(config-if)# interface serial 0/0/1
R2(config-if)# bandwidth 128
R2(config-if)# ip address 172.16.23.2 255.255.255.0
R2(config-if)# clock rate 128000
R2(config-if)# no shutdown
```

```
R3(config)# interface fastethernet 0/0
R3(config-if)# ip address 172.16.20.3 255.255.255.0
R3(config-if)# no shutdown
R3(config-if)# interface serial 0/0/1
R3(config-if)# bandwidth 128
R3(config-if)# ip address 172.16.23.3 255.255.255.0
R3(config-if)# no shutdown
```

Note: If you do not use the basic-ios.cfg and basic-tgn.cfg files, enter these commands on R4 to configure it for traffic generation.

```
TrafGen(config)# interface fastethernet 0/0
TrafGen(config-if)# ip address 172.16.10.4 255.255.255.0
TrafGen(config-if)# no shutdown
TrafGen(config-if)# interface fastethernet 0/1
TrafGen(config-if)# ip address 172.16.20.4
TrafGen(config-if)# no shutdown
```

From global configuration mode on TrafGen, enter TGN configuration mode:

```
TrafGen# tgn


TrafGen(TGN:OFF<Fa0/0:none)#
```

Enter (or copy and paste) the following commands at the prompt. (You can download this configuration at http://www.ciscopress.com/title/9781587132162 under the More Information section on the

page.) Note that you will need to enter the MAC address of R1's Fast Ethernet 0/0 interface in the highlighted field.

```
fastethernet 0/0
add tcp
rate 1000
L2-dest [enter MAC address of R1 Fa0/0]
L3-src 172.16.10.4
L3-dest 172.16.20.4
L4-dest 23
length random 16 to 1500
burst on
burst duration off 1000 to 2000
burst duration on 1000 to 3000
add fastethernet0/0 1
l4-dest 80
data ascii 0 GET /index.html HTTP/1.1
add fastethernet0/0 1
l4-dest 21
add fastethernet0/0 1
l4-dest 123
add fastethernet0/0 1
l4-dest 110
add fastethernet0/0 1
l4-dest 25
add fastethernet0/0 1
l4-dest 22
add fastethernet0/0 1
l4-dest 6000
!
end
```

Start generating traffic by entering the **start** command at the TGN prompt:

```
TrafGen(TGN:ON,Fa0/0:8/8)# start
```

Step 2: Configure EIGRP AS 1

Configure routing between R1, R2, and R3 using Enhanced Interior Gateway Routing Protocol (EIGRP). Include the entire 172.16.0.0/16 major network in AS 1 and disable automatic summarization.

```
R1(config)# router eigrp 1
R1(config-router)# no auto-summary
R1(config-router)# network 172.16.0.0
```

```
R2(config)# router eigrp 1
R2(config-router)# no auto-summary
```

```
R2(config-router)# network 172.16.0.0
```

```
R3(config)# router eigrp 1
R3(config-router)# no auto-summary
R3(config-router)# network 172.16.0.0
```

Verify that the number of packets counted is increasing on the outbound interface of R3 using the **show interfaces fastethernet 0/1 command**. Issue the command twice to make sure that the number of packets output has changed. If the number is not increasing, troubleshoot Layer 1, 2, and 3 connectivity and the EIGRP configurations.

Step 3: Configure AutoQoS

AutoQoS is an IOS feature that observes traffic patterns on an interface through Network-Based Application Recognition (NBAR) and generates appropriate class-based QoS policies based on observed traffic patterns.

You must initiate AutoQoS in a discovery phase in which the application observes traffic on an interface. You might decide to observe traffic over a significant period of time to ensure that all types of traffic have been accounted for.

Then, you must instruct AutoQoS to create QoS policies. The policies that AutoQoS creates can both mark traffic and implement various traffic-shaping mechanisms. For more information on NBAR and the Modular QoS CLI (MQC), consult Lab 4.5: Class-Based Queuing and NBAR.

Configure AutoQoS on R1's Serial 0/0/0 interface so that the application can observe traffic passing through R1 toward R2. Begin the discovery phase of AutoQoS by applying the **auto discovery qos** command in interface configuration mode.

```
R1(config)# interface serial 0/0/0
R1(config-if)# auto discovery qos
```

The router might not respond to input for a few moments while AutoQoS starts.

Let auto-discovery run for a few minutes, and then peruse the traffic profile and suggested policy using the **show auto discovery qos** command. Your output can vary, as the results from this command are dynamically generated based on the traffic patterns observed.

```
R1# show auto discovery qos

Serial0/0/0
 AutoQoS Discovery enabled for applications
 Discovery up time: 2 minutes, 26 seconds
 AutoQoS Class information:
 Class Voice:
  No data found.
 Class Interactive Video:
  No data found.
 Class Signaling:
  No data found.
 Class Streaming Video:
  No data found.
 Class Transactional:
```

```
  Recommended Minimum Bandwidth: 10635 Kbps/688% (AverageRate)
  Detected applications and data:
  Application/       AverageRate        PeakRate           Total
  Protocol           (kbps/%)           (kbps/%)           (bytes)
  -----------        -----------        --------           ------------
  telnet             3640/235           4235/274           66441515
  ssh                3536/229           4359/282           64545226
  xwindows           3459/224           3863/250           63133333
 Class Bulk:
  Recommended Minimum Bandwidth: 10568 Kbps/684% (AverageRate)
  Detected applications and data:
  Application/       AverageRate        PeakRate           Total
  Protocol           (kbps/%)           (kbps/%)           (bytes)
  -----------        -----------        --------           ------------
  ftp                3564/230           4110/266           65052327
  smtp               3522/228           4086/264           64278471
  pop3               3482/225           4314/279           63556253
 Class Scavenger:
  No data found.
 Class Management:
  No data found.
 Class Routing:
  Recommended Minimum Bandwidth: 0 Kbps/0% (AverageRate)
  Detected applications and data:
  Application/       AverageRate        PeakRate           Total
  Protocol           (kbps/%)           (kbps/%)           (bytes)
  -----------        -----------        --------           ------------
  eigrp              0/0                0/0                1984
 Class Best Effort:
  Current Bandwidth Estimation: 6953 Kbps/450% (AverageRate)
  Detected applications and data:
  Application/       AverageRate        PeakRate           Total
  Protocol           (kbps/%)           (kbps/%)           (bytes)
  -----------        -----------        --------           ------------
  ntp                3510/227           4127/267           64072875
  http               3443/222           4159/269           62848166

Suggested AutoQoS Policy for the current uptime:
 !
 class-map match-any AutoQoS-Transactional-Se0/0/0
  match protocol telnet
  match protocol ssh
  match protocol xwindows
 !
```

```
class-map match-any AutoQoS-Bulk-Se0/0/0
 match protocol ftp
 match protocol smtp
 match protocol pop3
!
policy-map AutoQoS-Policy-Se0/0/0
 class AutoQoS-Transactional-Se0/0/0
  bandwidth remaining percent 49
  random-detect dscp-based
  set dscp af21
 class AutoQoS-Bulk-Se0/0/0
  bandwidth remaining percent 49
  random-detect dscp-based
  set dscp af11
 class class-default
  fair-queue
```

You can make a few observations about this output. Besides the details of the statistics gathered, you can see that it separates traffic into classes based on function and latency requirements. At the end of the output, a suggested traffic policy is created. If the traffic generated by the traffic generator was different or more extensive, you might see other classes being utilized, with their own entries in the policy.

How many traffic classes has AutoQoS derived from the observed patterns?

Is this how you would also classify traffic generated by the Pagent router if you were to implement the suggested QoS policy on the command line? Explain.

What does the differentiated services code point (DSCP) marking AF11 indicate?

What does the DSCP marking AF21 indicate?

Are these markings locally significant to the router or globally significant over the entire routed path?

How much bandwidth do you expect to be allocated to the transactional and bulk traffic classes respectively?

_____

_____

Although auto-discovery uses NBAR for protocol recognition, it does not actually configure NBAR protocol discovery on the interface. You can verify this by looking at the running configuration for the serial interface.

```
R1# show run interface serial 0/0/0

Building configuration...

Current configuration : 107 bytes
!
interface Serial0/0/0
 ip address 172.16.12.1 255.255.255.0
 auto discovery qos
 clock rate 800000
end
```

Issue the **auto qos** command in interface configuration mode to implement the current AutoQoS-recommended configuration. This command requires AutoQoS's auto-discovery to already be active.

```
R1(config)# interface serial0/0/0
R1(config-if)# auto qos
```

Verify the configuration that AutoQoS has applied by issuing the **show auto qos** command.

```
R1# show auto qos

 !
 policy-map AutoQoS-Policy-Se0/0/0
  class AutoQoS-Transactional-Se0/0/0
   bandwidth remaining percent 49
   random-detect dscp-based
   set dscp af21
  class AutoQoS-Bulk-Se0/0/0
   bandwidth remaining percent 49
   random-detect dscp-based
   set dscp af11
  class class-default
   fair-queue
 !
 class-map match-any AutoQoS-Transactional-Se0/0/0
```

```
 match protocol ssh
 match protocol telnet
 match protocol xwindows
!
class-map match-any AutoQoS-Bulk-Se0/0/0
 match protocol ftp
 match protocol smtp
 match protocol pop3

Serial0/0/0 -
!
interface Serial0/0/0
 service-policy output AutoQoS-Policy-Se0/0/0
```

Which queuing tool does the policy generated on Router R1 represent?

Thus, when you issue the **auto qos** command, AutoQoS immediately generates the MQC configuration and applies it to the interface. Verify the statistics on the policy map using the **show policy-map interface serial 0/0/0** command.

```
R1# show policy-map interface serial 0/0/0

 Serial0/0/0

  Service-policy output: AutoQoS-Policy-Se0/0/0

    Class-map: AutoQoS-Transactional-Se0/0/0 (match-any)
      24415 packets, 19366297 bytes
      5 minute offered rate 194000 bps, drop rate 187000 bps
      Match: protocol ssh
        8564 packets, 6637316 bytes
        5 minute rate 69000 bps
      Match: protocol xwindows
        8758 packets, 7046646 bytes
        5 minute rate 77000 bps
      Match: protocol telnet
        7093 packets, 5682335 bytes
        5 minute rate 53000 bps
      Queueing
        Output Queue: Conversation 265
        Bandwidth remaining 49 (%)
        (pkts matched/bytes matched) 24564/19497687
```

```
        (depth/total drops/no-buffer drops) 41/23580/0
         exponential weight: 9
         mean queue depth: 41

 dscp    Transmitted      Random drop      Tail drop    Minimum Maximum  Mark
         pkts/bytes       pkts/bytes       pkts/bytes    thresh  thresh  prob
 af11       0/0              0/0              0/0           32      40  1/10
 af12       0/0              0/0              0/0           28      40  1/10
 af13       0/0              0/0              0/0           24      40  1/10
 af21     985/788284       145/117412     23486/18634727    32      40  1/10
 af22       0/0              0/0              0/0           28      40  1/10
 af23       0/0              0/0              0/0           24      40  1/10
 af31       0/0              0/0              0/0           32      40  1/10
 af32       0/0              0/0              0/0           28      40  1/10
 af33       0/0              0/0              0/0           24      40  1/10
 af41       0/0              0/0              0/0           32      40  1/10
 af42       0/0              0/0              0/0           28      40  1/10
 af43       0/0              0/0              0/0           24      40  1/10
  cs1       0/0              0/0              0/0           22      40  1/10
  cs2       0/0              0/0              0/0           24      40  1/10
  cs3       0/0              0/0              0/0           26      40  1/10
  cs4       0/0              0/0              0/0           28      40  1/10
  cs5       0/0              0/0              0/0           30      40  1/10
  cs6       0/0              0/0              0/0           32      40  1/10
  cs7       0/0              0/0              0/0           34      40  1/10
   ef       0/0              0/0              0/0           36      40  1/10
 rsvp       0/0              0/0              0/0           36      40  1/10
default     0/0              0/0              0/0           20      40  1/10

      QoS Set
        dscp af21
          Packets marked 24769

    Class-map: AutoQoS-Bulk-Se0/0/0 (match-any)
      25530 packets, 19973981 bytes
      5 minute offered rate 200000 bps, drop rate 192000 bps
      Match: protocol pop3
        7795 packets, 6150162 bytes
        5 minute rate 66000 bps
      Match: protocol smtp
        9381 packets, 7226367 bytes
        5 minute rate 67000 bps
      Match: protocol ftp
```

```
        8354 packets, 6597452 bytes
        5 minute rate 72000 bps
      Queueing
        Output Queue: Conversation 266
        Bandwidth remaining 49 (%)
        (pkts matched/bytes matched) 25847/20236550
        (depth/total drops/no-buffer drops) 41/24769/0
         exponential weight: 9
         mean queue depth: 41

 dscp    Transmitted      Random drop      Tail drop    Minimum Maximum  Mark
         pkts/bytes       pkts/bytes       pkts/bytes    thresh  thresh  prob
 af11    1090/869842        246/196528     24536/19186281    32      40  1/10
 af12       0/0               0/0             0/0           28      40  1/10
 af13       0/0               0/0             0/0           24      40  1/10
 af21       0/0               0/0             0/0           32      40  1/10
 af22       0/0               0/0             0/0           28      40  1/10
 af23       0/0               0/0             0/0           24      40  1/10
 af31       0/0               0/0             0/0           32      40  1/10
 af32       0/0               0/0             0/0           28      40  1/10
 af33       0/0               0/0             0/0           24      40  1/10
 af41       0/0               0/0             0/0           32      40  1/10
 af42       0/0               0/0             0/0           28      40  1/10
 af43       0/0               0/0             0/0           24      40  1/10
  cs1       0/0               0/0             0/0           22      40  1/10
  cs2       0/0               0/0             0/0           24      40  1/10
  cs3       0/0               0/0             0/0           26      40  1/10
  cs4       0/0               0/0             0/0           28      40  1/10
  cs5       0/0               0/0             0/0           30      40  1/10
  cs6       0/0               0/0             0/0           32      40  1/10
  cs7       0/0               0/0             0/0           34      40  1/10
   ef       0/0               0/0             0/0           36      40  1/10
 rsvp       0/0               0/0             0/0           36      40  1/10
default     0/0               0/0             0/0           20      40  1/10

      QoS Set
        dscp af11
          Packets marked 25975

    Class-map: class-default (match-any)
      16903 packets, 13301976 bytes
      5 minute offered rate 130000 bps, drop rate 128000 bps
      Match: any
```

```
      Queueing
        Flow Based Fair Queueing
        Maximum Number of Hashed Queues 256
        (total queued/total drops/no-buffer drops) 115/17584/0
```

Why is the auto-discovery step separate from the actual implementation of AutoQoS?

Step 4: Configure AutoQoS with DSCP

In the previous step, you configured AutoQoS with a base configuration that classified traffic based on protocols. The configuration marked the packets with various DSCP values in addition to configuring CBWFQ. AutoQoS in an enterprise deployment can be configured to trust DSCP values from other routers and make QoS decisions based on those values.

Describe the efficiency of enabling AutoQoS on all routers in your network, but not configuring AutoQoS to trust markings from other routers.

Modify the **auto discovery qos** command with the **trust** keyword on R2's Serial 0/0/0 interface.

```
R2(config)# interface serial 0/0/1
R2(config-if)# auto discovery qos trust
```

Wait a few minutes for auto-discovery to capture statistics. Then, use the **show auto discovery qos** command to view the traffic patterns that AutoQoS has observed.

```
R2# show auto discovery qos

Serial0/0/1
 AutoQoS Discovery enabled for trusted DSCP
 Discovery up time: 9 minutes, 23 seconds
 AutoQoS Class information:
 Class Voice:
  No data found.
 Class Interactive Video:
  No data found.
 Class Signaling:
  No data found.
 Class Streaming Video:
  No data found.
 Class Transactional:
```

```
  Recommended Minimum Bandwidth: 397 Kbps/25% (AverageRate)
  Detected DSCPs and data:
  DSCP value          AverageRate         PeakRate            Total
                      (kbps/%)            (kbps/%)            (bytes)
  -----------         -----------         --------            ------------
  18/af21             397/25              475/30              27986160
 Class Bulk:
  Recommended Minimum Bandwidth: 394 Kbps/25% (AverageRate)
  Detected DSCPs and data:
  DSCP value          AverageRate         PeakRate            Total
                      (kbps/%)            (kbps/%)            (bytes)
  -----------         -----------         --------            ------------
  10/af11             394/25              478/30              27770932
 Class Scavenger:
  No data found.
 Class Management:
  No data found.
 Class Routing:
  No data found.
 Class Best Effort:
  Current Bandwidth Estimation: 0 Kbps/0% (AverageRate)
  Detected DSCPs and data:
  DSCP value          AverageRate         PeakRate            Total
                      (kbps/%)            (kbps/%)            (bytes)
  -----------         -----------         --------            ------------
  0/default           0/0                 3/<1                54449

Suggested AutoQoS Policy for the current uptime:
 !
 class-map match-any AutoQoS-Transactional-Trust
  match ip dscp af21
  match ip dscp af22
  match ip dscp af23
 !
 class-map match-any AutoQoS-Bulk-Trust
  match ip dscp af11
  match ip dscp af12
  match ip dscp af13
 !
 policy-map AutoQoS-Policy-Se0/0/1-Trust
  class AutoQoS-Transactional-Trust
```

```
   bandwidth remaining percent 25
   random-detect dscp-based
  class AutoQoS-Bulk-Trust
   bandwidth remaining percent 25
   random-detect dscp-based
  class class-default
   fair-queue
```

Notice that the output is similar to the output in the previous step. However, this time, the statistics are based on DSCP values, not individual applications. Enable AutoQoS on the interface.

```
R2(config)# interface serial0/0/1
R2(config-if)# auto qos
```

Verify using the **show auto qos** command.

```
R2# show auto qos


 !
 policy-map AutoQoS-Policy-Se0/0/1-Trust
  class AutoQoS-Transactional-Trust
   bandwidth remaining percent 25
   random-detect dscp-based
  class AutoQoS-Bulk-Trust
   bandwidth remaining percent 25
   random-detect dscp-based
  class class-default
   fair-queue
 !
 class-map match-any AutoQoS-Bulk-Trust
  match ip dscp af11
  match ip dscp af12
  match ip dscp af13
 !
 class-map match-any AutoQoS-Transactional-Trust
  match ip dscp af21
  match ip dscp af22
  match ip dscp af23

Serial0/0/1 -
 !
 interface Serial0/0/1
  service-policy output AutoQoS-Policy-Se0/0/1-Trust
```