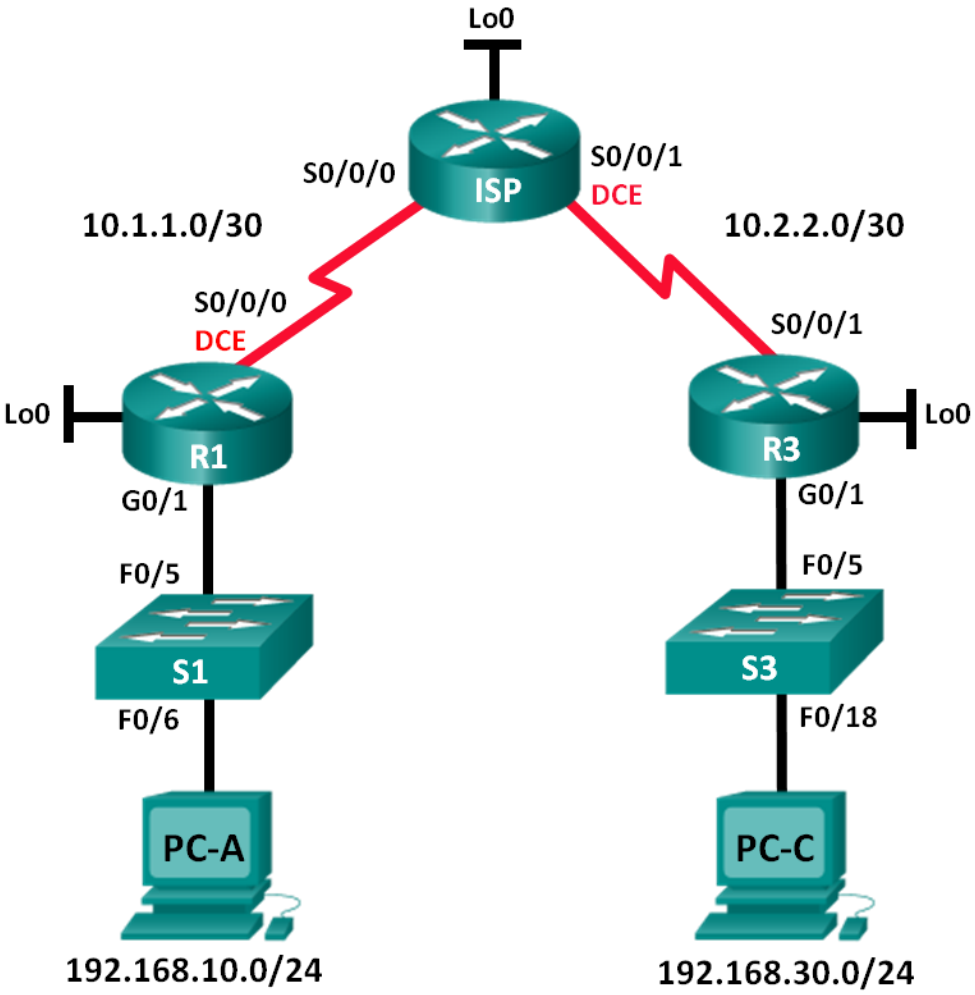
Lab – Configuring and Verifying Standard IPv4 ACLs (Solution)

Topology



Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway
R1	G0/1	192.168.10.1	255.255.255.0	N/A
	Lo0	192.168.20.1	255.255.255.0	N/A
	S0/0/0 (DCE)	10.1.1.1	255.255.255.252	N/A
ISP	S0/0/0	10.1.1.2	255.255.255.252	N/A
	S0/0/1 (DCE)	10.2.2.2	255.255.255.252	N/A
	Lo0	209.165.200.225	255.255.255.224	N/A
R3	G0/1	192.168.30.1	255.255.255.0	N/A
	Lo0	192.168.40.1	255.255.255.0	N/A
	S0/0/1	10.2.2.1	255.255.255.252	N/A
S1	VLAN 1	192.168.10.11	255.255.255.0	192.168.10.1
S3	VLAN 1	192.168.30.11	255.255.255.0	192.168.30.1
PC-A	NIC	192.168.10.3	255.255.255.0	192.168.10.1
PC-C	NIC	192.168.30.3	255.255.255.0	192.168.30.1

Objectives

Part 1: Set Up the Topology and Initialize Devices

- Set up equipment to match the network topology.
- Initialize and reload the routers and switches.

Part 2: Configure Devices and Verify Connectivity

- Assign a static IP address to PCs.
- Configure basic settings on routers.
- Configure basic settings on switches.
- Configure OSPF routing on R1, ISP, and R3.
- Verify connectivity between devices.

Part 3: Configure and Verify Standard Numbered and Named ACLs

- Configure, apply, and verify a numbered standard ACL.
- Configure, apply, and verify a named ACL.

Part 4: Modify a Standard ACL

- Modify and verify a named standard ACL.
- Test the ACL.

Background / Scenario

Network security is an important issue when designing and managing IP networks. The ability to configure proper rules to filter packets, based on established security policies, is a valuable skill.

In this lab, you will set up filtering rules for two offices represented by R1 and R3. Management has established some access policies between the LANs located at R1 and R3, which you must implement. The ISP router sitting between R1 and R3 will not have any ACLs placed on it. You would not be allowed any administrative access to an ISP router because you can only control and manage your own equipment.

Note: The routers used with CCNA hands-on labs are Cisco 1941 Integrated Services Routers (ISRs) with Cisco IOS Release 15.2(4)M3 (universalk9 image). The switches used are Cisco Catalyst 2960s with Cisco IOS Release 15.0(2) (lanbasek9 image). Other routers, switches, and Cisco IOS versions can be used. Depending on the model and Cisco IOS version, the commands available and output produced might vary from what is shown in the labs. Refer to the Router Interface Summary Table at the end of the lab for the correct interface identifiers.

Note: Make sure that the routers and switches have been erased and have no startup configurations. If you are unsure, contact your instructor.

Required Resources

- 3 Routers (Cisco 1941 with Cisco IOS Release 15.2(4)M3 universal image or comparable)
- 2 Switches (Cisco 2960 with Cisco IOS Release 15.0(2) lanbasek9 image or comparable)
- 2 PCs (Windows 7, Vista, or XP with terminal emulation program, such as Tera Term)
- Console cables to configure the Cisco IOS devices via the console ports
- Ethernet and serial cables as shown in the topology

Part 1: Set Up the Topology and Initialize Devices

In Part 1, you set up the network topology and clear any configurations, if necessary.

Step 1: **Cable the network as shown in the topology.**

Step 2: **Initialize and reload the routers and switches.**

Part 2: Configure Devices and Verify Connectivity

In Part 2, you configure basic settings on the routers, switches, and PCs. Refer to the Topology and Addressing Table for device names and address information.

Step 1: **Configure IP addresses on PC-A and PC-C.**

Step 2: **Configure basic settings for the routers.**

a. Console into the router and enter global configuration mode.

b. Copy the following basic configuration and paste it to the running-configuration on the router.

```
no ip domain-lookup
hostname R1
service password-encryption
enable secret class
banner motd #
Unauthorized access is strictly prohibited. #
Line con 0
password cisco
login
```

```
logging synchronous
line vty 0 4
password cisco
login
```

c. Configure the device name as shown in the topology.

d. Create loopback interfaces on each router as shown in the Addressing Table.

e. Configure interface IP addresses as shown in the Topology and Addressing Table.

f. Assign a clock rate of **128000** to the DCE serial interfaces.

g. Enable Telnet access.

h. Copy the running configuration to the startup configuration.

Step 3: **(Optional) Configure basic settings on the switches.**

a. Console into the switch and enter global configuration mode.

b. Copy the following basic configuration and paste it to the running-configuration on the switch.

```
no ip domain-lookup
service password-encryption
enable secret class
banner motd #
Unauthorized access is strictly prohibited. #
Line con 0
password cisco
login
logging synchronous
line vty 0 15
password cisco
login
exit
```

c. Configure the device name as shown in the topology.

d. Configure the management interface IP address as shown in the Topology and Addressing Table.

e. Configure a default gateway.

f. Enable Telnet access.

g. Copy the running configuration to the startup configuration.

Step 4: **Configure Rip routing on R1, ISP, and R3.**

a. Configure RIP version 2 and advertise all networks on R1, ISP, and R3. The OSPF configuration for R1 and ISP is included for reference.

```
R1(config)# router rip
R1(config-router)# version 2
R1(config-router)# network 192.168.10.0
R1(config-router)# network 192.168.20.0
R1(config-router)# network 10.1.1.0
```

```
ISP(config)# router rip
ISP(config-router)# version 2
ISP(config-router)# network 209.165.200.224
ISP(config-router)# network 10.1.1.0
ISP(config-router)# network 10.2.2.0

R3(config)# router RIP
R1(config-router)# version 2
R3(config-router)# network 192.168.30.0
R3(config-router)# network 192.168.40.0
R3(config-router)# network 10.2.2.0
```

b. After configuring Rip on R1, ISP, and R3, verify that all routers have complete routing tables, listing all networks. Troubleshoot if this is not the case.

Step 5: **Verify connectivity between devices.**

Note: It is very important to test whether connectivity is working **before** you configure and apply access lists! You want to ensure that your network is properly functioning before you start to filter traffic.

a. From PC-A, ping PC-C and the loopback interface on R3. Were your pings successful? _____ Yes

b. From R1, ping PC-C and the loopback interface on R3. Were your pings successful? _____ Yes

c. From PC-C, ping PC-A and the loopback interface on R1. Were your pings successful? _____ Yes

d. From R3, ping PC-A and the loopback interface on R1. Were your pings successful? _____ Yes

Part 3: Configure and Verify Standard Numbered and Named ACLs

Step 1: **Configure a numbered standard ACL.**

Standard ACLs filter traffic based on the source IP address only. A typical best practice for standard ACLs is to configure and apply it as close to the destination as possible. For the first access list, create a standard numbered ACL that allows traffic from all hosts on the 192.168.10.0/24 network and all hosts on the 192.168.20.0/24 network to access all hosts on the 192.168.30.0/24 network. The security policy also states that a **deny any** access control entry (ACE), also referred to as an ACL statement, should be present at the end of all ACLs.

What wildcard mask would you use to allow all hosts on the 192.168.10.0/24 network to access the 192.168.30.0/24 network?

_____0.0.0.255

Following Cisco's recommended best practices, on which router would you place this ACL? _____ R3

On which interface would you place this ACL? In what direction would you apply it?

_____

G0/1. The ACL should be applied going out. Students may answer with placing the ACL on the S0/0/1 interface on R3 going **in.** Emphasize to them that this would effectively block the LANs on R1 from getting to the 192.168.40.0/24 network as well!

a. Configure the ACL on R3. Use 1 for the access list number.

```
R3(config)# access-list 1 remark Allow R1 LANs Access
R3(config)# access-list 1 permit 192.168.10.0 0.0.0.255
```

```
R3(config)# access-list 1 permit 192.168.20.0 0.0.0.255
R3(config)# access-list 1 deny any
```

b. Apply the ACL to the appropriate interface in the proper direction.

```
R3(config)# interface g0/1
R3(config-if)# ip access-group 1 out
```

c. Verify a numbered ACL.

The use of various **show** commands can aid you in verifying both the syntax and placement of your ACLs in your router.

To see access list 1 in its entirety with all ACEs, which command would you use?

_____

```
R3# show access-lists 1
```

or

```
R3# show access-lists
```

What command would you use to see where the access list was applied and in what direction?

_____

```
R3# show ip interface g0/1
```

or

```
R3# show ip interface
```

1) On R3, issue the **show access-lists 1** command.

```
R3# show access-list 1
Standard IP access list 1
    10 permit 192.168.10.0, wildcard bits 0.0.0.255
    20 permit 192.168.20.0, wildcard bits 0.0.0.255
    30 deny   any
```

2) On R3, issue the **show ip interface g0/1** command.

```
R3# show ip interface g0/1
GigabitEthernet0/1 is up, line protocol is up
  Internet address is 192.168.30.1/24
  Broadcast address is 255.255.255.255
  Address determined by non-volatile memory
  MTU is 1500 bytes
  Helper address is not set
  Directed broadcast forwarding is disabled
  Multicast reserved groups joined: 224.0.0.10
  Outgoing access list is 1
  Inbound access list is not set
  Output omitted
```

3) Test the ACL to see if it allows traffic from the 192.168.10.0/24 network access to the 192.168.30.0/24 network. From the PC-A command prompt, ping the PC-C IP address. Were the pings successful? _____ Yes

4) Test the ACL to see if it allows traffic from the 192.168.20.0/24 network access to the 192.168.30.0/24 network. You must do an extended ping and use the loopback 0 address on R1 as your source. Ping PC-C's IP address. Were the pings successful? _____ Yes

```
R1# ping
Protocol [ip]:
Target IP address: 192.168.30.3
Repeat count [5]:
Datagram size [100]:
Timeout in seconds [2]:
Extended commands [n]: y
Source address or interface: 192.168.20.1
Type of service [0]:
Set DF bit in IP header? [no]:
Validate reply data? [no]:
Data pattern [0xABCD]:
Loose, Strict, Record, Timestamp, Verbose[none]:
Sweep range of sizes [n]:
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.30.3, timeout is 2 seconds:
Packet sent with a source address of 192.168.20.1
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 28/29/32 ms
```

d. From the R1 prompt, ping PC-C's IP address again.

```
R1# ping 192.168.30.3
```

Was the ping successful? Why or why not?

_____

_____

_____

No, the pings failed. When you ping from the router, it uses the closest interface to the destination as its source address. The pings had a source address of 10.1.1.1. The access list on R3 only allows the 192.168.10.0/24 and the 192.168.20.0/24 networks access.

Step 2: **Configure a named standard ACL.**

Create a named standard ACL that conforms to the following policy: allow traffic from all hosts on the 192.168.40.0/24 network access to all hosts on the 192.168.10.0/24 network. Also, only allow host PC-C access to the 192.168.10.0/24 network. The name of this access list should be called BRANCH-OFFICE-POLICY.

Following Cisco's recommended best practices, on which router would you place this ACL? _____ R1

On which interface would you place this ACL? In what direction would you apply it?

_____

G0/1. The ACL should be applied going out. Students may answer with placing the ACL on the S0/0/0 interface on R1 going in. Emphasize to them that this would effectively block all traffic from the LANs on R3 from getting to the 192.168.20.0/24 network.

a. Create the standard named ACL BRANCH-OFFICE-POLICY on R1.

```
R1(config)# ip access-list standard BRANCH-OFFICE-POLICY
R1(config-std-nacl)# permit host 192.168.30.3
R1(config-std-nacl)# permit 192.168.40.0 0.0.0.255
```

```
R1(config-std-nacl)# end
R1#
*Feb 15 15:56:55.707: %SYS-5-CONFIG_I: Configured from console by console
```

Looking at the first permit ACE in the access list, what is another way to write this?

_____

```
R1(config-std-nacl)# permit 192.168.30.3 0.0.0.0
```

b. Apply the ACL to the appropriate interface in the proper direction.

```
R1# config t
R1(config)# interface g0/1
R1(config-if)# ip access-group BRANCH-OFFICE-POLICY out
```

c. Verify a named ACL.

1) On R1, issue the **show access-lists** command.

```
R1# show access-lists
Standard IP access list BRANCH-OFFICE-POLICY
    10 permit 192.168.30.3
    20 permit 192.168.40.0, wildcard bits 0.0.0.255
```

Is there any difference between this ACL on R1 with the ACL on R3? If so, what is it?

_____

_____

_____

_____

_____

Although there is no line 30 with a **deny any** on R1, it is implied. You may wish to emphasize this to your students. Having them actually configure the **deny any** ACE is a good practice and reinforces the concept as it shows up in the ACL when issuing a **show access-lists** command. It is easy to forget the implicit **deny any** when troubleshooting ACLs. This could easily result in traffic being denied that should have been allowed.

2) On R1, issue the **show ip interface g0/1** command.

```
R1# show ip interface g0/1
GigabitEthernet0/1 is up, line protocol is up
  Internet address is 192.168.10.1/24
  Broadcast address is 255.255.255.255
  Address determined by non-volatile memory
  MTU is 1500 bytes
  Helper address is not set
  Directed broadcast forwarding is disabled
  Multicast reserved groups joined: 224.0.0.10
  Outgoing access list is BRANCH-OFFICE-POLICY
  Inbound access list is not set
<Output omitted>
```

3) Test the ACL. From the command prompt on PC-C, ping PC-A's IP address. Were the pings successful? _____ Yes

4) Test the ACL to ensure that only the PC-C host is allowed access to the 192.168.10.0/24 network. You must do an extended ping and use the G0/1 address on R3 as your source. Ping PC-A's IP address. Were the pings successful? _____ No

```
R3# ping
Protocol [ip]:
Target IP address: 192.168.10.3
Repeat count [5]:
Datagram size [100]:
Timeout in seconds [2]:
Extended commands [n]: y
Source address or interface: 192.168.30.1
Type of service [0]:
Set DF bit in IP header? [no]:
Validate reply data? [no]:
Data pattern [0xABCD]:
Loose, Strict, Record, Timestamp, Verbose[none]:
Sweep range of sizes [n]:
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.10.3, timeout is 2 seconds:
Packet sent with a source address of 192.168.30.1
U.U.U
```

5) Test the ACL to see if it allows traffic from the 192.168.40.0/24 network access to the 192.168.10.0/24 network. You must perform an extended ping and use the loopback 0 address on R3 as your source. Ping PC-A's IP address. Were the pings successful? _____ Yes

```
R3# ping
Protocol [ip]:
Target IP address: 192.168.10.3
Repeat count [5]:
Datagram size [100]:
Timeout in seconds [2]:
Extended commands [n]: y
Source address or interface: 192.168.40.1
Type of service [0]:
Set DF bit in IP header? [no]:
Validate reply data? [no]:
Data pattern [0xABCD]:
Loose, Strict, Record, Timestamp, Verbose[none]:
Sweep range of sizes [n]:
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.10.3, timeout is 2 seconds:
Packet sent with a source address of 192.168.40.1
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 32/40/60 ms
```

Part 4: Modify a Standard ACL

It is common in business for security policies to change. For this reason, ACLs may need to be modified. In Part 4, you will change one of the previous ACLs you configured to match a new management policy being put in place.

Management has decided that users from the 209.165.200.224/27 network should be allowed full access to the 192.168.10.0/24 network. Management also wants ACLs on all of their routers to follow consistent rules. A **deny any** ACE should be placed at the end of all ACLs. You must modify the BRANCH-OFFICE-POLICY ACL.

You will add two additional lines to this ACL. There are two ways you could do this:

OPTION 1: Issue a **no ip access-list standard BRANCH-OFFICE-POLICY** command in global configuration mode. This would effectively take the whole ACL out of the router. Depending upon the router IOS, one of the following scenarios would occur: all filtering of packets would be cancelled and all packets would be allowed through the router; or, because you did not take off the **ip access-group** command on the G0/1 interface, filtering is still in place. Regardless, when the ACL is gone, you could retype the whole ACL, or cut and paste it in from a text editor.

OPTION 2: You can modify ACLs in place by adding or deleting specific lines within the ACL itself. This can come in handy, especially with ACLs that have many lines of code. The retyping of the whole ACL or cutting and pasting can easily lead to errors. Modifying specific lines within the ACL is easily accomplished.

Note: For this lab, use Option 2.

Step 1: Modify a named standard ACL.

a. From R1 privileged EXEC mode, issue a **show access-lists** command.

```
R1# show access-lists
Standard IP access list BRANCH-OFFICE-POLICY
    10 permit 192.168.30.3 (8 matches)
    20 permit 192.168.40.0, wildcard bits 0.0.0.255 (5 matches)
```

b. Add two additional lines at the end of the ACL. From global config mode, modify the ACL, BRANCH-OFFICE-POLICY.

```
R1#(config)# ip access-list standard BRANCH-OFFICE-POLICY
R1(config-std-nacl)# 30 permit 209.165.200.224 0.0.0.31
R1(config-std-nacl)# 40 deny any
R1(config-std-nacl)# end
```

c. Verify the ACL.

1) On R1, issue the **show access-lists** command.

```
R1# show access-lists
Standard IP access list BRANCH-OFFICE-POLICY
    10 permit 192.168.30.3 (8 matches)
    20 permit 192.168.40.0, wildcard bits 0.0.0.255 (5 matches)
    30 permit 209.165.200.224, wildcard bits 0.0.0.31
    40 deny   any
```

Do you have to apply the BRANCH-OFFICE-POLICY to the G0/1 interface on R1?

_____

_____

No, the **ip access-group BRANCH-OFFICE-POLICY out** command is still in place on G0/1.

2) From the ISP command prompt, issue an extended ping. Test the ACL to see if it allows traffic from the 209.165.200.224/27 network access to the 192.168.10.0/24 network. You must do an extended ping and use the loopback 0 address on ISP as your source. Ping PC-A's IP address. Were the pings successful? _____ Yes

Reflection

1. As you can see, standard ACLs are very powerful and work quite well. Why would you ever have the need for using extended ACLs?

   _____

   _____

   _____

   _____

   Standard ACLs can only filter based on the source address. Also, they are not granular. They allow or deny EVERYTHING (protocols and services). Extended ACLs, while harder to write, are well-suited to complex networks where you may need to allow only certain ports access to networks while denying others.

2. Typically, more typing is required when using a named ACL as opposed to a numbered ACL. Why would you choose named ACLs over numbered?

   _____

   _____

   _____

   _____

   Students could list two reasons here. The first reason is that using named ACLs gives you the ability to modify specific lines within the ACL itself, without retyping the whole thing. NOTE: Newer versions of the IOS allows numbered ACLs to be modified just liked named ACLs. Secondly, having a named ACL is a good best practice as it helps to document the purpose of the ACL with a descriptive name.

Router Interface Summary Table

Router Interface Summary				
Router Model	**Ethernet Interface #1**	**Ethernet Interface #2**	**Serial Interface #1**	**Serial Interface #2**
1800	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
1900	Gigabit Ethernet 0/0 (G0/0)	Gigabit Ethernet 0/1 (G0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2801	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/1/0 (S0/1/0)	Serial 0/1/1 (S0/1/1)
2811	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2900	Gigabit Ethernet 0/0 (G0/0)	Gigabit Ethernet 0/1 (G0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)

Note: To find out how the router is configured, look at the interfaces to identify the type of router and how many interfaces the router has. There is no way to effectively list all the combinations of configurations for each router class. This table includes identifiers for the possible combinations of Ethernet and Serial interfaces in the device. The table does not include any other type of interface, even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in Cisco IOS commands to represent the interface.

Device Configs

Router R1

```
R1#sh run
Building configuration...

Current configuration : 1590 bytes
!
version 15.2
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R1
!
boot-start-marker
boot-end-marker
enable secret 4 tnhtc92DXBhelxjYk8LWJrPV36S2i4ntXrpb4RFmfqY
!
no aaa new-model
!
no ip domain lookup
ip cef
no ipv6 cef
multilink bundle-name authenticated
```

```
!
interface Loopback0
 ip address 192.168.20.1 255.255.255.0
!
interface GigabitEthernet0/0
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface GigabitEthernet0/1
 ip address 192.168.10.1 255.255.255.0
 ip access-group BRANCH-OFFICE-POLICY out
 duplex auto
 speed auto
!
interface Serial0/0/0
 ip address 10.1.1.1 255.255.255.252
 clock rate 128000
!
interface Serial0/0/1
 no ip address
 shutdown
 clock rate 128000
!
!
router rip
 version 2
 network 10.1.1.0
 network 192.168.10.0
 network 192.168.20.0
!
ip forward-protocol nd
!
no ip http server
no ip http secure-server
!
!
ip access-list standard BRANCH-OFFICE-POLICY
 permit 192.168.30.3
 permit 192.168.40.0 0.0.0.255
 permit 209.165.200.224 0.0.0.31
 deny   any

control-plane
!
!
!
line con 0
```

```
line aux 0
line vty 0 4
 password class
 login
 transport input all
!
scheduler allocate 20000 1000
!
end
```

Router R3

```
R3#sh run
Building configuration...

Current configuration : 1506 bytes
!
version 15.2
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R3
!
boot-start-marker
boot-end-marker
enable secret 4 tnhtc92DXBhelxjYk8LWJrPV36S2i4ntXrpb4RFmfqY
!
no aaa new-model
!
no ip domain lookup
ip cef
no ipv6 cef
multilink bundle-name authenticated
!
interface Loopback0
 ip address 192.168.40.1 255.255.255.0
!
interface GigabitEthernet0/0
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface GigabitEthernet0/1
 ip address 192.168.30.1 255.255.255.0
 ip access-group 1 out
 duplex auto
 speed auto
!
```

```
interface Serial0/0/0
 no ip address
 shutdown
 clock rate 2000000
!
interface Serial0/0/1
 ip address 10.2.2.1 255.255.255.252
!
!
router rip
 version 2
 network 10.2.2.0
 network 192.168.30.0
 network 192.168.40.0
!
ip forward-protocol nd
!
no ip http server
no ip http secure-server
!
!
access-list 1 remark Allow R1 LANs Access
access-list 1 permit 192.168.10.0 0.0.0.255
access-list 1 permit 192.168.20.0 0.0.0.255
access-list 1 deny   any
!
control-plane
!
line con 0
line aux 0
line vty 0 4
 password class
 login
 transport input all
!
scheduler allocate 20000 1000
!
end
```

Router ISP

```
ISP#sh run
Building configuration...

Current configuration : 1313 bytes
!
version 15.2
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encrypt
```

```
!
hostname ISP
!
boot-start-marker
boot-end-marker
!
!
enable secret 4 tnhtc92DXBhelxjYk8LWJrPV36S2i4ntXrpb4RFmfqY
!
no aaa new-model
!
no ip domain lookup
ip cef
no ipv6 cef
multilink bundle-name authenticated
!
interface Loopback0
 ip address 209.165.200.225 255.255.255.224
!
interface GigabitEthernet0/0
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface GigabitEthernet0/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface Serial0/0/0
 ip address 10.1.1.2 255.255.255.252
!
interface Serial0/0/1
 ip address 10.2.2.2 255.255.255.252
 clock rate 128000
!
router rip
 version 2
 network 10.1.1.0
 network 10.2.2.0
 network 209.165.200.224
!
ip forward-protocol nd
!
no ip http server
no ip http secure-server
!
```

```
control-plane
!
line con 0
line aux 0
line vty 0 4
 password class
 login
 transport input all
!
scheduler allocate 20000 1000
!
end
```

Switch S1

```
S1# show run
Building configuration...

Current configuration : 2990 bytes
!
version 15.0
no service pad
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname S1
!
boot-start-marker
boot-end-marker
!
enable secret 4 tnhtc92DXBhelxjYk8LWJrPV36S2i4ntXrpb4RFmfqY
!
no aaa new-model
system mtu routing 1500
!
!
no ip domain-lookup
!
!<output omitted>
!
interface FastEthernet0/24
!
interface GigabitEthernet0/1
!
interface GigabitEthernet0/2
!
interface Vlan1
 ip address 192.168.10.11 255.255.255.0
!
```

```
ip default-gateway 192.168.10.1
ip http server
ip http secure-server
!
!
line con 0
line vty 0 4
 password cisco
 login
line vty 5 15
 password cisco
 login
!
end
```

Switch S3

```
S3# show start
Using 1696 out of 65536 bytes
!
version 15.0
no service pad
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname S3
!
boot-start-marker
boot-end-marker
!
enable secret 4 tnhtc92DXBhelxjYk8LWJrPV36S2i4ntXrpb4RFmfqY
!
no aaa new-model
system mtu routing 1500
!
!
no ip domain-lookup
!
!<output omitted>
!
interface FastEthernet0/24
!
interface GigabitEthernet0/1
!
interface GigabitEthernet0/2
!
interface Vlan1
 ip address 192.168.30.11 255.255.255.0
!
```

```
ip default-gateway 192.168.30.1
ip http server
ip http secure-server
!
!
line con 0
line vty 0 4
 password cisco
 login
line vty 5 15
 password cisco
 login
!
end
```