Code Snippets

Many titles include programming code or configuration examples. To optimize the presentation of these elements, view the eBook in single-column, landscape mode and adjust the font size to the smallest setting. In addition to presenting code and configurations in the reflowable text format, we have included images of the code that mimic the presentation found in the print book; therefore, where the reflowable format may compromise the presentation of the code listing, you will see a “Click here to view code image” link. Click the link to view the print-fidelity code image. To return to the previous page viewed, click the Back button on your device or app.

access-list {**1-99** | **1300-1999**} {**permit** | **deny**} *matching-parameters*

```
access-list 1 permit host 10.1.1.1
access-list 1 permit 10.1.1.1 0.0.0.0
```

```
access-list 1 permit 172.16.8.0 0.0.3.255
```

access-list *access-list-number* {**deny** | **permit**} *source* [*source-wildcard*]

```
R2# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)# access-list 1 permit 10.1.1.1
R2(config)# access-list 1 deny 10.1.1.0 0.0.0.255
R2(config)# access-list 1 permit 10.0.0.0 0.255.255.255
R2(config)# interface gigabitethernet 0/0/1
R2(config-if)# ip access-group 1 in
R2(config-if)# ^Z
R2# show running-config
! Lines omitted for brevity

access-list 1 permit 10.1.1.1
access-list 1 deny 10.1.1.0 0.0.0.255
access-list 1 permit 10.0.0.0 0.255.255.255
```

```
R2# show ip access-lists
Standard IP access list 1
    10 permit 10.1.1.1 (107 matches)
    20 deny   10.1.1.0, wildcard bits 0.0.0.255 (4 matches)
    30 permit 10.0.0.0, wildcard bits 0.255.255.255 (10 matches)
R2# show access-lists
Standard IP access list 1
    10 permit 10.1.1.1 (107 matches)
    20 deny   10.1.1.0, wildcard bits 0.0.0.255 (4 matches)
    30 permit 10.0.0.0, wildcard bits 0.255.255.255 (10 matches)
R2# show ip interface g0/0/1
GigabitEthernet0/0/1 is up, line protocol is up
  Internet address is 10.1.2.2/24
  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: 224.0.0.9
  Outgoing access list is not set
  Inbound access list is 1
! Lines omitted for brevity
```

```
access-list 2 remark This ACL permits server S1 traffic to host A's subnet
access-list 2 permit 10.2.2.1
!
access-list 3 remark This ACL permits server S2 traffic to host C's subnet
access-list 3 permit 10.2.2.2
!
interface G0/0/0
 ip access-group 2 out
!
interface G0/0/3
 ip access-group 3 out
```

```
R1# show running-config
! lines removed for brevity
access-list 2 remark This ACL permits server S1 traffic to host A's subnet
access-list 2 permit 10.2.2.1 log
!
interface G0/0/0
 ip access-group 2 out

R1#
Feb 4 18:30:24.082: %SEC-6-IPACCESSLOGNP: list 2 permitted 0 10.2.2.1 -> 10.1.1.1,
1 packet
```

```
R2# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)# access-list 21 permit 10.1.1.1 0.0.255.255
R2(config)# ^Z
R2#
R2# show ip access-lists
Standard IP access list 21
    10 permit 10.1.0.0, wildcard bits 0.0.255.255
```

```
ip access-list extended sample
  10 permit tcp 10.22.33.0 0.0.0.63 10.33.22.0 0.0.0.127 eq 22
  20 permit tcp 10.22.33.0 0.0.0.127 eq 24 10.33.22.0 0.0.0.63
  30 permit tcp 10.22.33.0 0.0.0.127 10.33.22.0 0.0.0.127 eq 22
  40 permit tcp 10.22.33.0 0.0.0.255 10.33.22.0 0.0.0.31 eq 24
```

```
R2# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)# ip access-list standard Hannah
R2(config-std-nacl)# remark A sample ACL, originally five lines
R2(config-std-nacl)# permit 10.1.1.2
R2(config-std-nacl)# deny 10.1.1.1
R2(config-std-nacl)# deny 10.1.3.0 0.0.0.255
R2(config-std-nacl)# deny 10.1.2.0 0.0.0.255
R2(config-std-nacl)# permit any
R2(config-std-nacl)# interface GigabitEthernet0/0/1
R2(config-if)# ip access-group Hannah out
R2(config-if)# ^Z
R2#
```

```
R2# show running-config
Building configuration...

Current configuration:
! lines omitted for brevity
interface GigabitEthernet0/0/1
 ip access-group Hannah out
!
ip access-list standard Hannah
 10 permit 10.1.1.2
 20 deny   10.1.1.1
 30 deny   10.1.3.0 0.0.0.255
 40 deny   10.1.2.0 0.0.0.255
 50 permit any

R2# show access-list
Standard IP access list Hannah
    10 permit 10.1.1.2 (3 matches)
    20 deny   10.1.1.1 (5 matches)
    30 deny   10.1.3.0, wildcard bits 0.0.0.255 (10 matches)
    40 deny   10.1.2.0, wildcard bits 0.0.0.255 (15 matches)
    50 permit any (1256 matches)
```

```
R2# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)# ip access-list extended Hannah
R2(config-std-nacl)# no deny 10.1.2.0 0.0.0.255
R2(config-std-nacl)# no 20
R2(config-std-nacl)# ^Z
R2# show access-lists

Standard IP access list Hannah
    10 permit 10.1.1.2
    30 deny   10.1.3.0, wildcard bits 0.0.0.255
    50 permit any
```

```
R2# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)# ip access-list extended Hannah
R2(config-std-nacl)# deny 10.1.2.0 0.0.0.255
R2(config-std-nacl)# deny 10.1.1.1
R2(config-std-nacl)# ^Z
R2# show access-lists

Standard IP access list Hannah
    10 permit 10.1.1.2
    30 deny   10.1.3.0, wildcard bits 0.0.0.255
    50 permit any
    60 deny 10.1.2.0 0.0.0.255
    70 deny 10.1.1.1
```

```
R2# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)# ip access-list extended Hannah
R2(config-std-nacl)# 40 deny 10.1.2.0 0.0.0.255
R2(config-std-nacl)# 20 deny 10.1.1.1
R2(config-std-nacl)# ^Z
R2# show access-lists

Standard IP access list Hannah
    10 permit 10.1.1.2
    20 deny   10.1.1.1
    30 deny   10.1.3.0, wildcard bits 0.0.0.255
    40 deny   10.1.2.0, wildcard bits 0.0.0.255
    50 permit any
```

```
R2# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)# access-list 8 permit 10.1.1.2
R2(config)# access-list 8 deny 10.1.1.1
R2(config)# access-list 8 deny 10.1.3.0 0.0.0.255
R2(config)# access-list 8  deny 10.1.2.0 0.0.0.255
R2(config)# access-list 8 permit any
R2(config)# interface GigabitEthernet0/0/1
R2(config-if)# ip access-group 8 out
R2(config-if)# ^Z
R2#
```

```
R2# show access-lists 8
Standard IP access list 8
    10 permit 10.1.1.2
    20 deny   10.1.1.1
    30 deny   10.1.3.0, wildcard bits 0.0.0.255
    40 deny   10.1.2.0, wildcard bits 0.0.0.255
    50 permit any
R2# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)# ip access-list standard 8
R2(config-std-nacl)# no deny 10.1.2.0 0.0.0.255
R2(config-std-nacl)# no 20
R2(config-std-nacl)# ^Z
R2# show access-lists 8
Standard IP access list 8
    10 permit 10.1.1.2
    30 deny   10.1.3.0, wildcard bits 0.0.0.255
    50 permit any

R2# show running-config
! Lines omitted for brevity
access-list 8 permit 10.1.1.2
access-list 8 deny   10.1.3.0 0.0.0.255
access-list 8 permit any
```

```
R1# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)# ip access-list extended branch_WAN
R1(config-ext-nacl)# remark Example ACL to match HTTP/S
R1(config-ext-nacl)# permit tcp 10.1.4.0 0.0.1.255 10.2.16.0 0.0.3.255 eq 80
R1(config-ext-nacl)# permit tcp 10.1.4.0 0.0.1.255 10.2.16.0 0.0.3.255 eq 443
R1(config-ext-nacl)# permit tcp 10.1.4.0 0.0.1.255 host 10.2.32.1 eq 80
R1(config-ext-nacl)# permit tcp 10.1.4.0 0.0.1.255 host 10.2.32.1 eq 443
R1(config-ext-nacl)# interface gigabitethernet0/0/1
R1(config-if)# ip access-group branch_WAN out
R1(config-if)# ^Z
R1#
```

```
R1# show ip interface gigabitethernet0/0/1
GigabitEthernet0/0/1 is up, line protocol is up
  Internet address is 10.1.12.1/24
  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: 224.0.0.5 224.0.0.10 224.0.0.6
  Outgoing access list is branch_WAN
  Inbound access list is not set
! Lines omitted for brevity

R1# show access-list
Extended IP access list branch_WAN
    10 permit tcp 10.1.4.0 0.0.1.255 10.2.16.0 0.0.3.255 eq www (18 matches)
    20 permit tcp 10.1.4.0 0.0.1.255 10.2.16.0 0.0.3.255 eq 443 (416 matches)
    30 permit tcp 10.1.4.0 0.0.1.255 host 10.2.32.1 eq www
    40 permit tcp 10.1.4.0 0.0.1.255 host 10.2.32.1 eq 443
```

```
R2# show running-config | section access-list
ip access-list extended DC_WAN
 10 permit tcp 10.2.16.0 0.0.3.255 eq www 10.1.4.0 0.0.1.255
 20 permit tcp 10.2.16.0 0.0.3.255 eq 443 10.1.4.0 0.0.1.255
 30 permit tcp host 10.2.32.1 eq www 10.1.4.0 0.0.1.255
 40 permit tcp host 10.2.32.1 eq 443 10.1.4.0 0.0.1.255
```

```
R2# show running-config | section access-list
ip access-list extended DC_WAN
 10 permit tcp 10.2.16.0 0.0.3.255 eq www 10.1.4.0 0.0.1.255
 20 permit tcp 10.2.16.0 0.0.3.255 eq 443 10.1.4.0 0.0.1.255
 25 permit udp 10.2.16.0 0.0.3.255 eq 443 10.1.4.0 0.0.1.255
 30 permit tcp host 10.2.32.1 eq www 10.1.4.0 0.0.1.255
 40 permit tcp host 10.2.32.1 eq 443 10.1.4.0 0.0.1.255
 45 permit udp host 10.2.32.1 eq 443 10.1.4.0 0.0.1.255
```

```
ip access-list extended QA_01
  10 permit tcp host 172.16.12.1 any eq 520
  20 permit tcp host 172.16.12.1 any
  30 permit ospf host 224.0.0.5 any
  40 permit ospf host 172.16.12.1 any
```

```
ip access-list extended QA_04
   10 permit udp 172.16.1.0 0.0.0.255 any eq 22
   20 permit tcp 172.16.1.0 0.0.0.255 any eq 22
   30 deny udp any any eq 22
   40 deny tcp any any eq 22
```

```
R1# show running-config | section access-list
! ACEs below are part of extended ACL Branch_Common
 50 permit udp any any eq domain
 60 permit tcp any any eq domain
```

```
R1# show running-config | section access-list
! Excerpt from extended ACL Branch_Common, replacing previous example's ACEs
 110 permit udp any host 10.2.32.1 eq domain
 120 permit udp any host 10.2.32.2 eq domain
 130 permit tcp any host 10.2.32.1 eq domain
 140 permit tcp any host 10.2.32.2 eq domain
! The next lines mimic example 8-1's ACEs, denying DNS (UDP and TCP)
 150 deny udp any any eq domain
 160 deny tcp any any eq domain
```

```
! The following single ACE achieves scenario 1 above
 210 permit icmp any any

! Alternately, the following two ACEs achieve scenario 2 above
 220 permit icmp 10.0.0.0 0.255.255.255 10.0.0.0 0.255.255.255
 230 deny icmp any any
```

```
! ACEs for the third ICMP scenario
ip access-list extended icmp_Echo_network_10
 250 permit icmp 10.0.0.0 0.255.255.255 10.0.0.0 0.255.255.255 echo
 260 permit icmp 10.0.0.0 0.255.255.255 10.0.0.0 0.255.255.255 echo-reply
 270 deny icmp any any
```

```
! Line 310 for OSPF scenario 1
 310 permit ospf any any
! Alternately, lines 320 and 330 for OSPF scenario 2.
 320 permit ospf host 10.1.12.2 any
 330 deny ospf any any
```

```
R2# show running-config section access-list
! Option 1: Allow all packets destined to DHCP server port (bootps 67)
 240 permit udp any any eq bootps
! Option 2: permit DHCP to known server and discard other messages sent to DHCP 67
 250 permit udp any host 10.2.16.1 eq bootps
 260 deny udp any any eq bootps
```

```
R1# show running-config
(Lists relevant excerpts…)
interface GigabitEthernet0/0/0
  ip address 10.1.4.254 255.255.254.0
  ip helper-address 10.2.16.1
  ip access-group R1_Common in
!
! ACL excerpt: permit packets with unusual source/destination addresses to DHCP server
250 permit udp host 0.0.0.0 host 255.255.255.255 eq bootps
260 deny udp any any eq bootps
```

```
! The following single ACE achieves SSH/Telnet scenario 1 above
 410 permit tcp any any range 22 telnet

! Alternately, the following two ACEs achieve SSH/Telnet scenario 2 above
 450 permit tcp 10.0.0.0 0.255.255.255 10.0.0.0 0.255.255.255 range 22 telnet
 470 deny tcp any any range 22 telnet
```

```
! SSH/Telnet scenario 1, revised for packets both to and from the server
 410 permit tcp any any range 22 telnet
 420 permit tcp any range 22 telnet any

! SSH/Telnet scenario 2, revised for packets both to and from the server
 450 permit tcp 10.0.0.0 0.255.255.255 10.0.0.0 0.255.255.255 range 22 telnet
 460 permit tcp 10.0.0.0 0.255.255.255 range 22 telnet 10.0.0.0 0.255.255.255
 470 deny tcp any any range 22 telnet
 480 deny tcp any range 22 telnet any
```

```
line vty 0 15
 transport input all
 access-class IT_only in
!
ip access-list standard IT_only
 10 remark matches packets sourced from subnet 10.1.1.0/24 only; implied deny any
 10 permit 10.1.1.0 0.0.0.255
```

```
! Configuration excerpt first
line vty 0 15
 transport input all
 access-class R2_WAN out
!
ip access-list standard R2_WAN
   10 permit host 10.1.12.1
!
! An attempt denied by the ACL to router R2's far-side LAN IP address
R1# ssh -l wendell 10.1.12.2
% Connections to that host not permitted from this terminal

! An attempt permitted by the ACL, resulting in password prompt from router R2.
R2# ssh -l wendell 10.1.12.1
Password:

R2>
```

```
R1# configure terminal
R1(config)# ip access-list resequence acl_01 100 20
R1(config)# do show access-list acl_01
Extended IP access list acl_01
    100 permit ip 10.1.4.0 0.0.1.255 any
    120 permit ip 10.2.4.0 0.0.1.255 any
    140 permit ip 10.0.0.0 0.255.255.255 10.0.0.0 0.255.255.255
```

```
R1# configure terminal
R1(config-if)# interface gigabitEthernet 0/0/1
R1(config-if)# ip access-group common common_all unique_01 out
R1(config-if)# do show ip interface g0/0/1
GigabitEthernet0/0/1 is up, line protocol is up
  Internet address is 10.1.12.1/24
  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: 224.0.0.5 224.0.0.10 224.0.0.6
  Outgoing Common access list is common_all
  Outgoing access list is unique_01
  Inbound Common access list is not set
  Inbound access list is not set
```

```
enable secret 5 $1$ZGMA$e8cmvkz4UjiJhVp7.maLE1
```

```
Switch3# show running-config | section line con 0
line con 0
 password cisco
 login

Switch3# configure terminal
Enter configuration commands, one per line.   End with CNTL/Z.
Switch3(config)# service password-encryption
Switch3(config)# ^Z

Switch3# show running-config | section line con 0
line con 0
 password 7 070C285F4D06
 login
```

```
Switch3(config)# enable secret fred
Switch3(config)# ^Z
Switch3# show running-config | include enable secret

enable secret 5 $1$ZGMA$e8cmvkz4UjiJhVp7.maLE1

Switch3# configure terminal
Enter configuration commands, one per line.   End with CNTL/Z.
Switch3(config)# no enable secret
Switch3(config)# ^Z
```

```
R1# show running-config | include enable
enable secret 5 $1$ZSYj$725dBZmLUJ0nx8gFPTtTv0
R1# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)# enable algorithm-type scrypt secret mypass1
R1(config)# ^Z
R1#
R1# show running-config | include enable
enable secret 9 $9$II/EeKiRW91uxE$fwYuOE5EHoii16AWv2wSywkLJ/KNeGj8uK/24B0TVU6
R1#
```

```
interface range gigabitethernet 0/1 - 24
switchport mode access
switchport port-security
switchport port-security mac-address sticky
```

```
SW1# show running-config
(Lines omitted for brevity)

interface FastEthernet0/1
 switchport mode access
 switchport port-security
 switchport port-security mac-address 0200.1111.1111
!
interface FastEthernet0/2
 switchport mode access
 switchport port-security
 switchport port-security mac-address sticky
!
interface FastEthernet0/3
 switchport mode access
 switchport port-security
!
interface FastEthernet0/4
 switchport mode trunk
 switchport port-security
 switchport port-security maximum 8
```

```
SW1# show running-config interface f0/2
Building configuration...
Current configuration : 188 bytes
!
interface FastEthernet0/2
  switchport mode access
  switchport port-security
  switchport port-security mac-address sticky
  switchport port-security mac-address sticky 0200.2222.2222
```

```
SW1# show port-security interface fastEthernet 0/1
Port Security               : Enabled
Port Status                 : Secure-shutdown
Violation Mode              : Shutdown
Aging Time                  : 0 mins
Aging Type                  : Absolute
SecureStatic Address Aging : Disabled
Maximum MAC Addresses       : 1
Total MAC Addresses         : 1
Configured MAC Addresses    : 1
Sticky MAC Addresses        : 0
Last Source Address:Vlan    : 0013.197b.5004:1
Security Violation Count    : 1

SW1# show port-security interface fastEthernet 0/2
Port Security               : Enabled
Port Status                 : Secure-up
Violation Mode              : Shutdown
Aging Time                  : 0 mins
Aging Type                  : Absolute
SecureStatic Address Aging : Disabled
Maximum MAC Addresses       : 1
Total MAC Addresses         : 1
Configured MAC Addresses    : 1
Sticky MAC Addresses        : 1
Last Source Address:Vlan    : 0200.2222.2222:1
Security Violation Count    : 0
```

```
SW1# show mac address-table secure interface F0/2
          Mac Address Table
-------------------------------------------

Vlan    Mac Address       Type          Ports
----    -----------       --------      -----
 1      0200.2222.2222    STATIC        Fa0/2
Total Mac Addresses for this criterion: 1

SW1# show mac address-table dynamic interface f0/2
          Mac Address Table
-------------------------------------------

Vlan    Mac Address       Type          Ports
----    -----------       --------      -----
SW1#
```

```
SW1# show port-security
Secure Port  MaxSecureAddr  CurrentAddr  SecurityViolation  Security Action
                 (Count)       (Count)          (Count)
---------------------------------------------------------------------------
     Fa0/13              1            1                  1         Shutdown
---------------------------------------------------------------------------
Total Addresses in System (excluding one mac per port) : 0
Max Addresses limit in System (excluding one mac per port) : 8192
```

```
! The next lines show the log message generated when the violation occurred.
Jul 31 18:00:22.810: %PORT_SECURITY-2-PSECURE_VIOLATION: Security violation
occurred, caused by MAC address 0200.3333.3333 on port FastEthernet0/13

! The next command shows the err-disabled state, implying a security violation.
SW1# show interfaces Fa0/13 status

Port     Name                 Status        Vlan   Duplex  Speed  Type
Fa0/13                        err-disabled  1      auto    auto   10/100BaseTX
!
! The next command's output has shading for several of the most important facts.
SW1# show port-security interface Fa0/13
Port Security              : Enabled
Port Status                : Secure-shutdown
Violation Mode             : Shutdown
Aging Time                 : 0 mins
Aging Type                 : Absolute
SecureStatic Address Aging : Disabled
Maximum MAC Addresses      : 1
Total MAC Addresses        : 1
Configured MAC Addresses   : 1
Sticky MAC Addresses       : 0
Last Source Address:Vlan   : 0200.3333.3333:2
Security Violation Count   : 1
```

```
SW1# show running-config
! Lines omitted for brevity
interface FastEthernet0/13
  switchport mode access
  switchport port-security
  switchport port-security mac-address 0200.1111.1111
  switchport port-security violation protect
! Lines omitted for brevity

SW1# show port-security interface Fa0/13
Port Security               : Enabled
Port Status                 : Secure-up
Violation Mode              : Protect
Aging Time                  : 0 mins
Aging Type                  : Absolute
SecureStatic Address Aging  : Disabled
Maximum MAC Addresses       : 1
Total MAC Addresses         : 1
Configured MAC Addresses    : 1
Sticky MAC Addresses        : 0
Last Source Address:Vlan    : 0000.0000.0000:0
Security Violation Count    : 0
```

```
SW1# show port-security interface fa0/13
Port Security               : Enabled
Port Status                 : Secure-up
Violation Mode              : Restrict
Aging Time                  : 0 mins
Aging Type                  : Absolute
SecureStatic Address Aging  : Disabled
Maximum MAC Addresses       : 1
Total MAC Addresses         : 1
Configured MAC Addresses    : 1
Sticky MAC Addresses        : 0
Last Source Address:Vlan    : 0200.3333.3333:1
Security Violation Count    : 97
!
! The following log message also points to a port security issue.
!
01:46:58: %PORT_SECURITY-2-PSECURE_VIOLATION: Security violation occurred, caused by
MAC address 0200.3333.3333 on port FastEthernet0/13.
```

```
ip dhcp snooping
ip dhcp snooping vlan 11
no ip dhcp snooping information option
!
interface GigabitEthernet1/0/2
 ip dhcp snooping trust
```

```
SW2# show ip dhcp snooping
Switch DHCP snooping is enabled
Switch DHCP gleaning is disabled
DHCP snooping is configured on following VLANs:
11
DHCP snooping is operational on following VLANs:
11
Smartlog is configured on following VLANs:
none
Smartlog is operational on following VLANs:
none
DHCP snooping is configured on the following L3 Interfaces:

Insertion of option 82 is disabled
   circuit-id default format: vlan-mod-port
   remote-id: bcc4.938b.a180 (MAC)
Option 82 on untrusted port is not allowed
Verification of hwaddr field is enabled
Verification of giaddr field is enabled
DHCP snooping trust/rate is configured on the following Interfaces:

Interface                   Trusted    Allow option    Rate limit (pps)
-----------------------     -------    ------------    ----------------
GigabitEthernet1/0/2        yes        yes             unlimited
  Custom circuit-ids:
```

```
errdisable recovery cause dhcp-rate-limit
errdisable recovery interval 30
!
interface GigabitEthernet1/0/2
 ip dhcp snooping limit rate 10
!
interface GigabitEthernet1/0/3
 ip dhcp snooping limit rate 2
```

```
SW2# show ip dhcp snooping
! Lines omitted for brevity

Interface                Trusted    Allow option    Rate limit (pps)
-----------------------  -------    ------------    ----------------
GigabitEthernet1/0/2     yes        yes             10
  Custom circuit-ids:
GigabitEthernet1/0/3     no         no              2
  Custom circuit-ids:
```

```
ip arp inspection vlan 11
!
interface GigabitEthernet1/0/2
 ip arp inspection trust
```

```
ip arp inspection vlan 11
ip dhcp snooping
ip dhcp snooping vlan 11
no ip dhcp snooping information option
!
interface GigabitEthernet1/0/2
 ip dhcp snooping trust
 ip arp inspection trust
```

```
SW2# show ip arp inspection

Source Mac Validation      : Disabled
Destination Mac Validation : Disabled
IP Address Validation      : Disabled

 Vlan     Configuration    Operation   ACL Match          Static ACL
 ----     -------------    ---------   ---------          ----------
   11     Enabled          Active

 Vlan     ACL Logging      DHCP Logging      Probe Logging
 ----     -----------      ------------      -------------
   11     Deny             Deny              Off

 Vlan       Forwarded         Dropped     DHCP Drops       ACL Drops
 ----       ---------         -------     ----------       ---------
   11              59               0              0               0

 Vlan   DHCP Permits    ACL Permits  Probe Permits   Source MAC Failures
 ----   ------------    -----------  -------------   -------------------
   11              7              0             49                     0

 Vlan   Dest MAC Failures   IP Validation Failures   Invalid Protocol Data
 ----   -----------------   ----------------------   ---------------------

 Vlan   Dest MAC Failures   IP Validation Failures   Invalid Protocol Data
 ----   -----------------   ----------------------   ---------------------
   11                   0                        0                       0
SW2# show ip dhcp snooping binding
MacAddress          IpAddress       Lease(sec) Type           VLAN  Interface
------------------  -------------  ---------- -------------  ----  ------------------
--
02:00:11:11:11:11  172.16.2.101    86110      dhcp-snooping    11  GigabitEthernet1/0/3
02:00:22:22:22:22  172.16.2.102    86399      dhcp-snooping    11  GigabitEthernet1/0/4
Total number of bindings: 2
```

```
Jul 25 14:28:20.763: %SW_DAI-4-DHCP_SNOOPING_DENY: 1 Invalid ARPs (Req) on Gi1/0/4,
vlan 11.([0200.2222.2222/172.16.2.101/0000.0000.0000/172.16.2.1/09:28:20 EST Thu Jul
25 2019])

SW2# show ip arp inspection statistics

 Vlan      Forwarded         Dropped     DHCP Drops       ACL Drops
 ----      ---------         -------     ----------       ---------
   11             59              17             17               0

 Vlan   DHCP Permits    ACL Permits  Probe Permits   Source MAC Failures
 ----   ------------    -----------  -------------   -------------------
   11              7              0             49                     0

 Vlan   Dest MAC Failures   IP Validation Failures   Invalid Protocol Data
 ----   -----------------   ----------------------   ---------------------
   11                    0                        0                      0
```

```
errdisable recovery cause dhcp-rate-limit
errdisable recovery cause arp-inspection
errdisable recovery interval 30
!
interface GigabitEthernet1/0/2
 ip dhcp snooping limit rate 10
 ip arp inspection limit rate 8
!
interface GigabitEthernet1/0/3
 ip dhcp snooping limit rate 2
 ip arp inspection limit rate 8 burst interval 4
```

```
SW2# show ip arp inspection interfaces
 Interface        Trust State     Rate (pps)     Burst Interval
 ---------------  -----------     ----------     --------------
 Gi1/0/1          Untrusted               15                  1
 Gi1/0/2          Trusted                  8                  1
 Gi1/0/3          Untrusted                8                  4
 Gi1/0/4          Untrusted               15                  1
! Lines omitted for brevity
```

```
SW2# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.

SW2(config)# ip arp inspection validate ?
  dst-mac  Validate destination MAC address
  ip       Validate IP addresses
  src-mac  Validate source MAC address

SW2(config)# ip arp inspection validate src-mac
SW2(config)# ^Z
SW2#
SW2# show ip arp inspection

Source Mac Validation      : Enabled
Destination Mac Validation : Disabled
IP Address Validation      : Disabled
```

```
*Dec 18 17:10:15.079: %LINEPROTO-5-UPDOWN: Line protocol on Interface
FastEthernet0/0, changed state to down
```

```
R1(config)# no service timestamps
R1(config)# service sequence-numbers
R1(config)# end
R1#
000011: %SYS-5-CONFIG_I: Configured from console by console
```

```
R1# show logging
Syslog logging: enabled (0 messages dropped, 3 messages rate-limited, 0 flushes, 0
overruns, xml disabled, filtering disabled)

No Active Message Discriminator.

No Inactive Message Discriminator.

    Console logging: level debugging, 45 messages logged, xml disabled,
                     filtering disabled
    Monitor logging: level debugging, 0 messages logged, xml disabled,
                     filtering disabled
    Buffer logging: level warnings, 0 messages logged, xml disabled,
                    filtering disabled
    Exception Logging: size (8192 bytes)
    Count and timestamp logging messages: disabled
    Persistent logging: disabled
 No active filter modules.
    Trap logging: level warnings, 0 message lines logged
       Logging to 172.16.3.9 (udp port 514, audit disabled,
            link up),
            0 message lines logged,
            0 message lines rate-limited,
            0 message lines dropped-by-MD,
            xml disabled, sequence number disabled
            filtering disabled
       Logging Source-Interface: VRF Name:
    TLS Profiles:

Log Buffer (8192 bytes):
```

```
R1# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)# interface g0/1
R1(config-if)# shutdown
R1(config-if)#
*Oct 21 20:07:07.244: %LINK-5-CHANGED: Interface GigabitEthernet0/1, changed state
  to administratively down
*Oct 21 20:07:08.244: %LINEPROTO-5-UPDOWN: Line protocol on Interface
  GigabitEthernet0/1, changed state to down
R1(config-if)# no shutdown
R1(config-if)#
*Oct 21 20:07:24.312: %LINK-3-UPDOWN: Interface GigabitEthernet0/1, changed state to up
*Oct 21 20:07:25.312: %LINEPROTO-5-UPDOWN: Line protocol on Interface
  GigabitEthernet0/1, changed state to up
R1(config-if)# ^Z
R1#
*Oct 21 20:07:36.546: %SYS-5-CONFIG_I: Configured from console by console
R1# show logging
! Skipping about 20 lines, the same lines in Example 13-3, until the last few lines

Log Buffer (8192 bytes):

*Oct 21 20:07:24.312: %LINK-3-UPDOWN: Interface GigabitEthernet0/1, changed state to up
```

```
R1# debug ip ospf hello
OSPF hello debugging is on
R1#
*Aug 10 13:38:19.863: OSPF-1 HELLO Gi0/1: Send hello to 224.0.0.5 area 0 from
  172.16.1.1
*Aug 10 13:38:21.199: OSPF-1 HELLO Gi0/2: Rcv hello from 2.2.2.2 area 0 172.16.2.2
*Aug 10 13:38:22.843: OSPF-1 HELLO Gi0/2: Send hello to 224.0.0.5 area 0 from
  172.16.2.1
R1#
```

```
*Oct 19 13:38:37.568: %OSPF-5-ADJCHG: Process 1, Nbr 2.2.2.2 on GigabitEthernet0/2
from FULL to DOWN, Neighbor Down: Interface down or detached
*Oct 19 13:38:40.568: %LINEPROTO-5-UPDOWN: Line protocol on Interface
GigabitEthernet0/2, changed state to down
```

```
! These messages happened on router R2
Oct 19 09:44:09.027: %LINK-3-UPDOWN: Interface GigabitEthernet0/1, changed state to down
Oct 19 09:44:09.027: %OSPF-5-ADJCHG: Process 1, Nbr 1.1.1.1 on GigabitEthernet0/1
from FULL to DOWN, Neighbor Down: Interface down or detached
```

```
R1# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)# clock timezone EST -5
R1(config)# clock summer-time EDT recurring
R1(config)# ^Z
R1#
R1# clock set 12:32:00 19 January 2023
*Jan 19 17:32:00.005: %SYS-6-CLOCKUPDATE: System clock has been updated from
12:32:16 EST Thu Jan 19 2023 to 12:32:00 EST Thu Jan 19 2023, configured from
console by console.
R1# show clock
12:32:06.146 EST Thu Jan 19 2023
```

```
R1# show ntp status
Clock is synchronized, stratum 4, reference is 172.16.2.2
nominal freq is 250.0000 Hz, actual freq is 250.0000 Hz, precision is 2**21
ntp uptime is 1553800 (1/100 of seconds), resolution is 4000
reference time is DA5E7147.56CADEA7 (15:24:38.694 EST Thu Jan 19 2023)
clock offset is 0.0986 msec, root delay is 2.46 msec
root dispersion is 22.19 msec, peer dispersion is 5.33 msec
loopfilter state is 'CTRL' (Normal Controlled Loop), drift is 0.000000009 s/s
system poll interval is 64, last update was 530 sec ago.
```

```
R1# show ntp associations
! This output is taken from router R1, acting in client/server mode
   address    ref clock st when poll reach  delay  offset disp
*~172.16.2.2 10.1.3.3  3   50  64     377  1.223  0.090  4.469
 * sys.peer, # selected, + candidate, - outlyer, x falseticker, ~ configured
```

```
 R2# show ntp associations
! This output is taken from router R2, acting in client/server mode
 address      ref clock    st  when poll  reach  delay  offset  disp
*~172.16.3.3  127.127.1.1  2   49    64   377    1.220  -7.758  3.695
 * sys.peer, # selected, + candidate, - outlyer, x falseticker, ~ configured
```

```
R3# show ntp status
Clock is synchronized, stratum 2, reference is 127.127.1.1
nominal freq is 250.0000 Hz, actual freq is 250.0000 Hz, precision is 2**20
ntp uptime is 595300 (1/100 of seconds), resolution is 4000
reference time is E0F9174C.87277EBB (15:27:54.252 EST Thu Jan 19 2023)
clock offset is 0.0000 msec, root delay is 0.00 msec
root dispersion is 0.33 msec, peer dispersion is 0.23 msec
loopfilter state is 'CTRL' (Normal Controlled Loop), drift is 0.000000000 s/s
system poll interval is 16, last update was 8 sec ago.

R3# show ntp associations
  address         ref clock       st   when   poll reach  delay  offset   disp
*~127.127.1.1     .LOCL.           1     15     16   377  0.000   0.000  0.232
 * sys.peer, # selected, + candidate, - outlyer, x falseticker, ~ configured
```

```
SW2# show cdp neighbors
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone,
                  D - Remote, C - CVTA, M - Two-port Mac Relay

Device ID        Local Intrfce     Holdtme    Capability  Platform  Port ID
SW1              Gig 1/0/21        155              S I   WS-C2960X Gig 1/0/24
R1               Gig 1/0/2         131            R S I   C1111-8P  Gig 0/0/1

Total cdp entries displayed : 2
```

```
SW2# show cdp neighbors detail
-------------------------
Device ID: SW1
Entry address(es):
  IP address: 1.1.1.1
Platform: cisco C9200L-24P-4X,  Capabilities: Switch IGMP
Interface: GigabitEthernet1/0/21,  Port ID (outgoing port): GigabitEthernet1/0/24
Holdtime : 144 sec

Version :
Cisco IOS Software [Bengaluru], Catalyst L3 Switch Software (CAT9K_LITE_IOSXE),
Version 17.6.3, RELEASE SOFTWARE (fc4)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2022 by Cisco Systems, Inc.
Compiled Wed 30-Mar-22 21:23 by mcpre

advertisement version: 2
VTP Management Domain: 'fred'
Native VLAN: 1
Duplex: full
Management address(es):
  IP address: 1.1.1.1

-------------------------
Device ID: R1
Entry address(es):
  IP address: 10.12.25.5
Platform: cisco C1111-8P,  Capabilities: Router Switch IGMP
Interface: GigabitEthernet1/0/2,  Port ID (outgoing port): GigabitEthernet0/0/1
Holdtime : 151 sec

Version :
Cisco IOS Software [Fuji], ISR Software (ARMV8EB_LINUX_IOSD-UNIVERSALK9_IAS-M),
Version 16.8.1, RELEASE SOFTWARE (fc3)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2018 by Cisco Systems, Inc.
Compiled Tue 27-Mar-18 10:56 by mcpre

advertisement version: 2
VTP Management Domain: ''
Duplex: full
Management address(es):
  IP address: 10.12.25.5
```

```
Total cdp entries displayed : 2
```

```
SW2# show cdp
Global CDP information:
        Sending CDP packets every 60 seconds
        Sending a holdtime value of 180 seconds
        Sending CDPv2 advertisements is enabled

SW2# show cdp interface GigabitEthernet1/0/2
GigabitEthernet1/0/2 is up, line protocol is up
  Encapsulation ARPA
  Sending CDP packets every 60 seconds
  Holdtime is 180 seconds

SW2# show cdp traffic
CDP counters :
        Total packets output: 304, Input: 305
        Hdr syntax: 0, Chksum error: 0, Encaps failed: 0
        No memory: 0, Invalid packet: 0,
        CDP version 1 advertisements output: 0, Input: 0
        CDP version 2 advertisements output: 304, Input: 305
```

```
SW2# show lldp neighbors
Capability codes:
    (R) Router, (B) Bridge, (T) Telephone, (C) DOCSIS Cable Device
    (W) WLAN Access Point, (P) Repeater, (S) Station, (O) Other

Device ID           Local Intf     Hold-time  Capability      Port ID
R1                  Gi1/0/2        120        R               Gi0/0/1
SW1                 Gi1/0/21       120        B               Gi1/0/24

Total entries displayed: 2

SW2# show cdp neighbors
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone,
                  D - Remote, C - CVTA, M - Two-port Mac Relay

Device ID        Local Intrfce     Holdtme    Capability  Platform  Port ID
SW1              Gig 1/0/21        155              S I   WS-C2960X Gig 1/0/24
R1               Gig 1/0/2         131             R S I  C1111-8P  Gig 0/0/1
Total entries displayed: 2
```

```
SW2# show lldp entry R1

Capability codes:
    (R) Router, (B) Bridge, (T) Telephone, (C) DOCSIS Cable Device
    (W) WLAN Access Point, (P) Repeater, (S) Station, (O) Other
----------------------------------------------
Local Intf: Gi1/0/2
Chassis id: 70ea.1a9a.d300
Port id: Gi0/0/1
Port Description: GigabitEthernet0/0/1
System Name: R1

System Description:
Cisco IOS Software [Fuji], ISR Software (ARMV8EB_LINUX_IOSD-UNIVERSALK9_IAS-M),
Version 16.8.1, RELEASE SOFTWARE (fc3)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2022 by Cisco Systems, Inc.
Compiled Fri 08-Apr-22 12:42 by mcp

Time remaining: 100 seconds
System Capabilities: B,R
Enabled Capabilities: R
Management Addresses:
    IP: 10.12.25.5
Auto Negotiation - not supported
Physical media capabilities - not advertised
Media Attachment Unit type - not advertised
Vlan ID: - not advertised


Total entries displayed: 1
```

```
lldp run
!
interface gigabitEthernet1/0/17
 no lldp transmit
 no lldp receive
!
interface gigabitEthernet1/0/18
 no lldp receive
```

```
interface gigabitEthernet1/0/19
 lldp transmit
 lldp receive
!
interface gigabitEthernet1/0/20
 lldp receive
```

```
SW2# show lldp
Global LLDP Information:
    Status: ACTIVE
    LLDP advertisements are sent every 30 seconds
    LLDP hold time advertised is 120 seconds
    LLDP interface reinitialisation delay is 2 seconds

SW2# show lldp interface g1/0/2

GigabitEthernet1/0/2:
    Tx: enabled
    Rx: enabled
    Tx state: IDLE
    Rx state: WAIT FOR FRAME

SW2# show lldp traffic

LLDP traffic statistics:
    Total frames out: 259
    Total entries aged: 0
    Total frames in: 257
    Total frames received in error: 0
    Total frames discarded: 0
    Total TLVs discarded: 0
    Total TLVs unrecognized: 0
```

```
interface GigabitEthernet0/0/0
 description LAN interface (private)
 ip address 10.1.1.1 255.255.255.0
 ip nat inside
interface GigabitEthernet0/0/1
 description WAN interface (public)
 ip address 200.1.1.249 255.255.255.252
ip nat inside source list 1 interface GigabitEthernet0/0/1
access-list 1 permit 10.1.1.0 0.0.0.255
```

```
-- Inside Source
access-list 1 pool fred refcount 2288
 pool fred: netmask 255.255.255.240
 start 200.1.1.1 end 200.1.1.7
 type generic, total addresses 7, allocated 7 (100%), misses 965
```

```
NAT# show running-config
!
! Lines omitted for brevity
!
interface GigabitEthernet0/0/0
 ip address 10.1.1.3 255.255.255.0
 ip nat inside
!
interface GigabitEthernet0/0/1
 ip address 200.1.1.253 255.255.255.0
 ip nat outside
!
ip nat inside source static 10.1.1.2 200.1.1.2
ip nat inside source static 10.1.1.1 200.1.1.1
```

```
NAT# show ip nat translations
Pro Inside global      Inside local       Outside local      Outside global
--- 200.1.1.1          10.1.1.1           ---                ---
--- 200.1.1.2          10.1.1.2           ---                ---

NAT# show ip nat statistics
Total active translations: 2 (2 static, 0 dynamic; 0 extended)
Outside interfaces:
  GigabitEthernet0/0/1
Inside interfaces:
  GigabitEthernet0/0/0
Hits: 100 Misses: 0
Expired translations: 0
Dynamic mappings:
```

```
NAT# show running-config
!
! Lines omitted for brevity
!
interface GigabitEthernet0/0/0
 ip address 10.1.1.3 255.255.255.0
 ip nat inside
!
interface GigabitEthernet0/0/1
 ip address 200.1.1.253 255.255.255.0
 ip nat outside
!
ip nat pool fred 200.1.1.1 200.1.1.2 netmask 255.255.255.252
ip nat inside source list 1 pool fred
!
access-list 1 permit 10.1.1.2
access-list 1 permit 10.1.1.1
```

```
! The next command lists one empty line because NAT has not yet added table entries.
NAT# show ip nat translations

NAT# show ip nat statistics
Total active translations: 0 (0 static, 0 dynamic; 0 extended)
Peak translations: 8, occurred 00:02:44 ago
Outside interfaces:
  GigabitEthernet0/0/1
Inside interfaces:
  GigabitEthernet0/0/0
Hits: 0 Misses: 0
CEF Translated packets: 0, CEF Punted packets: 0
Expired translations: 0
Dynamic mappings:
-- Inside Source
[id 1] access-list 1 pool fred refcount 0
 pool fred: netmask 255.255.255.252
    start 200.1.1.1 end 200.1.1.2
    type generic, total addresses 2, allocated 0 (0%), misses 0

Total doors: 0
Appl doors: 0
Normal doors: 0
Queued Packets: 0
```

```
NAT# show ip nat translations
Pro Inside global      Inside local       Outside local      Outside global
--- 200.1.1.1          10.1.1.1           ---                ---

NAT# show ip nat statistics
Total active translations: 1 (0 static, 1 dynamic; 0 extended)
Peak translations: 11, occurred 00:04:32 ago
Outside interfaces:
  GigabitEthernet0/0/1
Inside interfaces:
  GigabitEthernet0/0/0
Hits: 69 Misses: 1
Expired translations: 0
Dynamic mappings:
-- Inside Source
access-list 1 pool fred refcount 1
[eml fred: netmask 255.255.255.252
    start 200.1.1.1 end 200.1.1.2
    type generic, total addresses 2, allocated 1 (50%), misses 0
```

```
! Host 10.1.1.1 currently uses inside global 200.1.1.1
NAT# show ip nat translations
Pro Inside global      Inside local       Outside local      Outside global
--- 200.1.1.1          10.1.1.1           ---                ---
NAT# clear ip nat translation *

!
! telnet from 10.1.1.2 to 170.1.1.1 happened next; not shown
!
! Now host 10.1.1.2 uses inside global 200.1.1.1

NAT# show ip nat translations
Pro Inside global      Inside local       Outside local      Outside global
--- 200.1.1.1          10.1.1.2           ---                ---
!
! Telnet from 10.1.1.1 to 170.1.1.1 happened next; not shown
!
NAT# debug ip nat
IP NAT debugging is on

Oct 20 19:23:03.263: NAT*: s=10.1.1.1->200.1.1.2, d=170.1.1.1 [348]
Oct 20 19:23:03.267: NAT*: s=170.1.1.1, d=200.1.1.2->10.1.1.1 [348]
Oct 20 19:23:03.464: NAT*: s=10.1.1.1->200.1.1.2, d=170.1.1.1 [349]
Oct 20 19:23:03.568: NAT*: s=170.1.1.1, d=200.1.1.2->10.1.1.1 [349]
```

```
NAT# show running-config
!
! Lines Omitted for Brevity
!
interface GigabitEthernet0/0/0
 ip address 10.1.1.3 255.255.255.0
 ip nat inside
!
interface GigabitEthernet0/0/1
 ip address 200.1.1.249 255.255.255.252
 ip nat outside
!
ip nat inside source list 1 interface GigabitEthernet0/0/1 overload
!
access-list 1 permit 10.1.1.2
access-list 1 permit 10.1.1.1
```

```
NAT# show ip nat translations
Pro  Inside global      Inside local       Outside local      Outside global
tcp  200.1.1.249:49712  10.1.1.1:49712     170.1.1.1:23       170.1.1.1:23
tcp  200.1.1.249:49713  10.1.1.2:49713     170.1.1.1:23       170.1.1.1:23
tcp  200.1.1.249:49913  10.1.1.2:49913     170.1.1.1:23       170.1.1.1:23

NAT# show ip nat statistics
Total active translations: 3 (0 static, 3 dynamic; 3 extended)
Peak translations: 12, occurred 00:01:11 ago
Outside interfaces:
  GigabitEthernet0/0/1
Inside interfaces:
  GigabitEthernet0/0/0
Hits: 103 Misses: 3
Expired translations: 0
Dynamic mappings:
-- Inside Source
access-list 1 interface GigabitEthernet0/0/1 refcount 3
```

```
R1#(config)# class-map matchingexample
R1(config-cmap)# match protocol ?

! output heavily edited for length
  amazon-ec2                Secure and resizable compute capacity in the cloud.
  amazon-instant-video      VOD service by Amazon
  amazon-s3                 Amazon S3 (Simple Storage Service) is a cloud
                            computing web service.
  amazon-web-services       Amazon collection of remote computing services
! Output snipped.
```

```
R2# show file systems
File Systems:

      Size(b)       Free(b)      Type  Flags  Prefixes
            -             -    opaque     rw   system:
            -             -    opaque     rw   tmpsys:
*  2968264704    1416036352      disk     rw   bootflash: flash: crashinfo:
   1634713600    1557024768      disk     ro   webui:
            -             -    opaque     rw   null:
            -             -    opaque     ro   tar:
            -             -   network     rw   tftp:
            -             -    opaque     wo   syslog:
     33554432      33534559     nvram     rw   nvram:
            -             -   network     rw   rcp:
            -             -   network     rw   http:
            -             -   network     rw   ftp:
            -             -   network     rw   scp:
            -             -   network     rw   sftp:
            -             -   network     rw   https:
            -             -    opaque     ro   cns:
  31022530560   31022514176      disk     rw   usb0:
```

```
R2# copy tftp: flash:
Address or name of remote host []? 2.2.2.1
Source filename []? c1100-universalk9.17.06.03a.SPA.bin
Destination filename [c1100-universalk9.17.06.03a.SPA.bin]?
Accessing tftp://2.2.2.1/c1100-universalk9.17.06.03a.SPA.bin...
Loading c1100-universalk9.17.06.03a.SPA.bin from 2.2.2.1 (via GigabitEthernet0/0/0):
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
[OK - 706422748 bytes]


706422748 bytes copied in 187.876 secs (3760047 bytes/sec)
R2#
```

```
R2# show flash:
-#- --length-- ---------date/time---------            path
  1       4096 Aug 01 2022 17:12:23.0000000000 +00:00 /bootflash/
  2       4096 Aug 01 2022 16:12:30.0000000000 +00:00 /bootflash/.installer
  3          5 Aug 01 2022 16:10:40.0000000000 +00:00 /bootflash/.installer/
install_global_trans_lock
  4         50 Aug 01 2022 16:10:40.0000000000 +00:00 /bootflash/.installer/
last_pkgconf_shasum
  5         11 Aug 01 2022 16:11:15.0000000000 +00:00 /bootflash/.installer/
watchlist
! Skipped many lines for brevity...
571  706422748 Jun 27 2022 17:08:17.0000000000 +00:00 /bootflash/c1100-
universalk9.17.06.03a.SPA.bin
! Many lines skipped for brevity...
1416802304 bytes available (1400680448 bytes used)
```

```
R2# pwd
bootflash:/

R2# dir
Directory of bootflash:/

88177   drwx            40960   Aug 1 2022 20:34:05 +00:00  tracelogs
64129   drwx             4096   Aug 1 2022 16:12:30 +00:00  .installer
56113   drwx             4096   Aug 1 2022 16:11:48 +00:00  license_evlog
15      -rw-               30   Aug 1 2022 16:11:39 +00:00  throughput_monitor_params
12      -rw-           134935   Aug 1 2022 16:11:23 +00:00  memleak.tcl
11      -rw-             1546   Aug 1 2022 16:11:00 +00:00  mode_event_log
40081   drwx             4096  Jun 27 2022 17:15:02 +00:00  .prst_sync
19      -rw-             1923  Jun 27 2022 17:14:30 +00:00  trustidrootx_ca_092024.ca
18      -rw-        706422748  Jun 27 2022 17:08:17 +00:00  c1100-universalk9.
17.06.03a.SPA.bin
! Lines omitted for brevity
2968264704 bytes total (1416704000 bytes free)

R2# cd license_evlog
R2# dir
Directory of bootflash:/license_evlog/

56121   -rw-             1656   Aug 1 2022 16:13:19 +00:00  SAEventRegular20220801_
161148.log
56120   -rw-             1927  Jul 29 2022 16:13:37 +00:00  SAEventRegular20220727_
161208.log
56119   -rw-             1809   Jul 1 2022 20:28:37 +00:00  SAEventRegular20220701_
184140.log
56118   -rw-             1555  Jun 27 2022 17:22:22 +00:00  SAEventRegular20220627_
171513.log

2968264704 bytes total (1416802304 bytes free)

R2# pwd
bootflash:/license_evlog/
```

```
R2# verify /sha512 flash0:c1100-universalk9.17.06.03a.SPA.bin 164199339e08502f9cd-
255f2271ccf6fc633d4abb595d46b13dd280811aca3313a080f6282efe2365076985fe28a2091e2da3f-
00b8ac558785b4090c869f8548
.....................................................................................
.....................................................................................
(many lines of periods skipped for brevity)...
Done!
Verified (bootflash:/c1100-universalk9.17.06.03a.SPA.bin) = 164199339e08502f9cd255f-
2271ccf6fc633d4abb595d46b13dd280811aca3313a080f6282efe2365076985fe28a2091e2da3f-
00b8ac558785b4090c869f8548
```

```
R1# copy ftp://wendell:odom@192.168.1.170/c1100-universalk9.17.06.03a.SPA.bin flash:
Destination filename [c1100-universalk9.17.06.03a.SPA.bin]?
Accessing ftp://192.168.1.170/c1100-universalk9.17.06.03a.SPA.bin...
Loading c1100-universalk9.17.06.03a.SPA.bin
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
[OK - 706422748/4096 bytes]

706422748 bytes copied in 119.604 secs (5906544 bytes/sec)
```

VM: **telnet://***host-ipaddress*:*portnumber*

From a UNIX xTerm terminal: **telnet** *host-ipaddress portnumber*

```
SW1# show interfaces gigabit 0/1 switchport
Name: Gi0/1
Switchport: Enabled
Administrative Mode: dynamic auto
Operational Mode: static access
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: native
Negotiation of Trunking: On
```

```
>>> interface1
{'trunk-config': 'dynamic auto', 'trunk-status': 'static access'}
>>>
```

access-list *access-list-number* **permit ip 192.168.0.0 0.0.127.255 any**

```
https://dnac.example.com/dna/intent/api/v1/
network-device?managementIPAddress=10.10.22.74
```

```
{
    "response": {
        "type": "Cisco Catalyst 9300 Switch",
        "family": "Switches and Hubs",
        "role": "ACCESS",
        "managementIpAddress": "10.10.22.66"
    }
}
```

```
'''
Sample program to multiply two numbers and display the result
'''
x = 3
y = -4
z = 1.247
heading = "The product is "
print(heading,x*y)
```

```
# Variable list1 is a list in Python (called an array in Java)
list1 = ["g0/0", "g0/1", "g0/2"]

# Variable dict1 is a dictionary (called an associative array in Java)
dict1 = {"config_speed":'auto', "config_duplex":"auto", "config_ip":"10.1.1.1"}
```

?managementIPAddress=10.10.22.66&macAddress=f8:7b:20:67:62:80

```
{
    "response": {
         "family": "Switches and Hubs",
        "type": "Cisco Catalyst 9000 UADP 8 Port Virtual Switch",
        "macAddress": "52:54:00:01:c2:c0",
        "softwareType": "IOS-XE",
        "softwareVersion": "17.9.20220318:182713",
        "serialNumber": "9SB9FYAFA2O",
        "upTime": "30 days, 10:05:18.00",
        "series": "Cisco Catalyst 9000 Series Virtual Switches",
        "hostname": "sw1.ciscotest.com",
        "managementIpAddress": "10.10.20.175",
        "platformId": "C9KV-UADP-8P",
        "role": "CORE"
    }
}
```

```
<?xml version="1.0" encoding="UTF-8"?>
<root>
   <response>
      <family>Switches and Hubs</family>
      <hostname>cat_9k_1</hostname>
      <interfaceCount>41</interfaceCount>
      <lineCardCount>2</lineCardCount>
      <macAddress>f8:7b:20:67:62:80</macAddress>
      <managementIpAddress>10.10.22.66</managementIpAddress>
      <role>ACCESS</role>
      <serialNumber>FCW2136L0AK</serialNumber>
      <series>Cisco Catalyst 9300 Series Switches</series>
      <softwareType>IOS-XE</softwareType>
      <softwareVersion>16.6.1</softwareVersion>
      <type>Cisco Catalyst 9300 Switch</type>
      <upTime>17 days, 22:51:04.26</upTime>
   </response>
</root>
```

```
---
# This comment line is a place to document this Playbook
- name: Get IOS Facts
  hosts: mylab
  vars:
    cli:
      host: "{{ ansible_host }}"
      username: "{{ username }}"
      password: "{{ password }}"

  tasks:
    - ios_facts:
        gather_subset: all
        provider: "{{ cli }}"
```

```
{
    "R1": ["GigabitEthernet0/0", "GigabitEthernet0/1", "GigabitEthernet0/2/0"],
    "R2": ["GigabitEthernet1/0", "GigabitEthernet1/1", "GigabitEthernet0/3/0"]
}
```

{"1stbest": "Messi", "2ndbest": "Ronaldo", "3rdbest": "Maradona"}

```
hostname BR1
!
interface GigabitEthernet0/0
 ip address 10.1.1.1 255.255.255.0
 ip ospf 1 area 11
!
interface GigabitEthernet0/1
!
interface GigabitEthernet0/1/0
 ip address 10.1.12.1 255.255.255.0
 ip ospf 1 area 11
!
router ospf 1
 router-id 1.1.1.1
```

```
hostname {{hostname}}
!
interface GigabitEthernet0/0
 ip address {{address1}} {{mask1}}
 ip ospf {{OSPF_PID}} area {{area}}
!
interface GigabitEthernet0/1
!
interface GigabitEthernet0/1/0
 ip address {{address2}} {{mask2}}
 ip ospf {{OSPF_PID}} area {{area}}
!
router ospf {{OSPF_PID}}
 router-id {{RID}}
```

```
R1> show ip interface s0/0/1
Serial0/0/1 is up, line protocol is up
 Internet address is 10.1.2.1/24
 Broadcast address is 255.255.255.255
 Address determined by setup command
 MTU is 1500 bytes
 Helper address is not set
 Directed broadcast forwarding is disabled
 Multicast reserved groups joined: 224.0.0.9
 Outgoing access list is not set
 Inbound access list is 102
! roughly 26 more lines omitted for brevity
```

```
R1# show ip access-lists
Extended IP access list 102
 10 permit ip 10.1.2.0 0.0.0.255 10.1.4.0 0.0.1.255 (15 matches)
```

```
R2# show ip access-lists
Standard IP access list Step3B
 10 permit 10.3.3.0 0.0.0.127
 20 deny 10.4.4.0 0.0.1.255
 30 permit 10.0.0.0 0.255.255.255 (12 matches)
R2#
R2# show ip interface G0/1 | include Inbound
 Inbound access list is Step3B
```

```
R1# show ip access-lists
Standard IP access list Step3G
 10 permit host 10.4.4.1
 20 permit 10.3.3.0 0.0.0.127 (12 matches)
! using the implicit deny to match everything else
R1#
! On router R1:
R1# show ip interface G0/2 | include Inbound
 Inbound access list is Step3G
```

```
R1# show ip access-lists
ip access-list extended RoutingProtocolExample
 10 permit udp any any eq 520
 20 permit ospf any any
 30 permit eigrp any any
 remark a complete ACL would also need more statements here
R1#
```

```
R1# show running-config
! Lines omitted for brevity
interface GigabitEthernet0/0
 ip address 10.1.1.9 255.255.255.0
 standby version 2
 standby 1 ip 10.1.1.1
 standby 1 priority 110
 standby 1 name HSRP-group-for-book
```

```
! The following configuration, on R2, is identical except for the HSRP priority and
! the interface IP address
R2# show running-config
! Lines omitted for brevity
interface GigabitEthernet0/0
 ip address 10.1.1.129 255.255.255.0
 standby version 2
 standby 1 ip 10.1.1.1
 standby 1 name HSRP-group-for-book
```

```
! First, the group status as seen from R1
R1# show standby brief
                     P indicates configured to preempt.
                     |
Interface   Grp Pri  P State   Active          Standby         Virtual IP
Gi0/0       1   110    Active  local           10.1.1.129      10.1.1.1
```

```
! The output here on R2 shows that R2 agrees with R1.
R2# show standby brief
                     P indicates configured to preempt.
                     |
Interface   Grp  Pri P State   Active          Standby         Virtual IP
Gi0/0       1    100   Standby 10.1.1.9        local           10.1.1.1
```

```
R1# show standby
GigabitEthernet0/0 - Group 1 (version 2)
  State is Active
    6 state changes, last state change 00:12:53
  Virtual IP address is 10.1.1.1
  Active virtual MAC address is 0000.0c9f.f001
    Local virtual MAC address is 0000.0c9f.f001 (v2 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 1.696 secs
  Preemption disabled
  Active router is local
  Standby router is 10.1.1.129, priority 100 (expires in 8.096 sec)
  Priority 110 (configured 110)
  Group name is "HSRP-group-for-book" (cfgd)
```

```
! The output here on R2 shows that R2 agrees with R1.
R2# show standby
GigabitEthernet0/0 - Group 1 (version 2)
  State is Standby
    4 state changes, last state change 00:12:05
 Virtual IP address is 10.1.1.1
 Active virtual MAC address is 0000.0c9f.f001
    Local virtual MAC address is 0000.0c9f.f001 (v2 default)
 Hello time 3 sec, hold time 10 sec
    Next hello sent in 0.352 secs
 Preemption disabled
 Active router is 10.1.1.9, priority 110 (expires in 9.136 sec)
    MAC address is 0200.0101.0101
 Standby router is local
 Priority 100 (default 100)
 Group name is "HSRP-group-for-book" (cfgd)
```

```
! First, R1's G0/0 is disabled and enabled; the ending log message shows a standby
! state.
R1# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)# interface gigabitEthernet 0/0
R1(config-if)# shutdown
*Mar 8 18:10:29.242: %HSRP-5-STATECHANGE: GigabitEthernet0/0 Grp 1 state Active ->
Init
*Mar 8 18:10:31.205: %LINK-5-CHANGED: Interface GigabitEthernet0/0, changed state to
administratively down
*Mar 8 18:10:32.205: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEther
net0/0, changed state to down
R1(config-if)#
R1(config-if)# no shutdown
R1(config-if)# ^Z
R1#
*Mar 8 18:11:08.355: %HSRP-5-STATECHANGE: GigabitEthernet0/0 Grp 1 state Speak ->
Standby
```

```
! Now from R2, note R2 is active, and 10.1.1.9 (R1) is standby
R2# show standby brief
                     P indicates configured to preempt.
                     |
Interface   Grp  Pri P State Active          Standby         Virtual IP
Gi0/1       1    100   Active local          10.1.1.9        10.1.1.1
```

```
! First, R1's G0/0 is disabled and enabled; the ending log message shows a standby
 ! state.
R1# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)# interface gigabitEthernet 0/0
R1(config-if)# shutdown
*Mar 8 18:10:29.242: %HSRP-5-STATECHANGE: GigabitEthernet0/0 Grp 1 state Active ->
  Init
*Mar 8 18:10:31.205: %LINK-5-CHANGED: Interface GigabitEthernet0/0, changed state to
  administratively down
*Mar 8 18:10:32.205: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEther
  net0/0, changed state to down
R1(config-if)# standby 1 preempt
R1(config-if)# no shutdown
R1(config-if)# ^Z
R1#
*Mar 8 18:19:14.355: %HSRP-5-STATECHANGE: GigabitEthernet0/0 Grp 1 state Listen ->
  Active
```

```
! Now from R2, note it is active, and 10.1.1.9 (R1) is standby

*Mar 8 18:18:55.948: %HSRP-5-STATECHANGE: GigabitEthernet0/0 Grp 1 state Standby ->
  Active
*Mar 8 18:19:14.528: %HSRP-5-STATECHANGE: GigabitEthernet0/0 Grp 1 state Active ->
  Speak
*Mar 8 18:19:26.298: %HSRP-5-STATECHANGE: GigabitEthernet0/0 Grp 1 state Speak ->
  Standby

R2# show standby brief
                     P indicates configured to preempt.
                     |
Interface    Grp Pri P State Active          Standby         Virtual IP
Gi0/0        1   100   Standby 10.1.1.9      local           10.1.1.1
```

```
! Configuration on R1, R2, and R4, all NTP clients
ntp server 172.16.9.9
```

```
! Configuration on R3 for its server function
interface loopback 0
 ip address 172.16.9.9 255.255.255.0
!
ntp master 4
ntp source loopback 0
```

```
! Verification on router R3
R3# show interfaces loopback 0
Loopback0 is up, line protocol is up
 Hardware is Loopback
 Internet address is 172.16.9.9/24
! lines omitted for brevity
```