

Running head: ASSIGNMENT SIX: CONFIGURE HSRP

Assignment Six: Configure Hot Standby Router Protocol

Brian Dwyer

Morrisville State College

Brian Dwyer  
CITA370  
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### Assignment Six: Configure Hot Standby Router Protocol

Hot Standby Router Protocol (HSRP) is a first hop redundancy protocol. First hop redundancy protocols help to eliminate single point of failure and provide high-availability to gateways on a common LAN segment. HSRP uses multiple routers configured with the same virtual IP address to provide a highly-available gateway address. In addition to maintaining a common virtual IP, members also use a common virtual MAC address which is also used only by the active router. The members of an HSRP standby group constantly poll other members to determine which router should assume the active role. The router with the highest priority for a standby group assumes the active role automatically. Prior to first hop redundancy protocols, the gateways would have to be switched manually by all users if the primary gateway went down. You can imagine why this is did not work well.

HSRP uses UDP-based hello packets to detect router failure and to determine active and standby routers. HSRP uses the multicast address of 224.0.0.2 to choose and maintain the active HSRP router. Hello packets by default are sent out every 3 seconds the default holdtime is 10 seconds. Hello packets are sent from the source routers non-virtual IP and indicate the status (active, standby) as well holdtime. Holdtime is the amount of time required before a router is considered down and the next highest priority router preemptively assumes the active role. The value of the hold time should always be configured at least three-times the value of the hello interval. For the purpose of this lab, I adjusted the timers to 15 millisecond hello and 50 millisecond hold timers respectively. Wireshark demonstrated the impracticability of this due to the massive amount of traffic generated.

VRRP or Virtual Router Redundancy Protocol is a non-proprietary HSRP alternative. VRRP has the advantage of being non-proprietary, meaning it can operate in mixed-vendor environments. VRRP also has faster default timer values than HSRP. VRRP also uses an interface IP address as the group address instead of the virtual IP assignment of HSRP.

While configuring HSRP, I realized that the standby routers function is only to provide redundancy; it does not share the work load with the active router. For this reason, I decided to configure a form of load balancing on the routers. I configured multiple HSRP groups so that all routers' hardware can be utilized while maintaining high-availability. In addition, I realized that if one router goes down, it effectively kills high-availability so I opted for a three router configuration instead. I configured three virtual IP's of 192.168.2.1, 192.168.2.2, and 192.168.2.3 respectively. In addition, I configured the priorities so that in a fully operational state, R1 assumes the role of 192.168.2.1, R2 assumes 192.168.2.2, and R3 assumes 192.168.2.3. I achieved this by tapering HSRP standby-group priorities. As you may notice in my screenshots, I at first had the configuration backwards; I assumed that a numerically lower priority would be chosen for the active delegation similar to how lower administrative distances are chosen for routing. I was wrong; the numerically higher priority is chosen for the active role! Once I realized this, I edited my configuration files, so the configuration files below are correct.

```
CITA370-R1#show standby
FastEthernet0/0 - Group 1
  Local state is Active, priority 110, may preempt
  Hellotime 15 msec, holdtime 50 msec
  Next hello sent in 0.007
  Virtual IP address is 192.168.2.1 configured
  Active router is local
  Standby router is unknown
  Virtual mac address is 0000.0c07.ac01
  2 state changes, last state change 00:00:11
  IP redundancy name is "hsrp-Fa0/0-1" (default)
FastEthernet0/0 - Group 2
  Local state is Active, priority 120, may preempt
  Hellotime 15 msec, holdtime 50 msec
  Next hello sent in 0.011
  Virtual IP address is 192.168.2.2 configured
  Active router is local
  Standby router is unknown
  Virtual mac address is 0000.0c07.ac02
  2 state changes, last state change 00:00:11
  IP redundancy name is "hsrp-Fa0/0-2" (default)
FastEthernet0/0 - Group 3
  Local state is Active, priority 130, may preempt
  Hellotime 15 msec, holdtime 50 msec
  Next hello sent in 0.011
  Virtual IP address is 192.168.2.3 configured
  Active router is local
  Standby router is unknown
  Virtual mac address is 0000.0c07.ac03
  2 state changes, last state change 00:00:23
  IP redundancy name is "hsrp-Fa0/0-3" (default)
```

**Figure 1**

Figure 1 shows the standby group information when only the R1 is powered on. Here, R1 assumes the role of all three gateways.

```
C:\Users\Brian>ping 192.168.2.1

Pinging 192.168.2.1 with 32 bytes of data:
Reply from 192.168.2.1: bytes=32 time=1ms TTL=255
Reply from 192.168.2.1: bytes=32 time=1ms TTL=255
Reply from 192.168.2.1: bytes=32 time=1ms TTL=255
Reply from 192.168.2.1: bytes=32 time=1ms TTL=255

Ping statistics for 192.168.2.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 1ms, Maximum = 1ms, Average = 1ms

C:\Users\Brian>ping 192.168.2.2

Pinging 192.168.2.2 with 32 bytes of data:
Reply from 192.168.2.2: bytes=32 time=2ms TTL=255
Reply from 192.168.2.2: bytes=32 time=1ms TTL=255
Reply from 192.168.2.2: bytes=32 time=1ms TTL=255
Reply from 192.168.2.2: bytes=32 time=1ms TTL=255

Ping statistics for 192.168.2.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 1ms, Maximum = 2ms, Average = 1ms

C:\Users\Brian>ping 192.168.2.3

Pinging 192.168.2.3 with 32 bytes of data:
Reply from 192.168.2.3: bytes=32 time=2ms TTL=255
Reply from 192.168.2.3: bytes=32 time=1ms TTL=255
Reply from 192.168.2.3: bytes=32 time=1ms TTL=255
Reply from 192.168.2.3: bytes=32 time=1ms TTL=255

Ping statistics for 192.168.2.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 1ms, Maximum = 2ms, Average = 1ms

C:\Users\Brian>ping 192.168.2.4

Pinging 192.168.2.4 with 32 bytes of data:
Reply from 192.168.2.4: bytes=32 time=2ms TTL=255
Reply from 192.168.2.4: bytes=32 time=1ms TTL=255
Reply from 192.168.2.4: bytes=32 time=1ms TTL=255
Reply from 192.168.2.4: bytes=32 time=1ms TTL=255

Ping statistics for 192.168.2.4:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 1ms, Maximum = 2ms, Average = 1ms

C:\Users\Brian>ping 192.168.2.5

Pinging 192.168.2.5 with 32 bytes of data:
Reply from 192.168.2.10: Destination host unreachable.
Reply from 192.168.2.10: Destination host unreachable.
Reply from 192.168.2.10: Destination host unreachable.
Reply from 192.168.2.10: Destination host unreachable.

Ping statistics for 192.168.2.5:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
```

**Figure 2**

Figure 2 demonstrates that all three virtual IP's are reachable and that the active router R1's physical interface IP address(192.168.2.4) is also reachable.

```

CITA370-R1#
00:33:20: %STANDBY-6-STATECHANGE: FastEthernet0/0 Group 1 state Active -> Speak
CITA370-R1#sh standby
FastEthernet0/0 - Group 1
  Local state is Standby, priority 110, may preempt
  Hellotime 15 msec, holdtime 50 msec
  Next hello sent in 0.007
  Virtual IP address is 192.168.2.1 configured
  Active router is 192.168.2.5, priority 120 expires in 0.034
  Standby router is local
  4 state changes, last state change 00:00:22
  IP redundancy name is "hsrp-Fa0/0-1" (default)
FastEthernet0/0 - Group 2
  Local state is Active, priority 120, may preempt
  Hellotime 15 msec, holdtime 50 msec
  Next hello sent in 0.007
  Virtual IP address is 192.168.2.2 configured
  Active router is local
  Standby router is 192.168.2.5, priority 110 expires in 0.030
  Virtual mac address is 0000.0c07.ac02
  2 state changes, last state change 00:17:22
  IP redundancy name is "hsrp-Fa0/0-2" (default)
FastEthernet0/0 - Group 3
  Local state is Active, priority 130, may preempt
  Hellotime 15 msec, holdtime 50 msec
  Next hello sent in 0.000
  Virtual IP address is 192.168.2.3 configured
  Active router is local
  Standby router is 192.168.2.5, priority 120 expires in 0.038
  Virtual mac address is 0000.0c07.ac03
  2 state changes, last state change 00:17:26
  IP redundancy name is "hsrp-Fa0/0-3" (default)

```

**Figure 3**

Figure 3 shows the standby group configuration with R1 and R2 connected. We can see that R2 has now assumed the Active Role of virtual IP 192.168.2.1.

It can also be seen that I configured the standby-group priorities backwards! Doh!

```

C:\Users\Brian>ping 192.168.2.1 -n 1

Pinging 192.168.2.1 with 32 bytes of data:
Reply from 192.168.2.1: bytes=32 time=3ms TTL=255

Ping statistics for 192.168.2.1:
    Packets: Sent = 1, Received = 1, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 3ms, Maximum = 3ms, Average = 3ms

C:\Users\Brian>ping 192.168.2.2 -n 1

Pinging 192.168.2.2 with 32 bytes of data:
Reply from 192.168.2.2: bytes=32 time=2ms TTL=255

Ping statistics for 192.168.2.2:
    Packets: Sent = 1, Received = 1, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 2ms, Maximum = 2ms, Average = 2ms

C:\Users\Brian>ping 192.168.2.3 -n 1

Pinging 192.168.2.3 with 32 bytes of data:
Reply from 192.168.2.3: bytes=32 time=5ms TTL=255

Ping statistics for 192.168.2.3:
    Packets: Sent = 1, Received = 1, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 5ms, Maximum = 5ms, Average = 5ms

C:\Users\Brian>ping 192.168.2.4 -n 1

Pinging 192.168.2.4 with 32 bytes of data:
Reply from 192.168.2.4: bytes=32 time=2ms TTL=255

Ping statistics for 192.168.2.4:
    Packets: Sent = 1, Received = 1, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 2ms, Maximum = 2ms, Average = 2ms

C:\Users\Brian>ping 192.168.2.5 -n 1

Pinging 192.168.2.5 with 32 bytes of data:
Reply from 192.168.2.5: bytes=32 time=2ms TTL=255

Ping statistics for 192.168.2.5:
    Packets: Sent = 1, Received = 1, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 2ms, Maximum = 2ms, Average = 2ms

C:\Users\Brian>ping 192.168.2.6 -n 1

Pinging 192.168.2.6 with 32 bytes of data:
Reply from 192.168.2.10: Destination host unreachable.

Ping statistics for 192.168.2.6:
    Packets: Sent = 1, Received = 1, Lost = 0 (0% loss),

```

**Figure 4**

Figure 4 shows that All Virtual IP's are reachable and that R3's physical interface IP of 192.168.2.6 is still unreachable. R3 is still disconnected.

```
CITA370-R1#show standby
00:37:17: %STANDBY-6-STATECHANGE: FastEthernet0/0 Group 2 state Standby -> Active
00:37:17: %STANDBY-6-STATECHANGE: FastEthernet0/0 Group 2 state Active -> Speak
FastEthernet0/0 - Group 1
  Local state is Listen, priority 110, may preempt
  Hellotime 15 msec, holdtime 50 msec
  Virtual IP address is 192.168.2.1 configured
  Active router is 192.168.2.6, priority 130 expires in 0.002
  Standby router is 192.168.2.5, priority 120 expired
  5 state changes, last state change 00:00:40
  IP redundancy name is "hsrp-Fa0/0-1" (default)
FastEthernet0/0 - Group 2
  Local state is Standby, priority 120, may preempt
  Hellotime 15 msec, holdtime 50 msec
  Next hello sent in 0.000
  Virtual IP address is 192.168.2.2 configured
  Active router is 192.168.2.6, priority 130 expired
  Standby router is local
  7 state changes, last state change 00:00:21
  IP redundancy name is "hsrp-Fa0/0-2" (default)
FastEthernet0/0 - Group 3
  Local state is Active, priority 130, may preempt
  Hellotime 15 msec, holdtime 50 msec
  Next hello sent in 0.000
  Virtual IP address is 192.168.2.3 configured
  Active router is local
  Standby router is 192.168.2.5, priority 120 expires in 0.042
  Virtual mac address is 0000.0c07.ac03
  2 state changes, last state change 00:21:23
  IP redundancy name is "hsrp-Fa0/0-3" (default)
```

**Figure 5**

Figure 5 shows HSRP status with all three routers connected. We can see here that a third HSRP state of listen exists. The listen state occurs when a router has a lower priority than the active and standby group members.

Once again, we can see that the priorities are configured backwards!

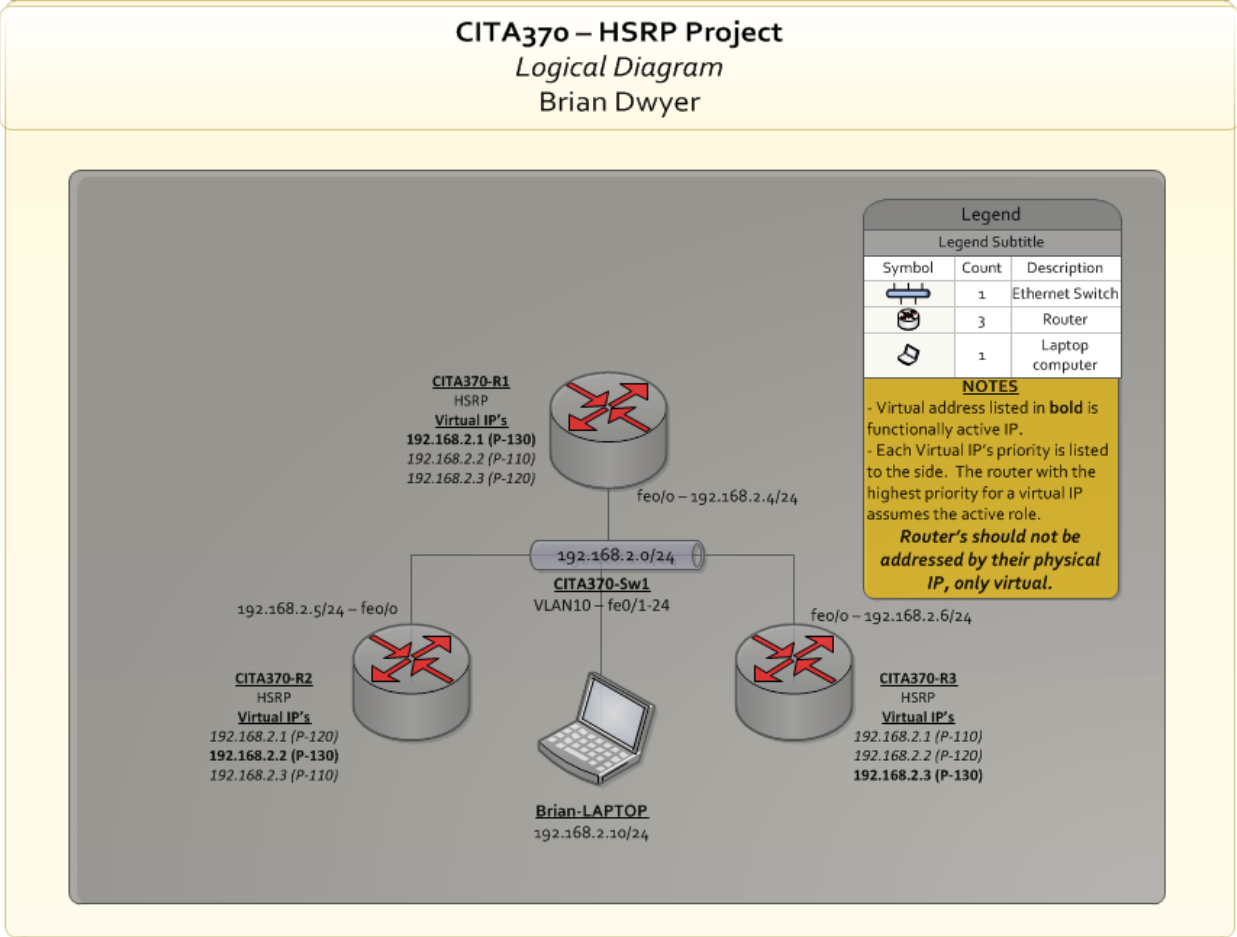
6000	15.960099	192.168.2.5	224.0.0.2	HSRP	Hello (state Standby)
6001	15.966916	192.168.2.6	224.0.0.2	HSRP	Hello (state Active)

```

⊕ Frame 6000: 62 bytes on wire (496 bits), 62 bytes captured (496 bits)
⊕ Ethernet II, Src: Cisco_cb:98:a0 (00:04:9a:cb:98:a0), Dst: IPv4mcast_00:00:02 (01:00:5e:00:00:02)
⊕ Internet Protocol, Src: 192.168.2.5 (192.168.2.5), Dst: 224.0.0.2 (224.0.0.2)
⊕ User Datagram Protocol, Src Port: hsrp (1985), Dst Port: hsrp (1985)
⊖ Cisco Hot Standby Router Protocol
  Version: 0
  Op Code: Hello (0)
  State: Standby (8)
  Hellotime: Non-Default (0)
  Holdtime: Non-Default (0)
  Priority: 120
  Group: 1
  Reserved: 0
  Authentication Data: Default (cisco)
  Virtual IP Address: 192.168.2.1 (192.168.2.1)
```

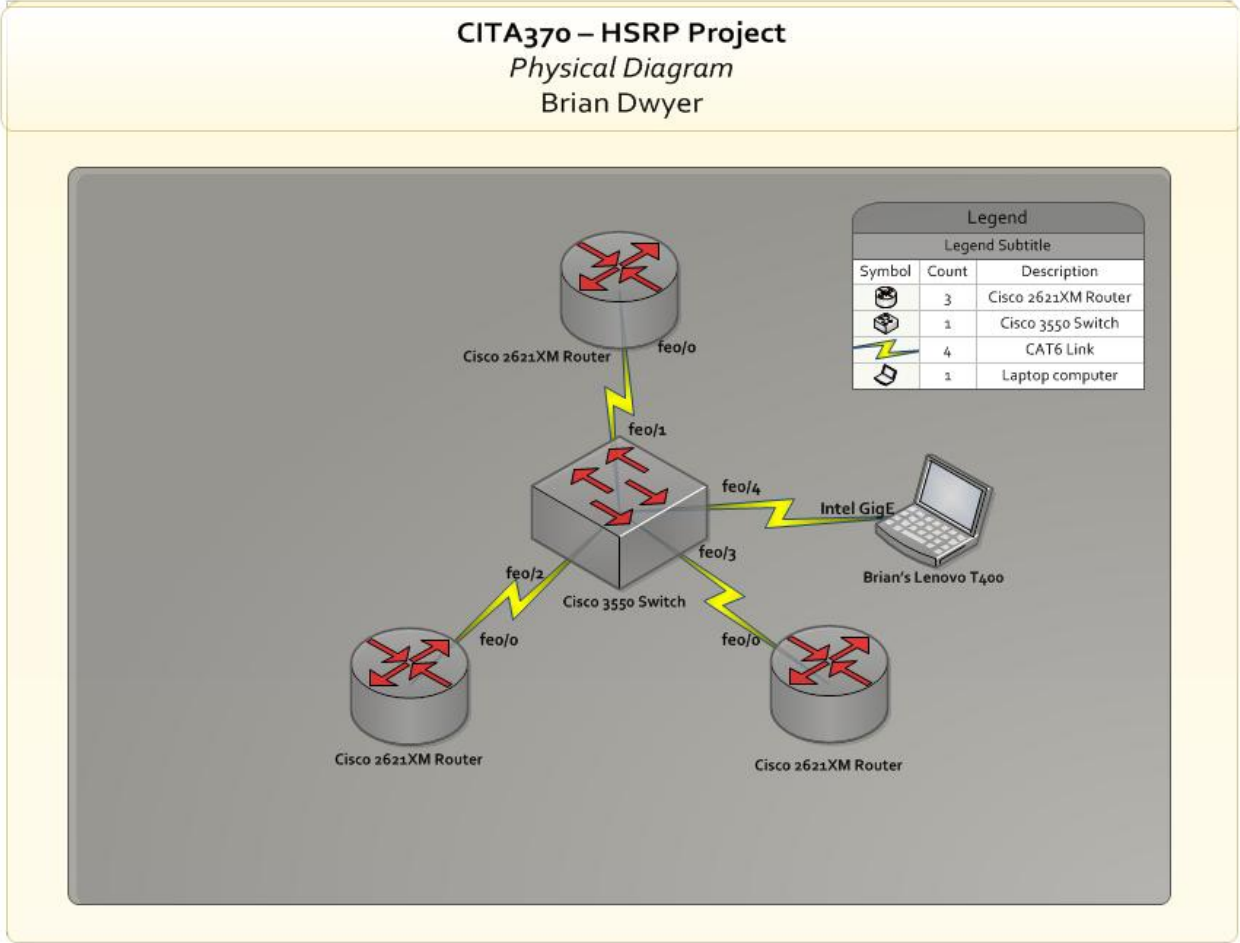
**Figure 6**

Figure 6 shows what information is contained in a hello packet. My analysis also shows that routers in an HSRP listen state do not transmit hello packets.



**Figure 7 – Logical Diagram**





**Figure 8 – Physical Diagram**

## CONFIGURATION FILES

- **Router 1 Configuration**

```

Current configuration : 883 bytes
!
version 12.2
service timestamps debug uptime
service timestamps log uptime
service password-encryption
!
hostname CITA370-R1
!
memory-size iomem 15
ip subnet-zero
no proxy-arp
!
!
call rsvp-sync
!
interface FastEthernet0/0
 ip address 192.168.2.4 255.255.255.0
 duplex auto
 speed auto
 standby 1 ip 192.168.2.1
 standby 1 timers msec 15 msec 50
 standby 1 priority 130
 standby 1 preempt
 standby 2 ip 192.168.2.2
 standby 2 timers msec 15 msec 50
 standby 2 priority 110
 standby 2 preempt
 standby 3 ip 192.168.2.3
 standby 3 timers msec 15 msec 50
 standby 3 priority 120
 standby 3 preempt
interface Serial10/0
 no ip address
 shutdown
!
interface FastEthernet0/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
router rip
 version 2
 redistribute connected
 passive-interface FastEthernet0/1
 network 192.168.2.0
 no auto-summary
!
ip classless
no ip http server
!
!
dial-peer cor custom
!
!
!
!
line con 0
line aux 0
line vty 0 4
 login
!
End

```

- **Router 2 Configuration**

```
hostname CITA370-R2

interface FastEthernet0/0
 ip address 192.168.2.5 255.255.255.0
 duplex auto
 speed auto
 standby 1 ip 192.168.2.1
 standby 1 timers msec 15 msec 50
 standby 1 priority 120
 standby 1 preempt
 standby 2 ip 192.168.2.2
 standby 2 timers msec 15 msec 50
 standby 2 priority 130
 standby 2 preempt
 standby 3 ip 192.168.2.3
 standby 3 timers msec 15 msec 50
 standby 3 priority 110

 standby 3 preempt
```

- **Router 3 Configuration**

```
hostname CITA370-R3

interface FastEthernet0/0
 ip address 192.168.2.6 255.255.255.0
 duplex auto
 speed auto
 standby 1 ip 192.168.2.1
 standby 1 timers msec 15 msec 50
 standby 1 priority 110
 standby 1 preempt
 standby 2 ip 192.168.2.2
 standby 2 timers msec 15 msec 50
 standby 2 priority 120
 standby 2 preempt
 standby 3 ip 192.168.2.3
 standby 3 timers msec 15 msec 50
 standby 3 priority 130
 standby 3 preempt
```

- **Switch 1 Configuration**

```
Current configuration : 1243 bytes
!
version 12.1
no service pad
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname CITA370-Sw1
!
!
interface FastEthernet0/1
 switchport access vlan 10
 spanning-tree portfast
!
interface FastEthernet0/2
```

```
switchport access vlan 10
spanning-tree portfast
!
interface FastEthernet0/3
switchport access vlan 10
spanning-tree portfast
!
interface FastEthernet0/4
switchport access vlan 10
spanning-tree portfast
!
!
interface Vlan1
no ip address
shutdown
!
ip classless
!
line con 0
line vty 0 4
login
!
!
End
```

## Works Cited

- Angelescu, S., & Swerczek, A. (2010). *CCNA Certification All-In-One For Dummies*. Indianapolis: Wiley Publishing, Inc.
- Hucaby, D., McQuerry, S., & Whitaker, A. (2010). *Cisco Router Configuration Handbook - Second Edition*. Chicago: Cisco Press.