ADVANCED NETWORKING VIRTUALIZATION AND CLOUD COMPUTING

CS4163

Assessment 01

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PS2626

CS4163

Assignment Overview

Design and simulate a **multi-layer hierarchical network** using Cisco Packet Tracer. The assignment is broken down into incremental tasks. You must submit (i.e., push to your repository) each task with **detailed comments, explanations, screenshots**, and the **.pkt files** showcasing your progress.

Network Topology

Create a hierarchical network composed of **three layers**:

1. **Core Layer –** Minimum of 2 core routers or switches.
2. **Aggregation/Distribution Layer –** Minimum of 3 devices.
3. **Access Layer –** Minimum of 4 access switches.

Requirements:

- Ensure logical separation between layers to support future enhancements (e.g., SDN policy enforcement).
- Use Cisco Packet Tracer to create a **network topology diagram** including all layers.
- Provide a **clear and labeled diagram** explaining your topology design.

IP Addressing and VLAN Segmentation

- Develop an **IP addressing scheme** for your network.
- Configure **basic IP addressing** on routers and switches.
- Create at least **two VLANs** (e.g., one for **Management/Engineering**, another for **Guest/Other Users**).
- Assign VLANs on access layer switches.
- Configure **inter-VLAN routing** using a router or Layer 3 switch.
- Use **sub-interfaces** if required to enable routing between VLANs.
- Provide **screenshots of the configuration output**.

Submit (git push) your `.pkt` file along with a **document explaining the IP addressing scheme** and **VLAN configurations**.

Security Policies and ACLs

- Implement and configure **Access Control Lists (ACLs)** on routers/firewalls to restrict **inter-VLAN traffic** based on your security policies.

Document each ACL entry with **comments and screenshots** showing successful traffic filtering.

Failover and Redundancy

- Implement a **redundancy protocol** such as **HSRP**, **VRRP**, or a **dynamic routing protocol** on routers/switches for automatic failover.
- Simulate a **network device or link failure** and show how traffic is automatically rerouted.

Document how the **failover mechanism** works with:

  - Detailed notes
  - Simulation captures/screenshots of **before and after the failure**
  - Clear comments on the behaviour observed

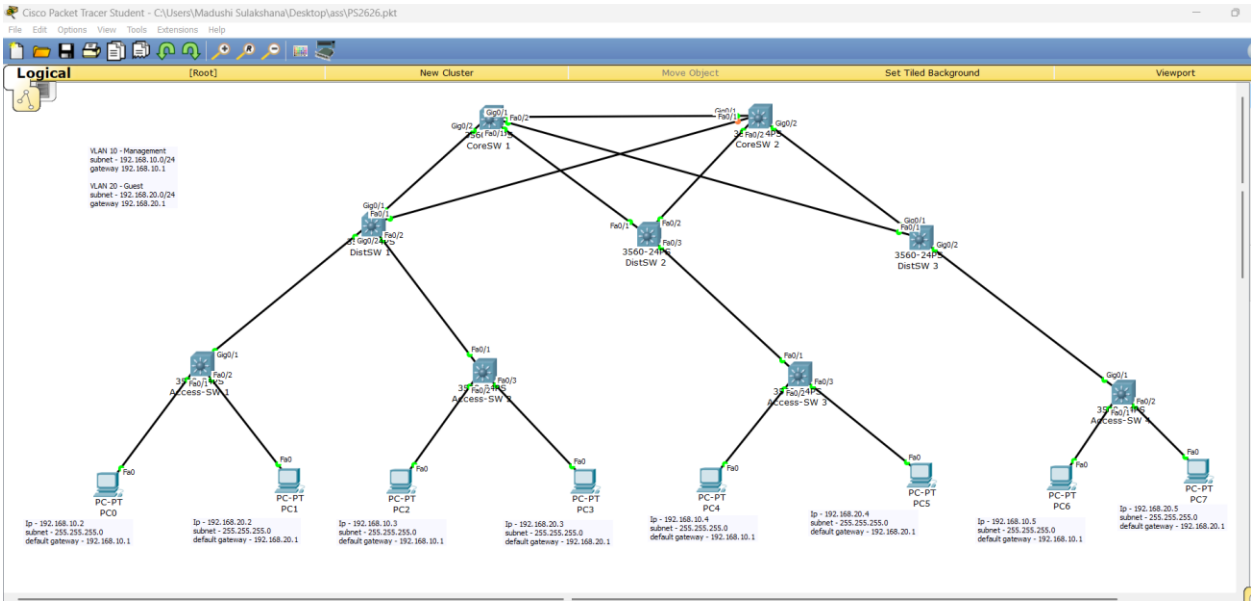
Documentation and Version-Controlled Updates

Submit your assignment in **stages**. Each submission must include:

- The **updated .pkt file**
- A **document or text file** explaining the changes made (include configuration snippets, screenshots, and commentary)
- **Git version control logs** detailing all incremental updates
- Clear labels for each task update with comments on:
  - Design choices
  - Configuration steps
  - Testing results

Your assignment will be evaluated based on the compressive commits showing the **step-by-step evolution** of your assignment.

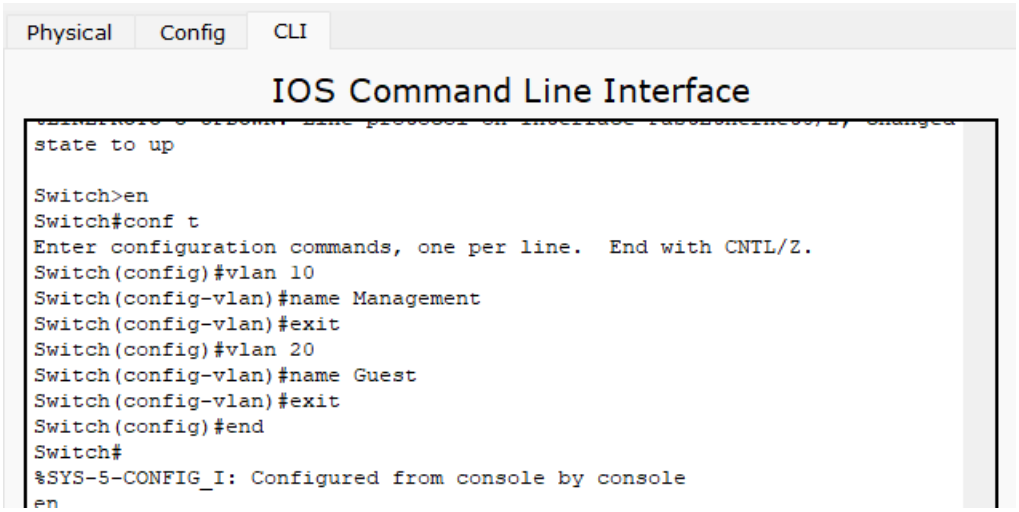
Network Topology Design



IP addressing and VLAN Configuration

Create VLANs on Access switches

- VLAN 10 for Management and VLAN 20 for Guest



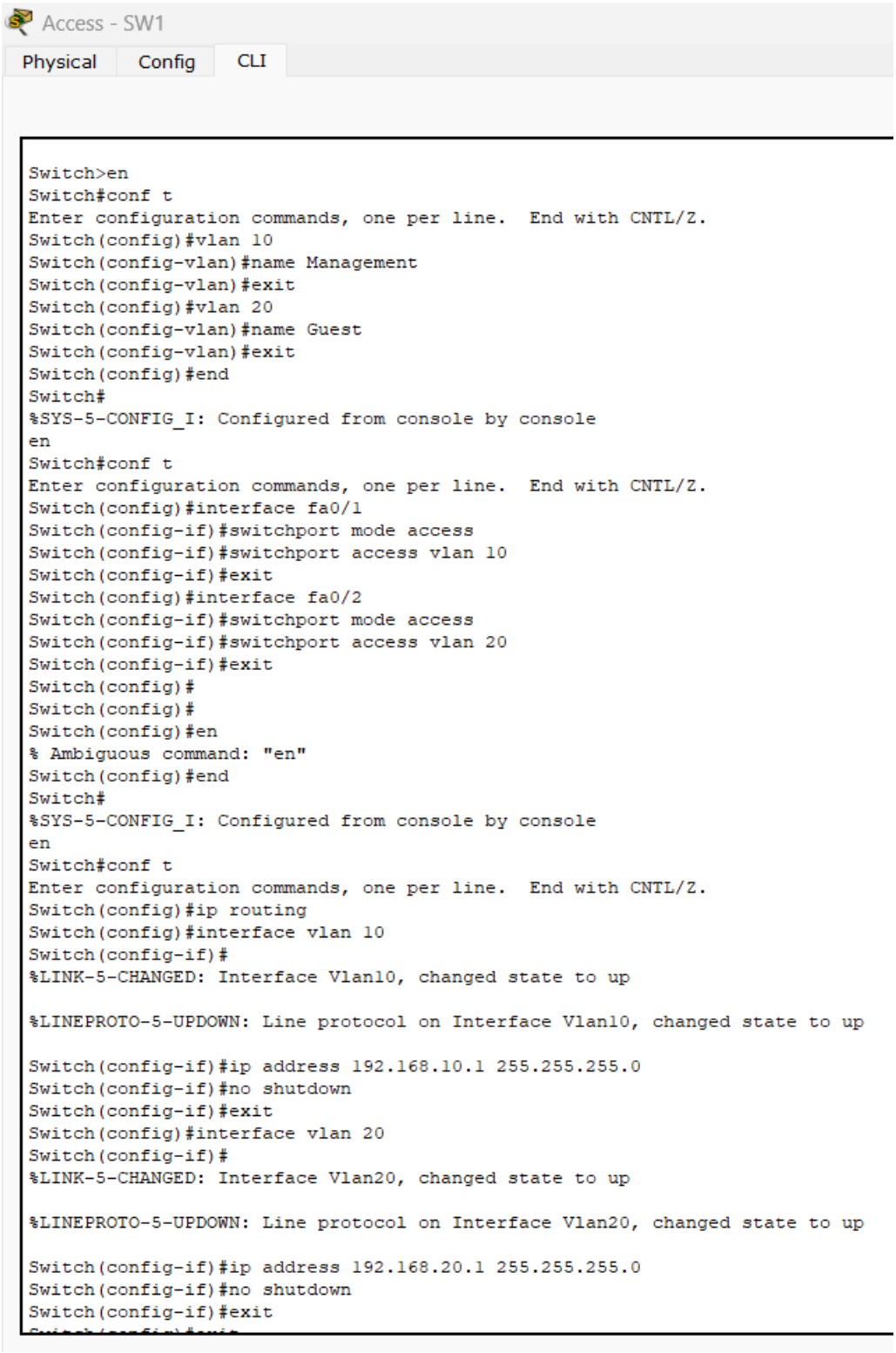
Assign VLANs to switch ports

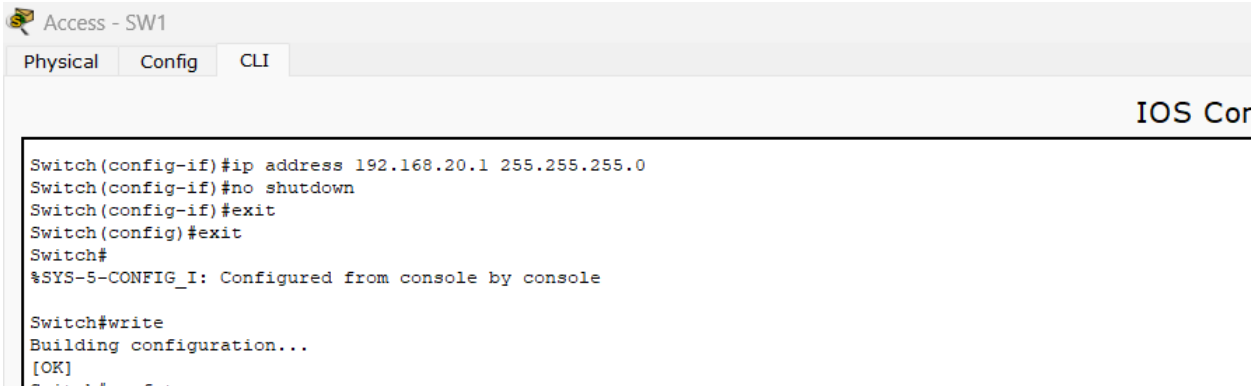
```
Switch#
%SYS-5-CONFIG_I: Configured from console by console
en
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#interface fa0/1
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 10
Switch(config-if)#exit
Switch(config)#interface fa0/2
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 20
Switch(config-if)#exit
Switch(config)#
Switch(config)#
```

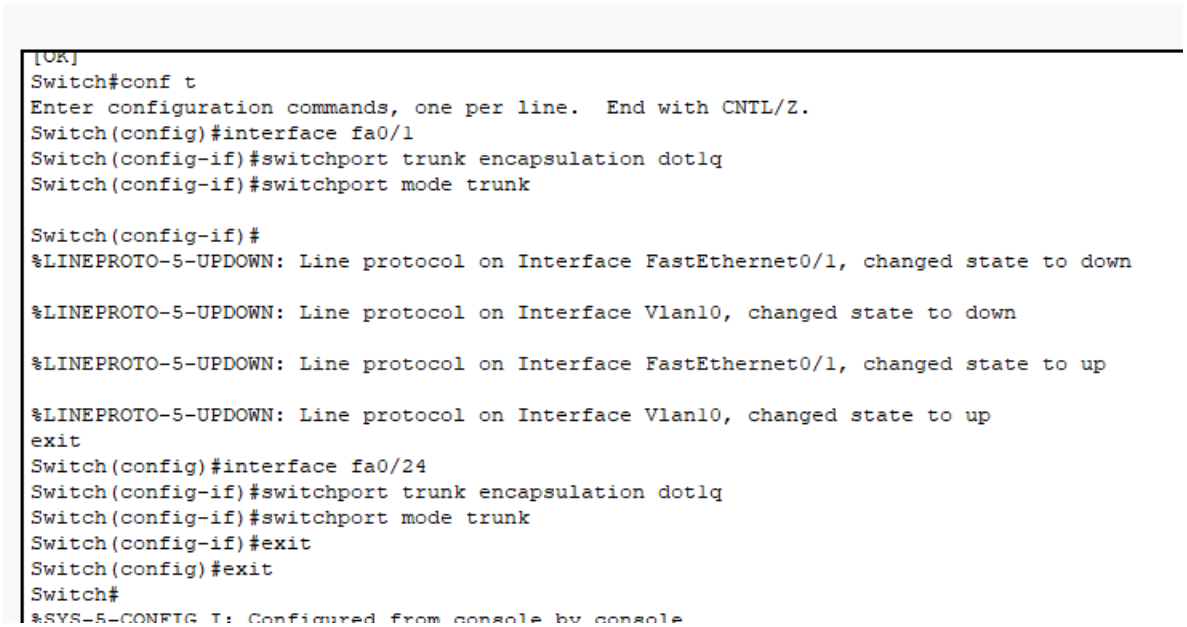
Commands on layer 3 switch

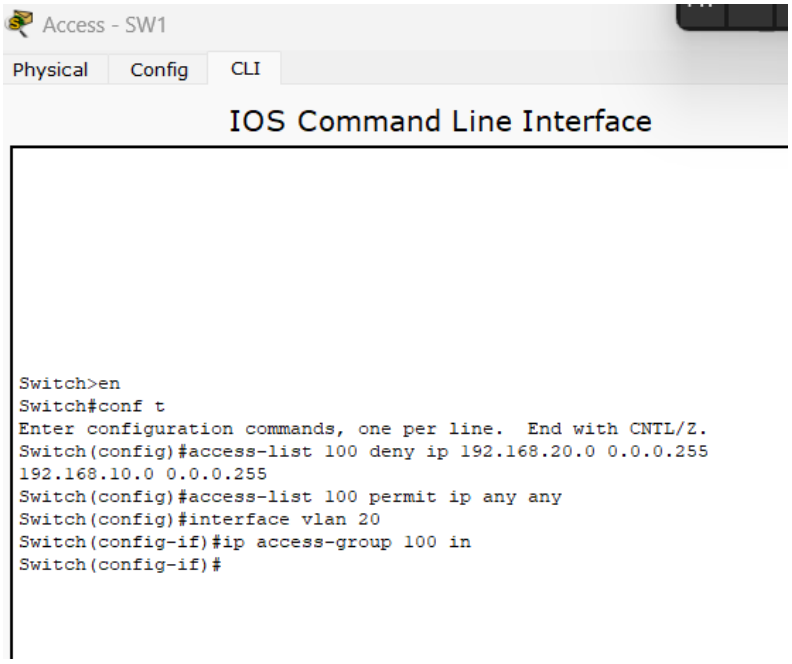
```
Switch(config)#
Switch(config)#ip routing
Switch(config)#interface vlan 10
Switch(config-if)#
%LINK-5-CHANGED: Interface Vlan10, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan10, changed state to up

Switch(config-if)#ip address 192.168.10.1 255.255.255.0
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#interface vlan 20
Switch(config-if)#
%LINK-5-CHANGED: Interface Vlan20, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan20, changed state to up

Switch(config-if)#ip address 192.168.20.1 255.255.255.0
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#write
               ^
% Invalid input detected at '^' marker.

Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
write
Building configuration...
[OK]
```

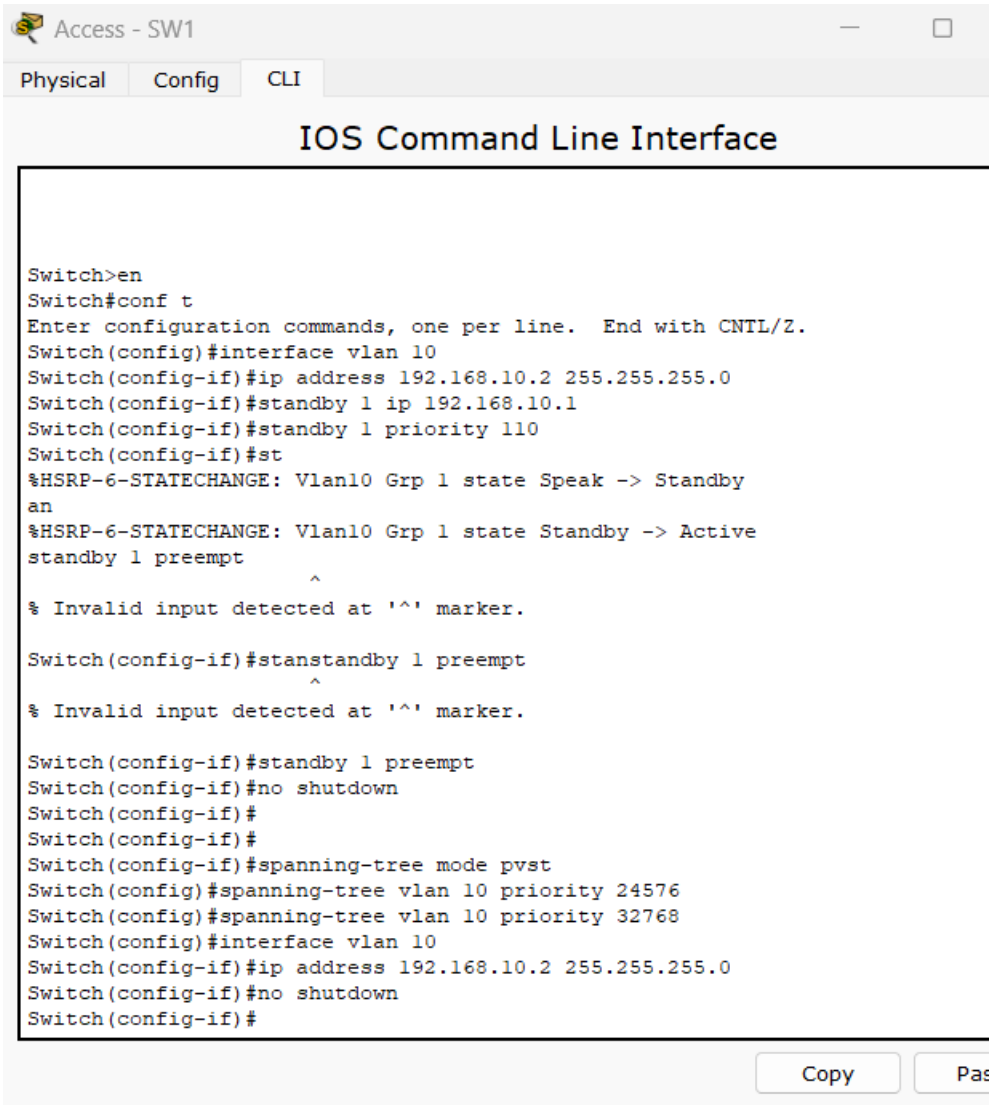
Access Switch 1




Access - SW1
Physical
Config
CLI
IOS Cor
Switch(config-if)#ip address 192.168.20.1 255.255.255.0
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
Switch#write
Building configuration...
[OK]


[OK]
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface fa0/1
Switch(config-if)#switchport trunk encapsulation dot1q
Switch(config-if)#switchport mode trunk
Switch(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan10, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan10, changed state to up
exit
Switch(config)#interface fa0/24
Switch(config-if)#switchport trunk encapsulation dot1q
Switch(config-if)#switchport mode trunk
Switch(config-if)#exit
Switch(config)#exit
Switch#


Access - SW1
Physical
Config
CLI
IOS Command Line Interface
Switch>en
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#access-list 100 deny ip 192.168.20.0 0.0.0.255
192.168.10.0 0.0.0.255
Switch(config)#access-list 100 permit ip any any
Switch(config)#interface vlan 20
Switch(config-if)#ip access-group 100 in
Switch(config-if)#


Access - SW1
Physical
Config
CLI
IOS Command Line Interface
Switch>en
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface vlan 10
Switch(config-if)#ip address 192.168.10.2 255.255.255.0
Switch(config-if)#standby 1 ip 192.168.10.1
Switch(config-if)#standby 1 priority 110
Switch(config-if)#st
%HSRP-6-STATECHANGE: Vlan10 Grp 1 state Speak -> Standby
an
%HSRP-6-STATECHANGE: Vlan10 Grp 1 state Standby -> Active
standby 1 preempt
^
% Invalid input detected at '^' marker.
Switch(config-if)#stanstandby 1 preempt
^
% Invalid input detected at '^' marker.
Switch(config-if)#standby 1 preempt
Switch(config-if)#no shutdown
Switch(config-if)#
Switch(config-if)#
Switch(config-if)#spanning-tree mode pvst
Switch(config)#spanning-tree vlan 10 priority 24576
Switch(config)#spanning-tree vlan 10 priority 32768
Switch(config)#interface vlan 10
Switch(config-if)#ip address 192.168.10.2 255.255.255.0
Switch(config-if)#no shutdown
Switch(config-if)#
Copy
Pas

Access - SW1

Physical | Config | CLI

```
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan20, changed state to up

%HSRP-6-STATECHANGE: Vlan10 Grp 1 state Speak -> Standby

%HSRP-6-STATECHANGE: Vlan10 Grp 1 state Standby -> Active

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up

Switch>show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/3, Fa0/4, Fa0/5, Fa0/6
                                                Fa0/7, Fa0/8, Fa0/9, Fa0/10
                                                Fa0/11, Fa0/12, Fa0/13, Fa0/14
                                                Fa0/15, Fa0/16, Fa0/17, Fa0/18
                                                Fa0/19, Fa0/20, Fa0/21, Fa0/22
                                                Fa0/23, Fa0/24, Gig0/2
10   Management                       active    Fa0/1
20   Guest                            active    Fa0/2
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active
Switch>show interfaces trunk
Port        Mode         Encapsulation  Status        Native vlan
Gig0/1      auto         n-802.1q       trunking      1

Port        Vlans allowed on trunk
Gig0/1      1-1005

Port        Vlans allowed and active in management domain
Gig0/1      1,10,20

Port        Vlans in spanning tree forwarding state and not pruned
Gig0/1      1,10,20
Switch>show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

C    192.168.10.0/24 is directly connected, Vlan10
C    192.168.20.0/24 is directly connected, Vlan20
Switch>
```

Access Switch 2

```
% Invalid input detected at '^' marker.

Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
write
Building configuration...
```

```
[OK]
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#interface fa0/1
Switch(config-if)#switchport trunk encapsulation dot1q
Switch(config-if)#switchport mode trunk

Switch(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan10, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan10, changed state to up
exit
Switch(config)#interface fa0/24
Switch(config-if)#switchport trunk encapsulation dot1q
Switch(config-if)#switchport mode trunk
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
```

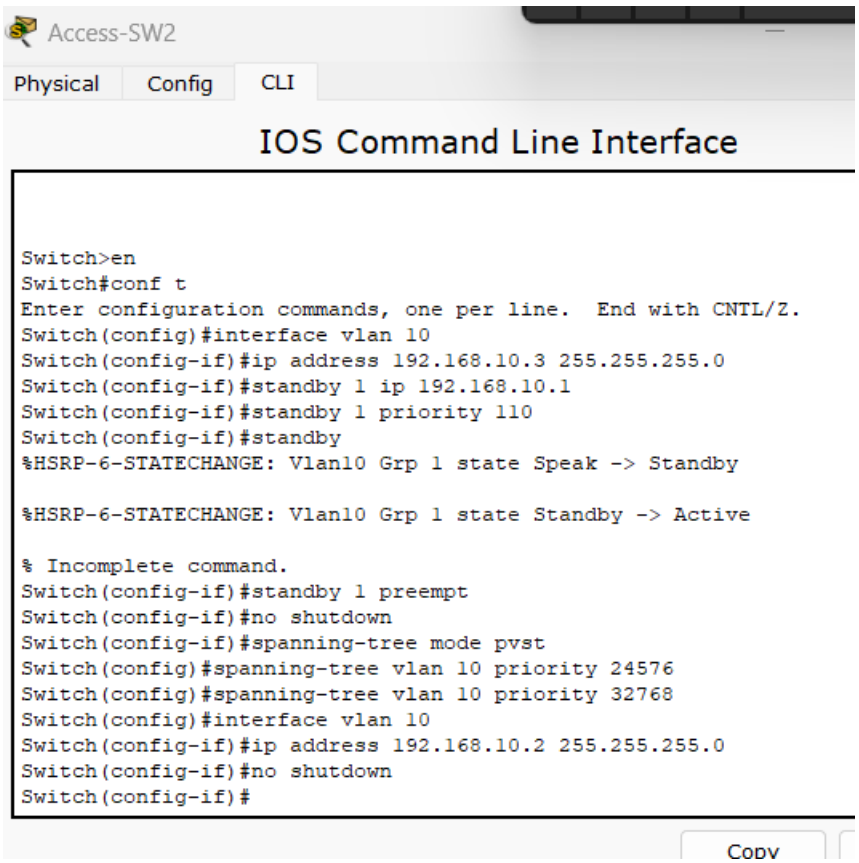
Access-SW2

Physical | Config | CLI

IOS Command Line Interface

```
Switch>en
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#access-list 100 deny ip 192.168.20.0 0.0.0.255
192.168.10.0 0.0.0.255
Switch(config)#access-list 100 permit ip any any
Switch(config)#interface vlan 20
Switch(config-if)#ip access-group 100 in
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
```

Copy | Paste

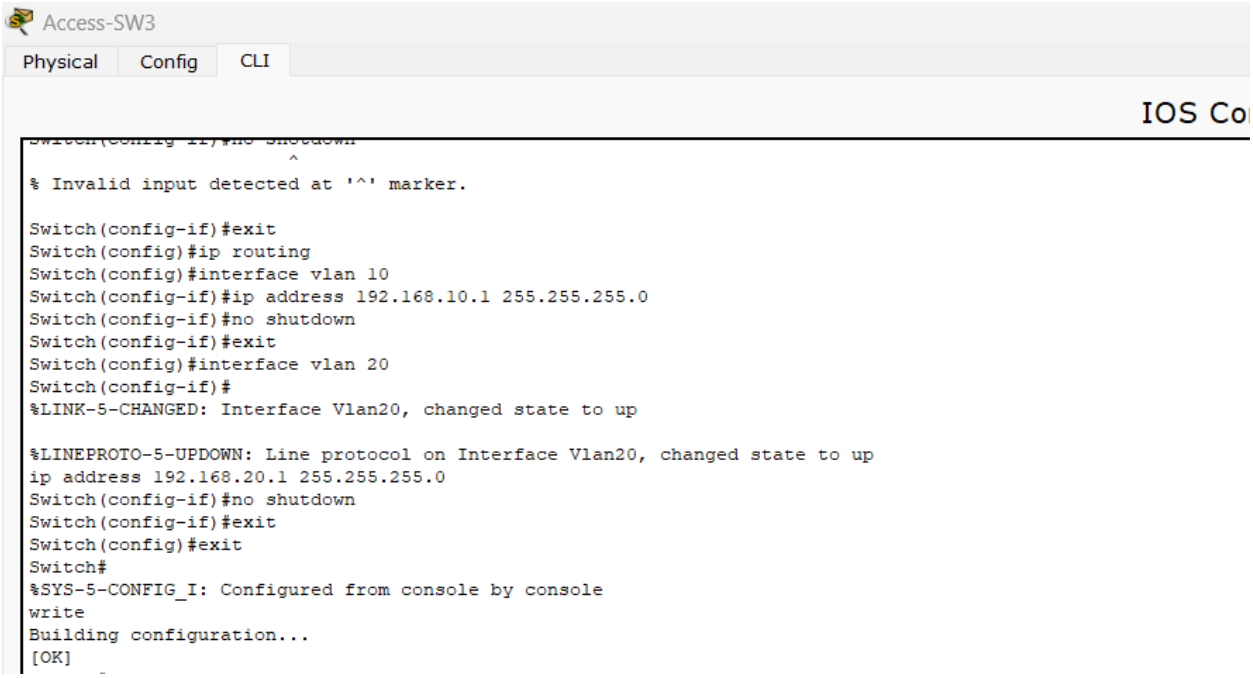

Access-SW2
Physical
Config
CLI
IOS Command Line Interface
Switch>en
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface vlan 10
Switch(config-if)#ip address 192.168.10.3 255.255.255.0
Switch(config-if)#standby 1 ip 192.168.10.1
Switch(config-if)#standby 1 priority 110
Switch(config-if)#standby
%HSRP-6-STATECHANGE: Vlan10 Grp 1 state Speak -> Standby
%HSRP-6-STATECHANGE: Vlan10 Grp 1 state Standby -> Active
% Incomplete command.
Switch(config-if)#standby 1 preempt
Switch(config-if)#no shutdown
Switch(config-if)#spanning-tree mode pvst
Switch(config)#spanning-tree vlan 10 priority 24576
Switch(config)#spanning-tree vlan 10 priority 32768
Switch(config)#interface vlan 10
Switch(config-if)#ip address 192.168.10.2 255.255.255.0
Switch(config-if)#no shutdown
Switch(config-if)#
Copy

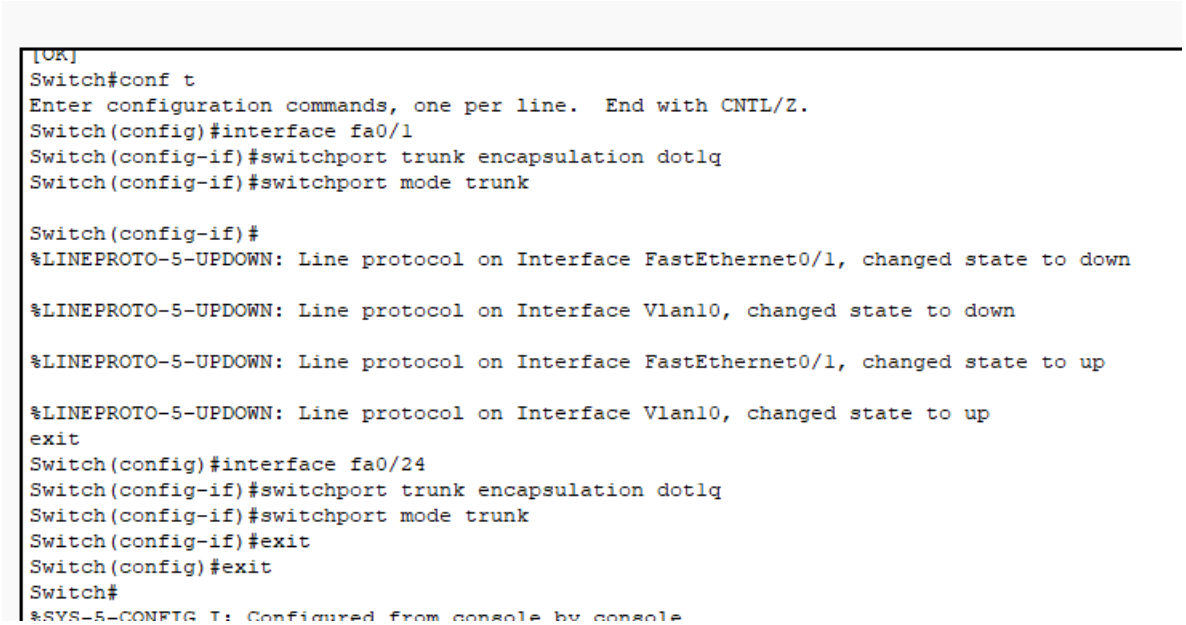
Access-SW2

Physical | Config | CLI

```
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan20, changed state to up

%HSRP-6-STATECHANGE: Vlan10 Grp 1 state Speak -> Standby

%HSRP-6-STATECHANGE: Vlan10 Grp 1 state Standby -> Active

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up

Switch>show  vlan brief

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    Fa0/4, Fa0/5, Fa0/6, Fa0/7
                                                 Fa0/8, Fa0/9, Fa0/10, Fa0/11
                                                 Fa0/12, Fa0/13, Fa0/14, Fa0/15
                                                 Fa0/16, Fa0/17, Fa0/18, Fa0/19
                                                 Fa0/20, Fa0/21, Fa0/22, Fa0/23
                                                 Fa0/24, Gig0/1, Gig0/2
10   Management                        active    Fa0/2
20   Guest                             active    Fa0/3
1002 fddi-default                      active
1003 token-ring-default                active
1004 fddinet-default                   active
1005 trnet-default                     active
Switch>show interfaces trunk
Port        Mode         Encapsulation  Status        Native vlan
Fa0/1       auto         n-802.1q       trunking      1

Port        Vlans allowed on trunk
Fa0/1       1-1005

Port        Vlans allowed and active in management domain
Fa0/1       1,10,20

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/1       1,10,20
Switch>show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

C    192.168.10.0/24 is directly connected, Vlan10
C    192.168.20.0/24 is directly connected, Vlan20
Switch>
```

Access Switch 3


Access-SW3
Physical
Config
CLI
IOS Co
^
% Invalid input detected at '^' marker.
Switch(config-if)#exit
Switch(config)#ip routing
Switch(config)#interface vlan 10
Switch(config-if)#ip address 192.168.10.1 255.255.255.0
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#interface vlan 20
Switch(config-if)#
%LINK-5-CHANGED: Interface Vlan20, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan20, changed state to up
ip address 192.168.20.1 255.255.255.0
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
write
Building configuration...
[OK]


[OK]
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface fa0/1
Switch(config-if)#switchport trunk encapsulation dot1q
Switch(config-if)#switchport mode trunk
Switch(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan10, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan10, changed state to up
exit
Switch(config)#interface fa0/24
Switch(config-if)#switchport trunk encapsulation dot1q
Switch(config-if)#switchport mode trunk
Switch(config-if)#exit
Switch(config)#exit
Switch#

Access-SW3

Physical | Config | CLI

IOS Command Line Interface

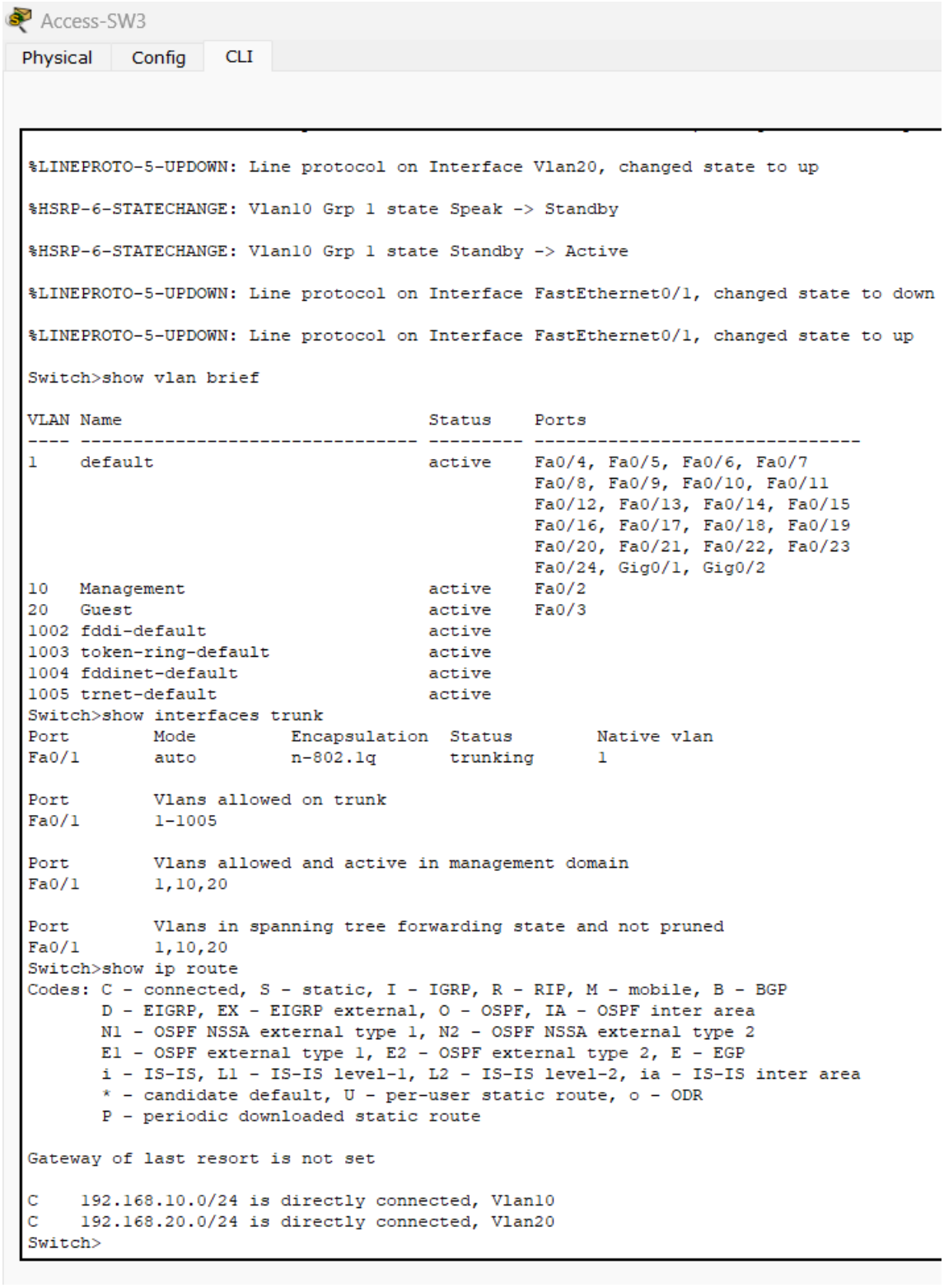
```
Switch>en
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#access-list 100 deny ip 192.168.20.0 0.0.0.255
192.168.10.0 0.0.0.255
Switch(config)#access-list 100 permit ip any any
Switch(config)#interface vlan 20
Switch(config-if)#ip access-group 100 in
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
```

Copy | P

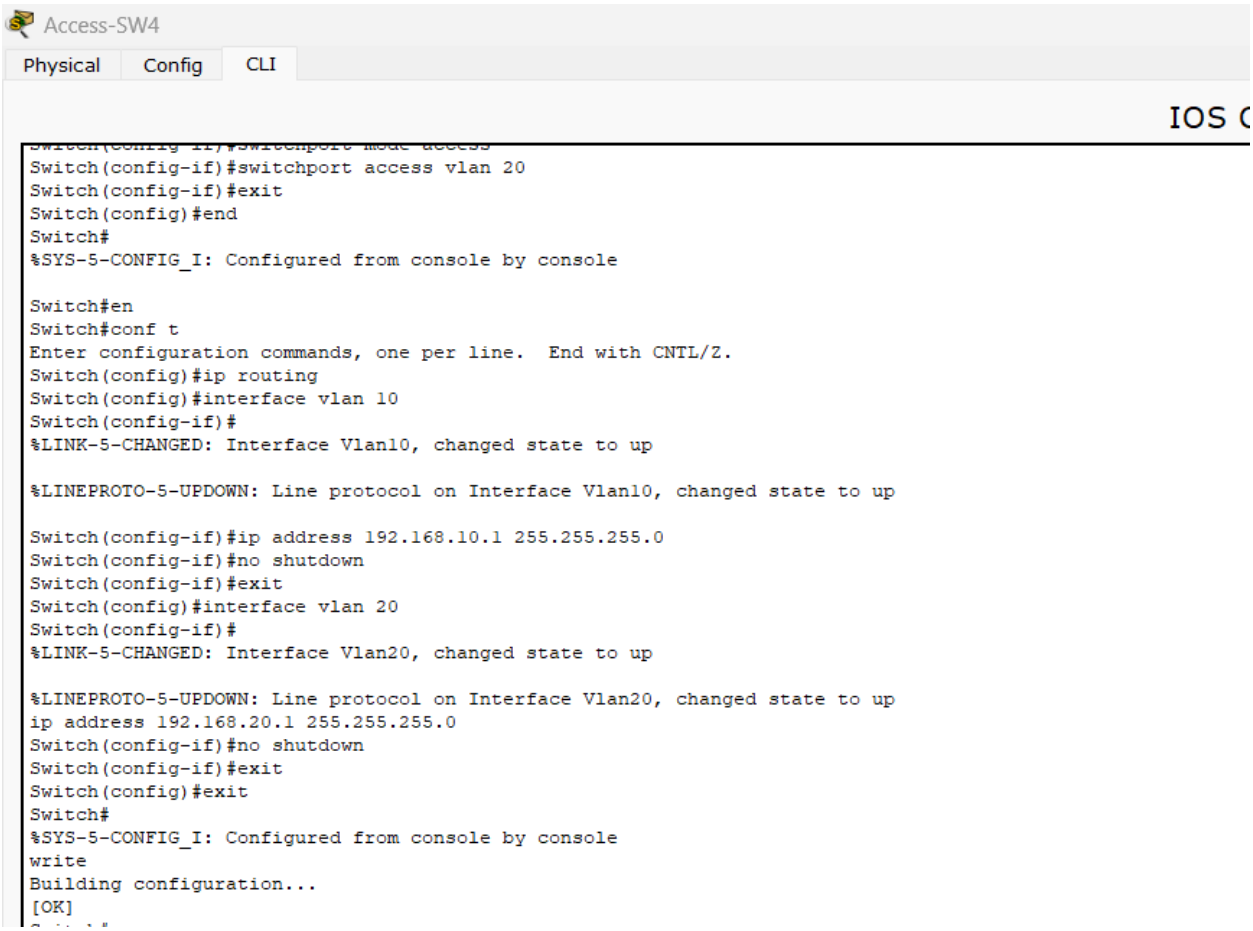
Access-SW3

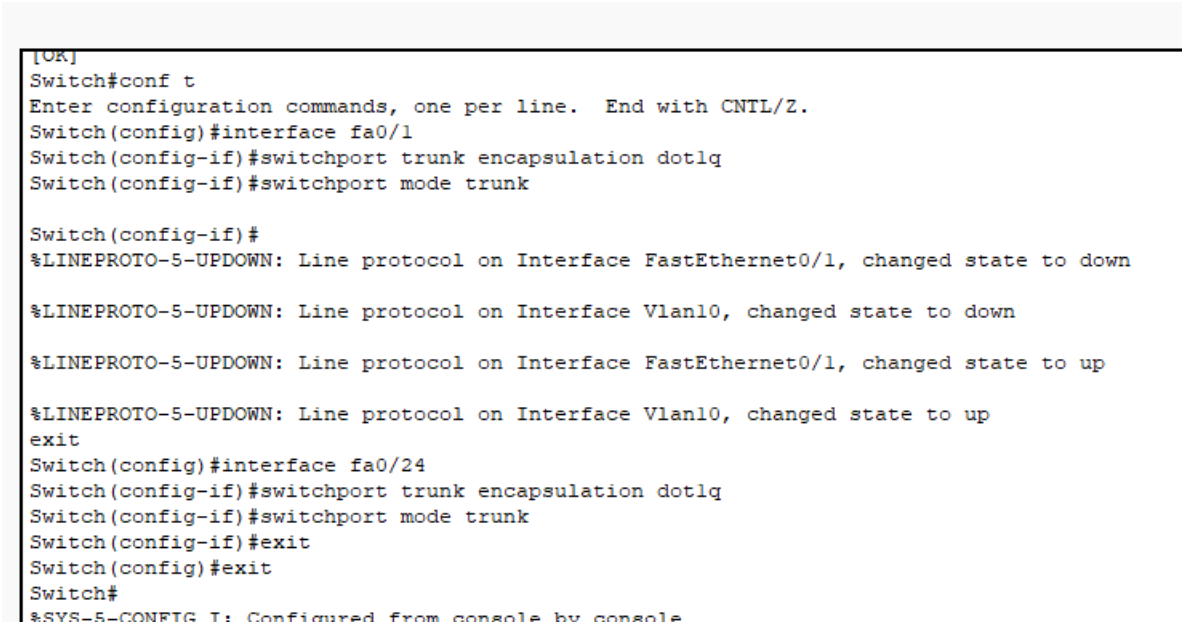
Physical | Config | CLI

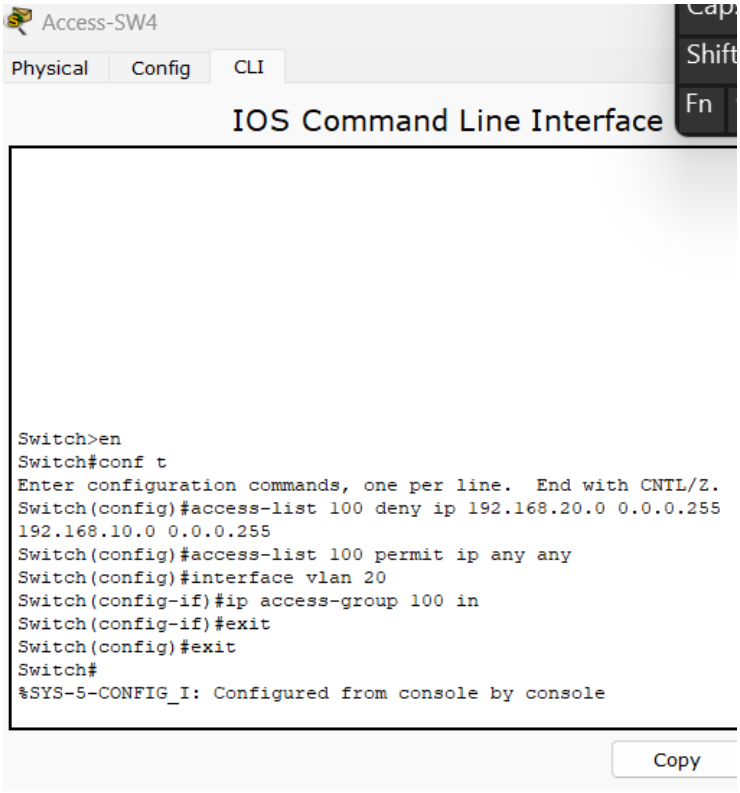
```
Switch>en
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#interface vlan 10
Switch(config-if)#ip 192.168.10.4 255.255.255.0
                   ^
% Invalid input detected at '^' marker.

Switch(config-if)#ip address 192.168.10.4 255.255.255.0
Switch(config-if)#standby 1 ip 192.168.10.1
Switch(config-if)#standby 1 priority 110
Switch(config-if)#
%HSRP-6-STATECHANGE: Vlan10 Grp 1 state Speak -> Standby

%HSRP-6-STATECHANGE: Vlan10 Grp 1 state Standby -> Active

Switch(config-if)#standby 1 preempt
Switch(config-if)#no shutdown
Switch(config-if)#spanning-tree mode pvst
Switch(config)#spanning-tree vlan 10 priority 24576
Switch(config)#spanning-tree vlan 10 priority 32768
Switch(config)#interface vlan 10
Switch(config-if)#ip address 192.168.10.4 255.255.255.0
Switch(config-if)#no shutdown
Switch(config-if)#
Switch(config-if)#
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console

Switch#
```

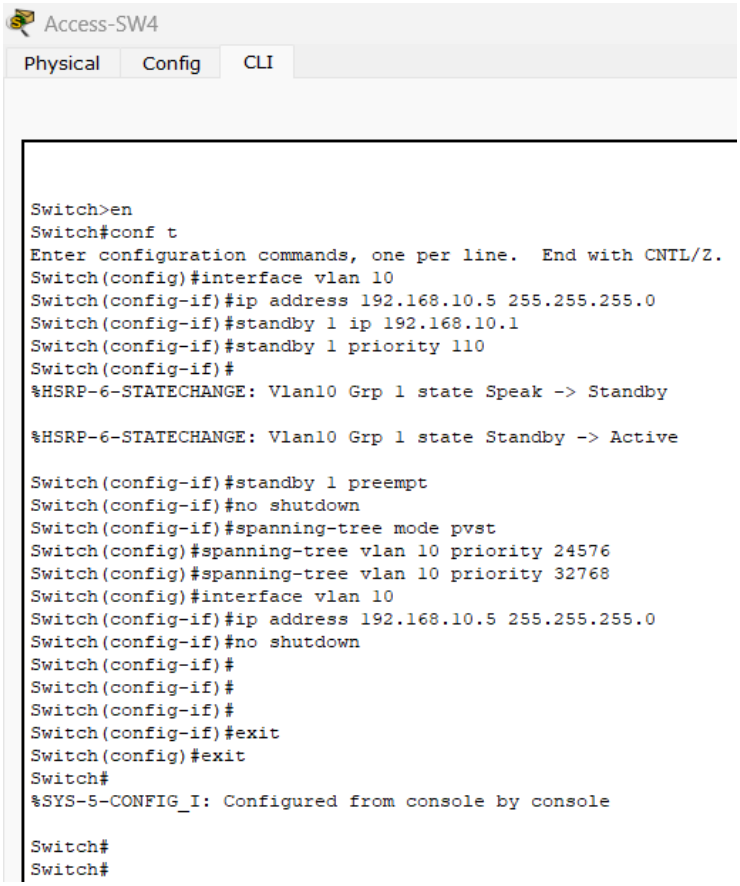

Access-SW3
Physical
Config
CLI
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan20, changed state to up
%HSRP-6-STATECHANGE: Vlan10 Grp 1 state Speak -> Standby
%HSRP-6-STATECHANGE: Vlan10 Grp 1 state Standby -> Active
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up
Switch>show vlan brief
VLAN Name Status Ports
1 default active Fa0/4, Fa0/5, Fa0/6, Fa0/7
Fa0/8, Fa0/9, Fa0/10, Fa0/11
Fa0/12, Fa0/13, Fa0/14, Fa0/15
Fa0/16, Fa0/17, Fa0/18, Fa0/19
Fa0/20, Fa0/21, Fa0/22, Fa0/23
Fa0/24, Gig0/1, Gig0/2
10 Management active Fa0/2
20 Guest active Fa0/3
1002 fddi-default active
1003 token-ring-default active
1004 fddinet-default active
1005 trnet-default active
Switch>show interfaces trunk
Port Mode Encapsulation Status Native vlan
Fa0/1 auto n-802.1q trunking 1
Port Vlans allowed on trunk
Fa0/1 1-1005
Port Vlans allowed and active in management domain
Fa0/1 1,10,20
Port Vlans in spanning tree forwarding state and not pruned
Fa0/1 1,10,20
Switch>show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
* - candidate default, U - per-user static route, o - ODR
P - periodic downloaded static route
Gateway of last resort is not set
C 192.168.10.0/24 is directly connected, Vlan10
C 192.168.20.0/24 is directly connected, Vlan20
Switch>

Access Switch 4


Access-SW4
Physical
Config
CLI
IOS C
Switch(config-if)#switchport access vlan 20
Switch(config-if)#exit
Switch(config)#end
Switch#
%SYS-5-CONFIG_I: Configured from console by console
Switch#en
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#ip routing
Switch(config)#interface vlan 10
Switch(config-if)#
%LINK-5-CHANGED: Interface Vlan10, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan10, changed state to up
Switch(config-if)#ip address 192.168.10.1 255.255.255.0
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#interface vlan 20
Switch(config-if)#
%LINK-5-CHANGED: Interface Vlan20, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan20, changed state to up
ip address 192.168.20.1 255.255.255.0
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
write
Building configuration...
[OK]


[OK]
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface fa0/1
Switch(config-if)#switchport trunk encapsulation dot1q
Switch(config-if)#switchport mode trunk
Switch(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan10, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan10, changed state to up
exit
Switch(config)#interface fa0/24
Switch(config-if)#switchport trunk encapsulation dot1q
Switch(config-if)#switchport mode trunk
Switch(config-if)#exit
Switch(config)#exit
Switch#


Access-SW4
Physical
Config
CLI
IOS Command Line Interface
Switch>en
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#access-list 100 deny ip 192.168.20.0 0.0.0.255
192.168.10.0 0.0.0.255
Switch(config)#access-list 100 permit ip any any
Switch(config)#interface vlan 20
Switch(config-if)#ip access-group 100 in
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
Copy

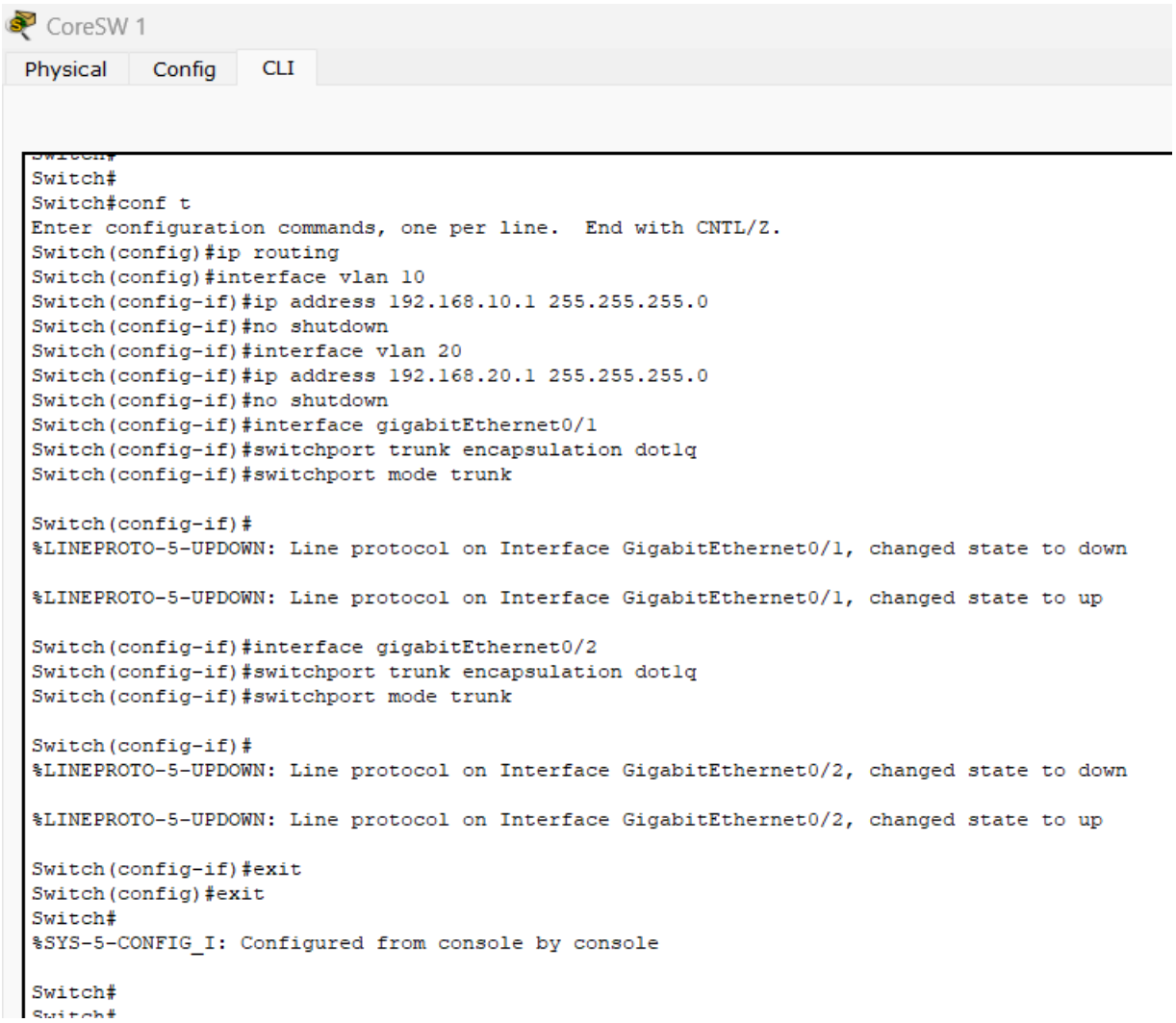

Access-SW4
Physical
Config
CLI
Switch>en
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface vlan 10
Switch(config-if)#ip address 192.168.10.5 255.255.255.0
Switch(config-if)#standby 1 ip 192.168.10.1
Switch(config-if)#standby 1 priority 110
Switch(config-if)#
%HSRP-6-STATECHANGE: Vlan10 Grp 1 state Speak -> Standby
%HSRP-6-STATECHANGE: Vlan10 Grp 1 state Standby -> Active
Switch(config-if)#standby 1 preempt
Switch(config-if)#no shutdown
Switch(config-if)#spanning-tree mode pvst
Switch(config)#spanning-tree vlan 10 priority 24576
Switch(config)#spanning-tree vlan 10 priority 32768
Switch(config)#interface vlan 10
Switch(config-if)#ip address 192.168.10.5 255.255.255.0
Switch(config-if)#no shutdown
Switch(config-if)#
Switch(config-if)#
Switch(config-if)#
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
Switch#
Switch#

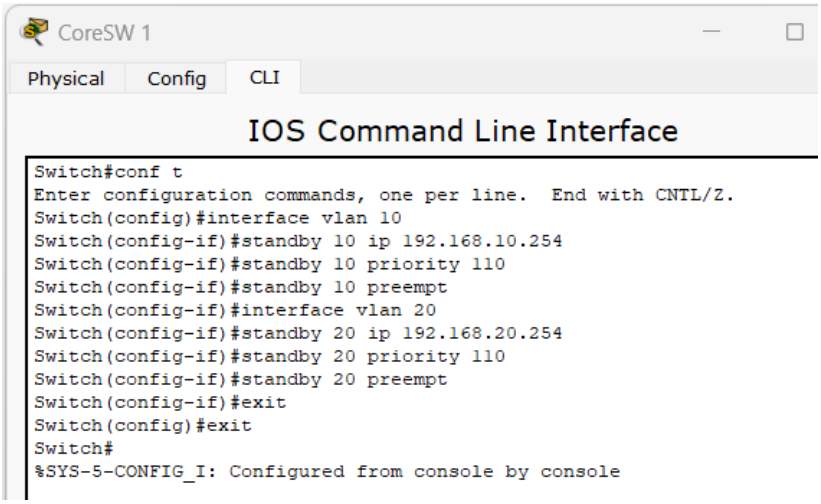
Access-SW4

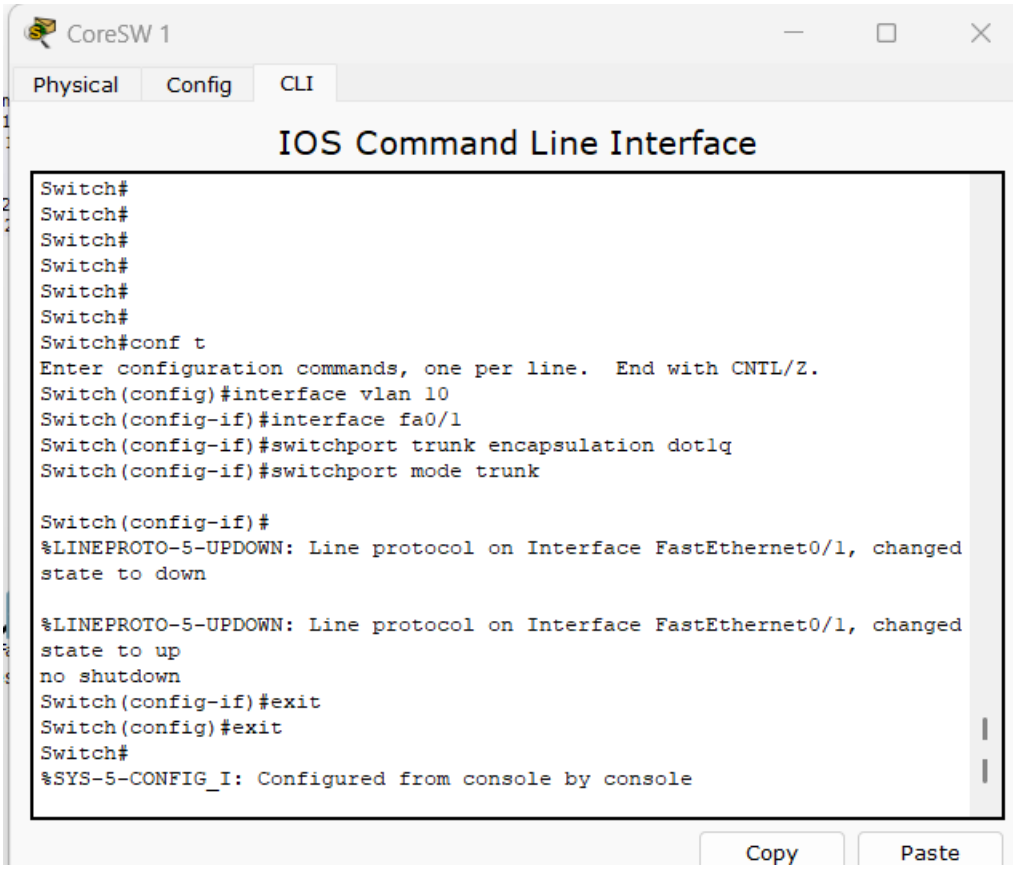
Physical | Config | CLI

```
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan20, changed state to up

%HSRP-6-STATECHANGE: Vlan10 Grp 1 state Speak -> Standby

%HSRP-6-STATECHANGE: Vlan10 Grp 1 state Standby -> Active

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to dowr

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up

Switch>show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/3, Fa0/4, Fa0/5, Fa0/6
                                                Fa0/7, Fa0/8, Fa0/9, Fa0/10
                                                Fa0/11, Fa0/12, Fa0/13, Fa0/14
                                                Fa0/15, Fa0/16, Fa0/17, Fa0/18
                                                Fa0/19, Fa0/20, Fa0/21, Fa0/22
                                                Fa0/23, Fa0/24, Gig0/2
10   Management                       active    Fa0/1
20   Guest                            active    Fa0/2
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active
Switch>show interfaces trunk
Port        Mode         Encapsulation  Status        Native vlan
Gig0/1      auto         n-802.1q       trunking      1

Port        Vlans allowed on trunk
Gig0/1      1-1005

Port        Vlans allowed and active in management domain
Gig0/1      1,10,20

Port        Vlans in spanning tree forwarding state and not pruned
Gig0/1      1,10,20
Switch>show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

C    192.168.10.0/24 is directly connected, Vlan10
C    192.168.20.0/24 is directly connected, Vlan20
Switch>
```

Core Layer (Top layer)



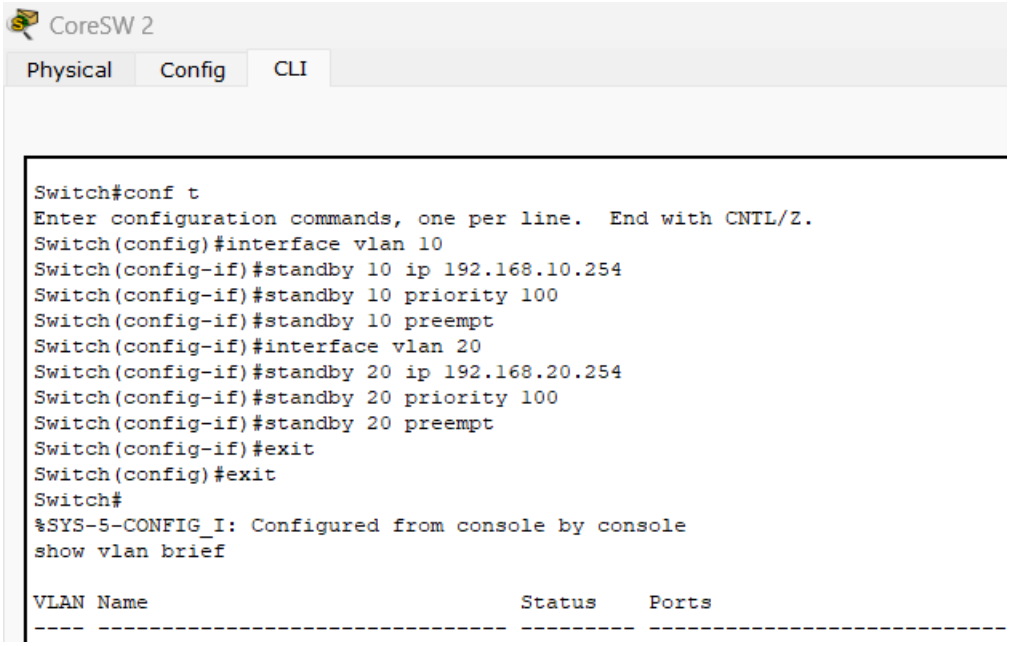


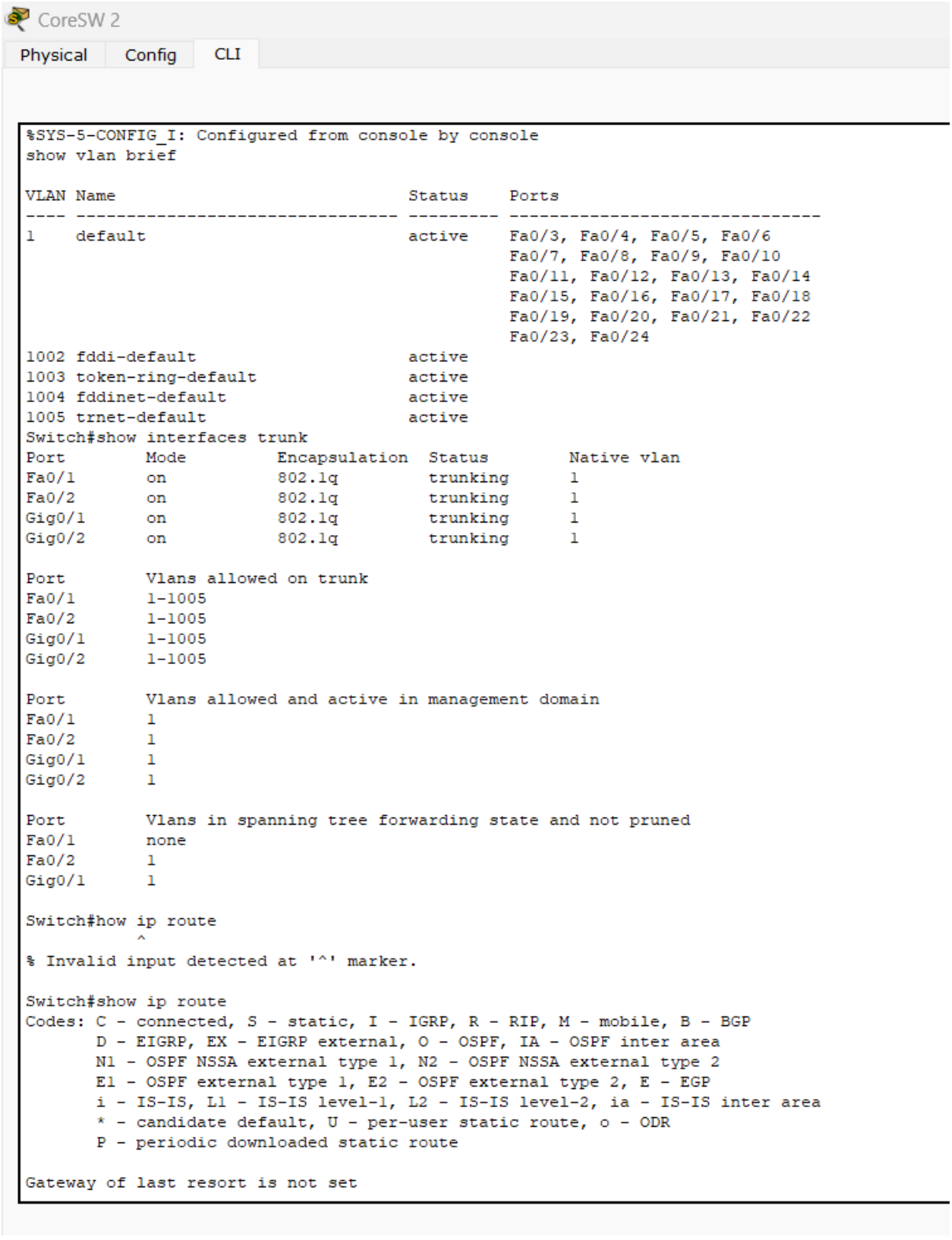

CoreSW 1
Physical
Config
CLI
IOS Command Line Interface
Switch#
Switch#
Switch#
Switch#
Switch#
Switch#
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface vlan 10
Switch(config-if)#interface fa0/1
Switch(config-if)#switchport trunk encapsulation dot1q
Switch(config-if)#switchport mode trunk
Switch(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up
no shutdown
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
Copy
Paste

CoreSW 2

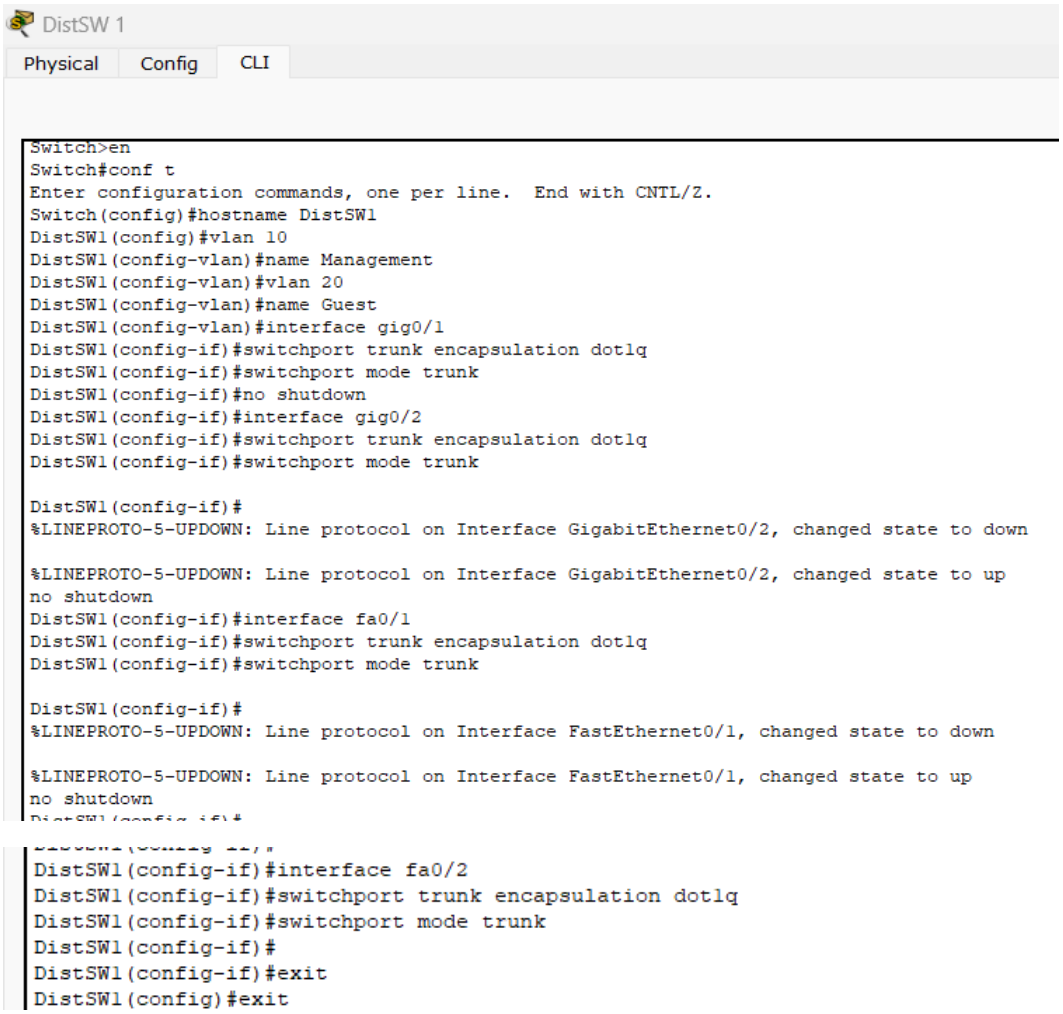
Physical | Config | CLI

```
Switch>en
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#ip routing
Switch(config)#interface vlan 10
Switch(config-if)#ip address 192.168.10.2 255.255.255.0
Switch(config-if)#no shutdown
Switch(config-if)#interface vlan 20
Switch(config-if)#ip address 192.168.20.2 255.255.255.0
Switch(config-if)#no shutdown
Switch(config-if)#
Switch(config-if)#interface gigabitEthernet0/1
Switch(config-if)#switchport trunk encapsulation dot1q
Switch(config-if)#switchport mode trunk
Switch(config-if)#interface gigabitEthernet0/2
Switch(config-if)#switchport trunk encapsulation dot1q
Switch(config-if)#switchport mode trunk

Switch(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to up

Switch(config-if)#interface fastEthernet0/1
Switch(config-if)#switchport trunk encapsulation dot1q
Switch(config-if)#switchport mode trunk

Switch(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up

Switch(config-if)#interface fastEthernet0/2
Switch(config-if)#switchport trunk encapsulation dot1q
Switch(config-if)#switchport mode trunk

Switch(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/2, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/2, changed state to up
exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console

Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#interface vlan 10
Switch(config-if)#standby 10 ip 192.168.10.254
Switch(config-if)#standby 10 priority 100
Switch(config-if)#standby 10 preempt
Switch(config-if)#interface vlan 20
Switch(config-if)#standby 20 ip 192.168.20.254
```


CoreSW 2
Physical
Config
CLI
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface vlan 10
Switch(config-if)#standby 10 ip 192.168.10.254
Switch(config-if)#standby 10 priority 100
Switch(config-if)#standby 10 preempt
Switch(config-if)#interface vlan 20
Switch(config-if)#standby 20 ip 192.168.20.254
Switch(config-if)#standby 20 priority 100
Switch(config-if)#standby 20 preempt
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
show vlan brief
VLAN Name Status Ports
---- --------------------------------- --------- -------------------------------

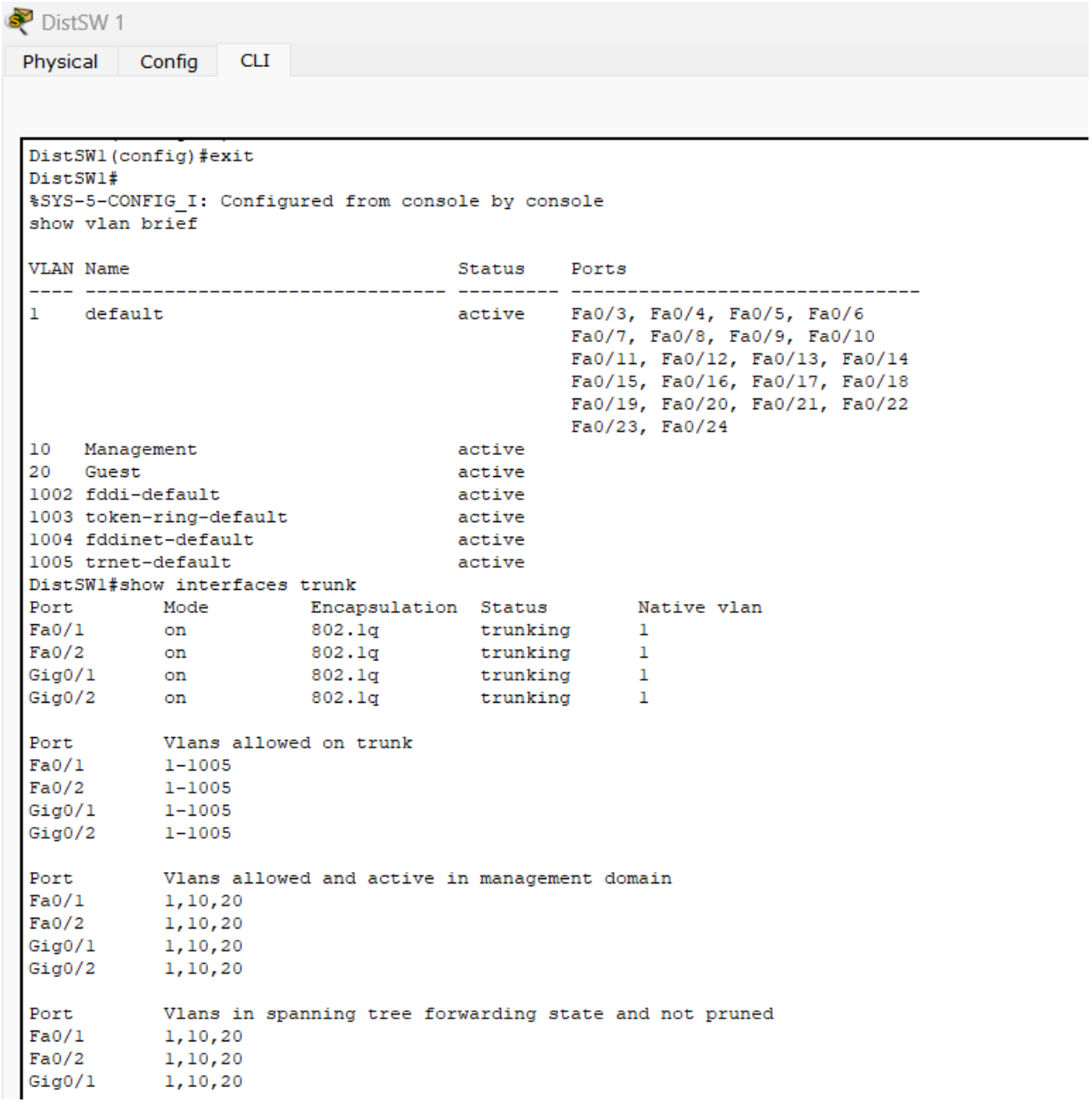

CoreSW 2
Physical
Config
CLI
%SYS-5-CONFIG_I: Configured from console by console
show vlan brief
VLAN Name Status Ports
---- -------------------------------- --------- -------------------------------
1 default active Fa0/3, Fa0/4, Fa0/5, Fa0/6
Fa0/7, Fa0/8, Fa0/9, Fa0/10
Fa0/11, Fa0/12, Fa0/13, Fa0/14
Fa0/15, Fa0/16, Fa0/17, Fa0/18
Fa0/19, Fa0/20, Fa0/21, Fa0/22
Fa0/23, Fa0/24
1002 fddi-default active
1003 token-ring-default active
1004 fddinet-default active
1005 trnet-default active
Switch#show interfaces trunk
Port Mode Encapsulation Status Native vlan
Fa0/1 on 802.1q trunking 1
Fa0/2 on 802.1q trunking 1
Gig0/1 on 802.1q trunking 1
Gig0/2 on 802.1q trunking 1
Port Vlans allowed on trunk
Fa0/1 1-1005
Fa0/2 1-1005
Gig0/1 1-1005
Gig0/2 1-1005
Port Vlans allowed and active in management domain
Fa0/1 1
Fa0/2 1
Gig0/1 1
Gig0/2 1
Port Vlans in spanning tree forwarding state and not pruned
Fa0/1 none
Fa0/2 1
Gig0/1 1
Switch#how ip route
^
% Invalid input detected at '^' marker.
Switch#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
* - candidate default, U - per-user static route, o - ODR
P - periodic downloaded static route
Gateway of last resort is not set

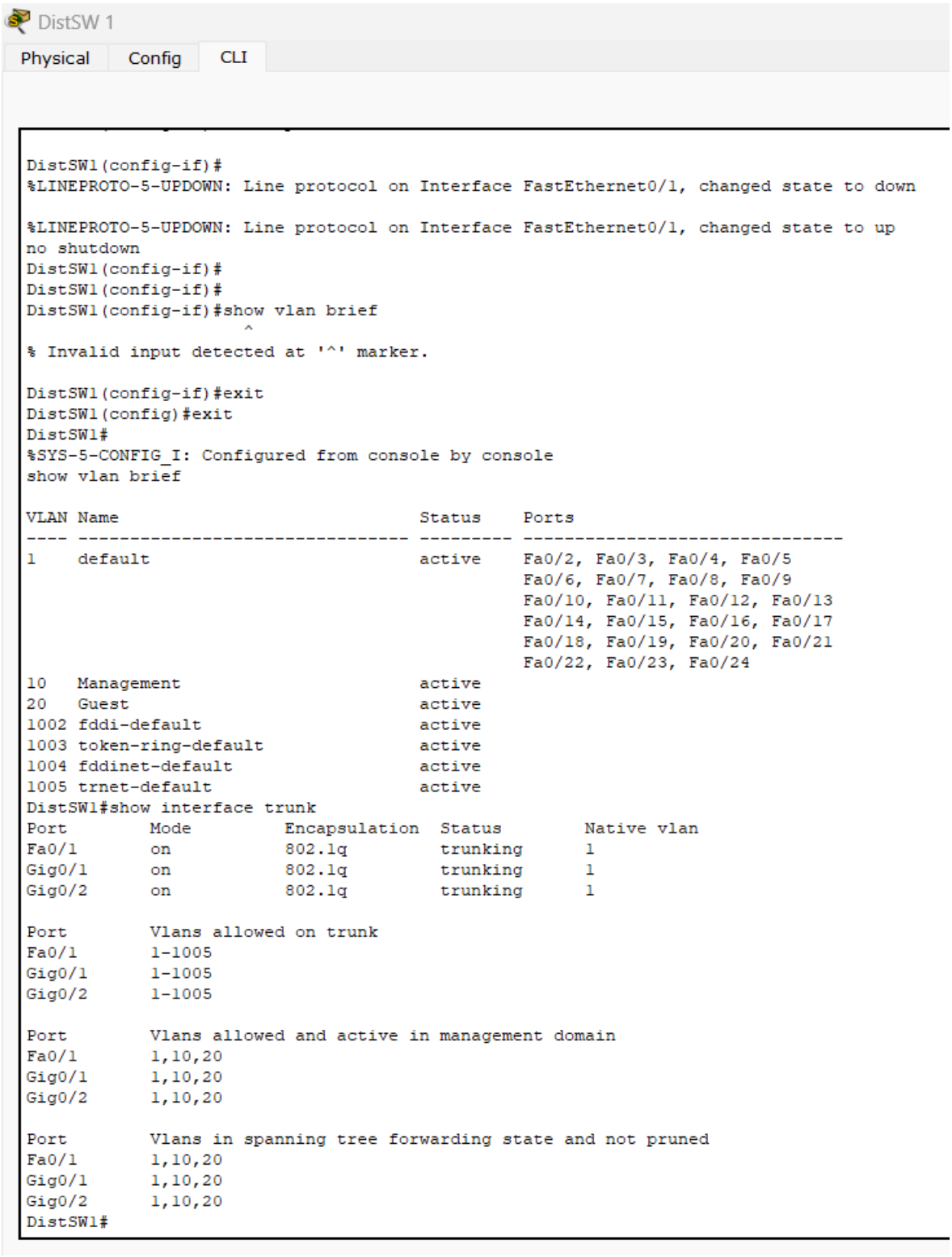
Distribution Layer (Middle Layer)

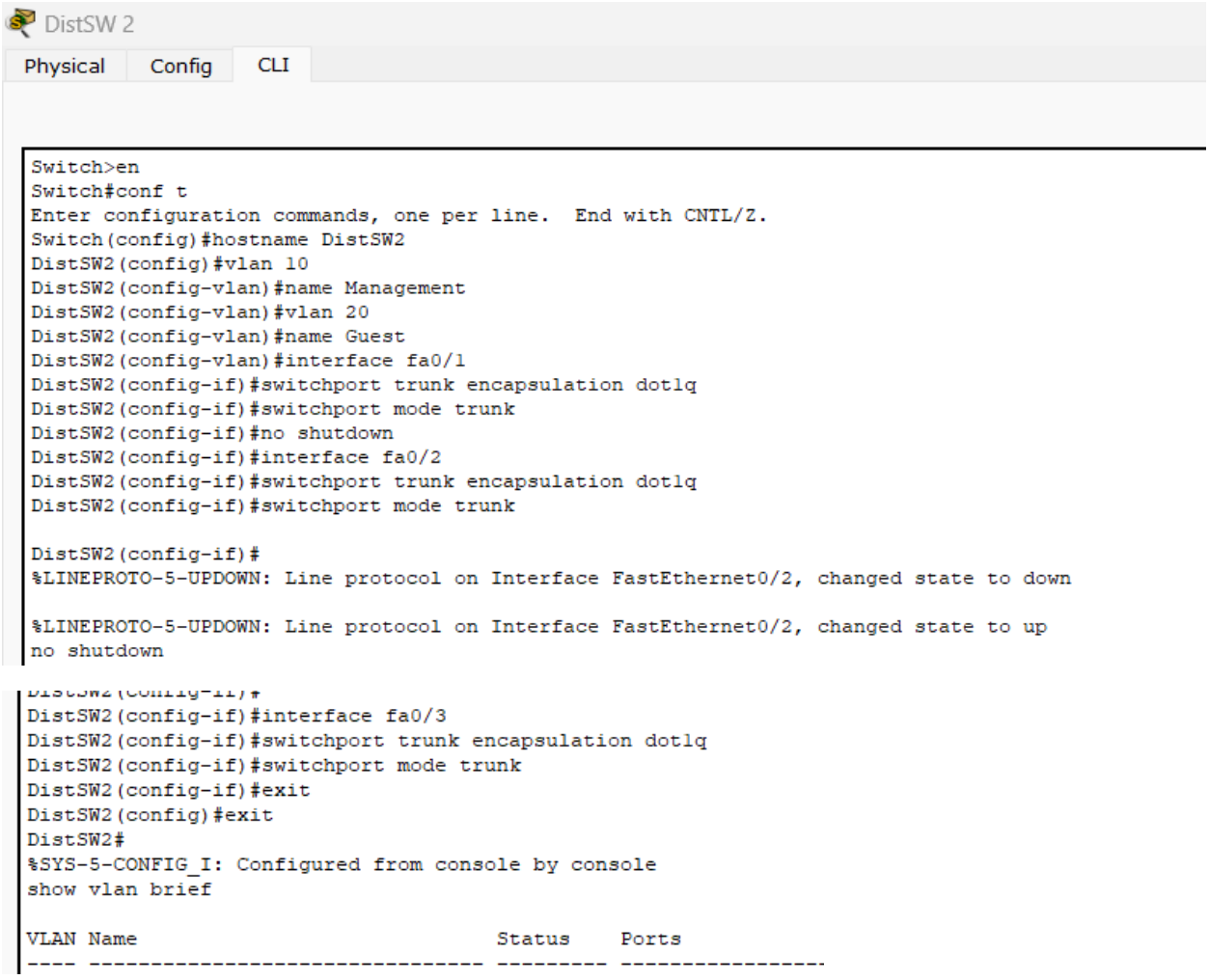


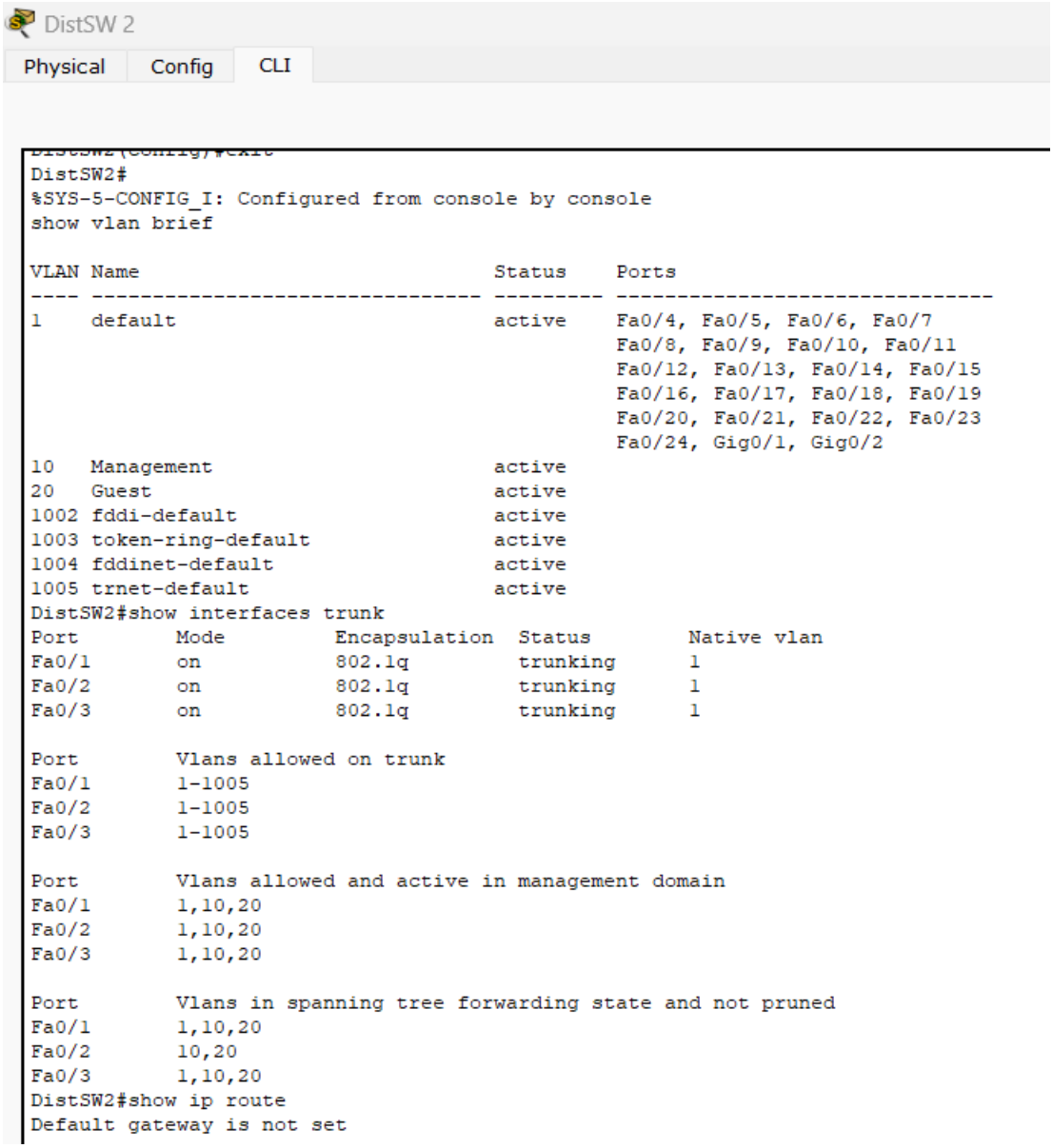

```
Switch>en
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#hostname DistSW1
DistSW1(config)#vlan 10
DistSW1(config-vlan)#name Management
DistSW1(config-vlan)#vlan 20
DistSW1(config-vlan)#name Guest
DistSW1(config-vlan)#interface gig0/1
DistSW1(config-if)#switchport trunk encapsulation dot1q
DistSW1(config-if)#switchport mode trunk
DistSW1(config-if)#no shutdown
DistSW1(config-if)#interface gig0/2
DistSW1(config-if)#switchport trunk encapsulation dot1q
DistSW1(config-if)#switchport mode trunk

DistSW1(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to up
no shutdown
DistSW1(config-if)#interface fa0/1
DistSW1(config-if)#switchport trunk encapsulation dot1q
DistSW1(config-if)#switchport mode trunk

DistSW1(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up
no shutdown
```

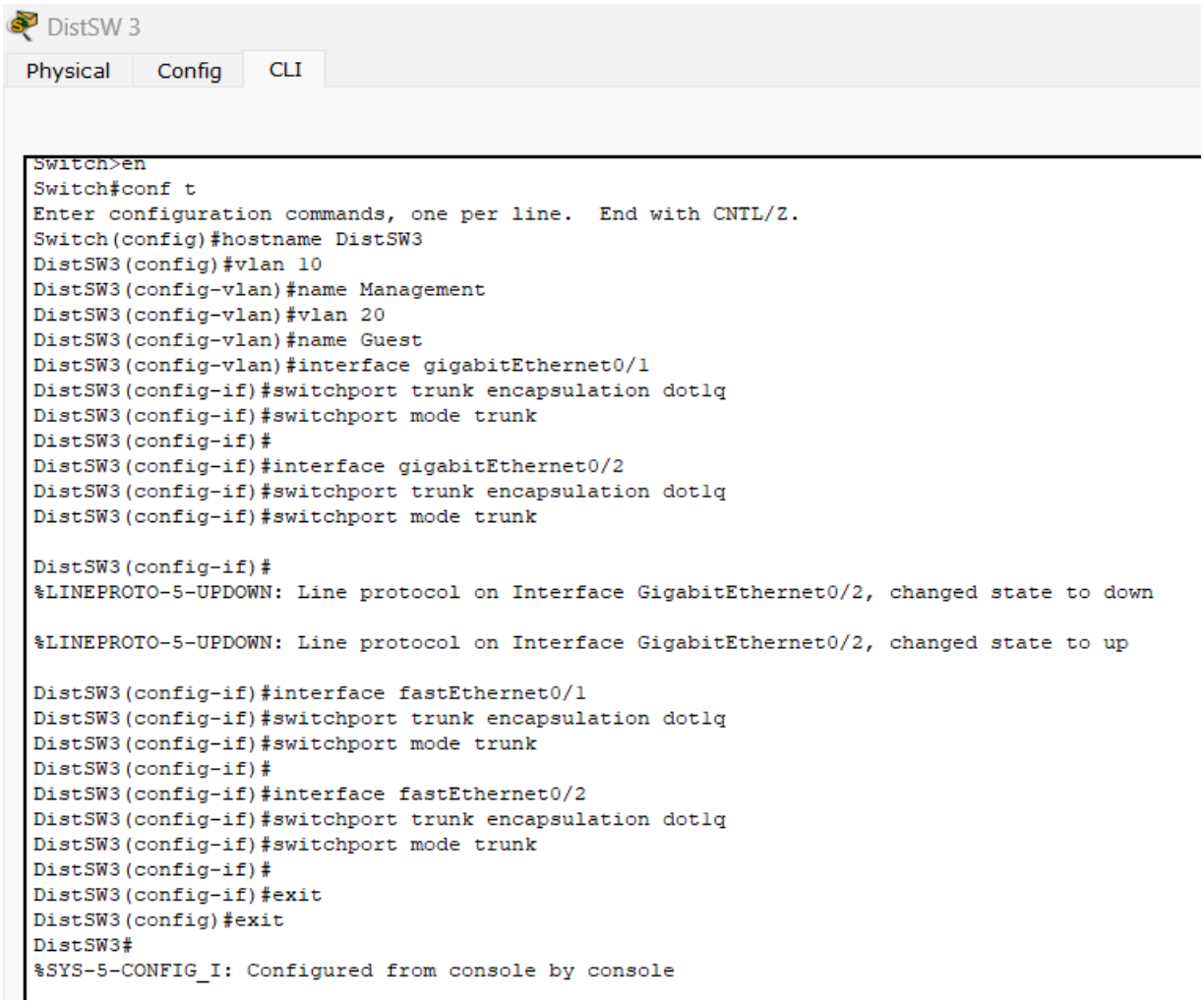
```
DistSW1(config-if)#interface fa0/2
DistSW1(config-if)#switchport trunk encapsulation dot1q
DistSW1(config-if)#switchport mode trunk
DistSW1(config-if)#
DistSW1(config-if)#exit
DistSW1(config)#exit
```


DistSW 1
Physical
Config
CLI
DistSW1(config)#exit
DistSW1#
%SYS-5-CONFIG_I: Configured from console by console
show vlan brief
VLAN Name Status Ports
---- -------------------------------- --------- -------------------------------
1 default active Fa0/3, Fa0/4, Fa0/5, Fa0/6
Fa0/7, Fa0/8, Fa0/9, Fa0/10
Fa0/11, Fa0/12, Fa0/13, Fa0/14
Fa0/15, Fa0/16, Fa0/17, Fa0/18
Fa0/19, Fa0/20, Fa0/21, Fa0/22
Fa0/23, Fa0/24
10 Management active
20 Guest active
1002 fddi-default active
1003 token-ring-default active
1004 fddinet-default active
1005 trnet-default active
DistSW1#show interfaces trunk
Port Mode Encapsulation Status Native vlan
Fa0/1 on 802.1q trunking 1
Fa0/2 on 802.1q trunking 1
Gig0/1 on 802.1q trunking 1
Gig0/2 on 802.1q trunking 1
Port Vlans allowed on trunk
Fa0/1 1-1005
Fa0/2 1-1005
Gig0/1 1-1005
Gig0/2 1-1005
Port Vlans allowed and active in management domain
Fa0/1 1,10,20
Fa0/2 1,10,20
Gig0/1 1,10,20
Gig0/2 1,10,20
Port Vlans in spanning tree forwarding state and not pruned
Fa0/1 1,10,20
Fa0/2 1,10,20
Gig0/1 1,10,20


DistSW 1
Physical
Config
CLI
DistSW1(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up
no shutdown
DistSW1(config-if)#
DistSW1(config-if)#
DistSW1(config-if)#show vlan brief
^
% Invalid input detected at '^' marker.
DistSW1(config-if)#exit
DistSW1(config)#exit
DistSW1#
%SYS-5-CONFIG_I: Configured from console by console
show vlan brief
VLAN Name Status Ports
---- -------------------------------- --------- -------------------------------
1 default active Fa0/2, Fa0/3, Fa0/4, Fa0/5
Fa0/6, Fa0/7, Fa0/8, Fa0/9
Fa0/10, Fa0/11, Fa0/12, Fa0/13
Fa0/14, Fa0/15, Fa0/16, Fa0/17
Fa0/18, Fa0/19, Fa0/20, Fa0/21
Fa0/22, Fa0/23, Fa0/24
10 Management active
20 Guest active
1002 fddi-default active
1003 token-ring-default active
1004 fddinet-default active
1005 trnet-default active
DistSW1#show interface trunk
Port Mode Encapsulation Status Native vlan
Fa0/1 on 802.1q trunking 1
Gig0/1 on 802.1q trunking 1
Gig0/2 on 802.1q trunking 1
Port Vlans allowed on trunk
Fa0/1 1-1005
Gig0/1 1-1005
Gig0/2 1-1005
Port Vlans allowed and active in management domain
Fa0/1 1,10,20
Gig0/1 1,10,20
Gig0/2 1,10,20
Port Vlans in spanning tree forwarding state and not pruned
Fa0/1 1,10,20
Gig0/1 1,10,20
Gig0/2 1,10,20
DistSW1#


DistSW 2
Physical
Config
CLI
Switch>en
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#hostname DistSW2
DistSW2(config)#vlan 10
DistSW2(config-vlan)#name Management
DistSW2(config-vlan)#vlan 20
DistSW2(config-vlan)#name Guest
DistSW2(config-vlan)#interface fa0/1
DistSW2(config-if)#switchport trunk encapsulation dot1q
DistSW2(config-if)#switchport mode trunk
DistSW2(config-if)#no shutdown
DistSW2(config-if)#interface fa0/2
DistSW2(config-if)#switchport trunk encapsulation dot1q
DistSW2(config-if)#switchport mode trunk
DistSW2(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/2, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/2, changed state to up
no shutdown
DistSW2(config-if)#interface fa0/3
DistSW2(config-if)#switchport trunk encapsulation dot1q
DistSW2(config-if)#switchport mode trunk
DistSW2(config-if)#exit
DistSW2(config)#exit
DistSW2#
%SYS-5-CONFIG_I: Configured from console by console
show vlan brief
VLAN Name Status Ports
---- --- --------- -----


DistSW 2
Physical
Config
CLI
DistSW2#
%SYS-5-CONFIG_I: Configured from console by console
show vlan brief
VLAN Name Status Ports
1 default active Fa0/4, Fa0/5, Fa0/6, Fa0/7
Fa0/8, Fa0/9, Fa0/10, Fa0/11
Fa0/12, Fa0/13, Fa0/14, Fa0/15
Fa0/16, Fa0/17, Fa0/18, Fa0/19
Fa0/20, Fa0/21, Fa0/22, Fa0/23
Fa0/24, Gig0/1, Gig0/2
10 Management active
20 Guest active
1002 fddi-default active
1003 token-ring-default active
1004 fddinet-default active
1005 trnet-default active
DistSW2#show interfaces trunk
Port Mode Encapsulation Status Native vlan
Fa0/1 on 802.1q trunking 1
Fa0/2 on 802.1q trunking 1
Fa0/3 on 802.1q trunking 1
Port Vlans allowed on trunk
Fa0/1 1-1005
Fa0/2 1-1005
Fa0/3 1-1005
Port Vlans allowed and active in management domain
Fa0/1 1,10,20
Fa0/2 1,10,20
Fa0/3 1,10,20
Port Vlans in spanning tree forwarding state and not pruned
Fa0/1 1,10,20
Fa0/2 10,20
Fa0/3 1,10,20
DistSW2#show ip route
Default gateway is not set


DistSW 3
Physical
Config
CLI
Switch>en
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#hostname DistSW3
DistSW3(config)#vlan 10
DistSW3(config-vlan)#name Management
DistSW3(config-vlan)#vlan 20
DistSW3(config-vlan)#name Guest
DistSW3(config-vlan)#interface gigabitEthernet0/1
DistSW3(config-if)#switchport trunk encapsulation dot1q
DistSW3(config-if)#switchport mode trunk
DistSW3(config-if)#
DistSW3(config-if)#interface gigabitEthernet0/2
DistSW3(config-if)#switchport trunk encapsulation dot1q
DistSW3(config-if)#switchport mode trunk
DistSW3(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/2, changed state to up
DistSW3(config-if)#interface fastEthernet0/1
DistSW3(config-if)#switchport trunk encapsulation dot1q
DistSW3(config-if)#switchport mode trunk
DistSW3(config-if)#
DistSW3(config-if)#interface fastEthernet0/2
DistSW3(config-if)#switchport trunk encapsulation dot1q
DistSW3(config-if)#switchport mode trunk
DistSW3(config-if)#
DistSW3(config-if)#exit
DistSW3(config)#exit
DistSW3#
%SYS-5-CONFIG_I: Configured from console by console

DistSW 3

Physical | Config | CLI

```
DistSW3(config-if)#switchport mode trunk
DistSW3(config-if)#
DistSW3(config-if)#interface fastEthernet0/2
DistSW3(config-if)#switchport trunk encapsulation dot1q
DistSW3(config-if)#switchport mode trunk
DistSW3(config-if)#
DistSW3(config-if)#exit
DistSW3(config)#exit
DistSW3#
%SYS-5-CONFIG_I: Configured from console by console

DistSW3#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/2, Fa0/3, Fa0/4, Fa0/5
                                                Fa0/6, Fa0/7, Fa0/8, Fa0/9
                                                Fa0/10, Fa0/11, Fa0/12, Fa0/13
                                                Fa0/14, Fa0/15, Fa0/16, Fa0/17
                                                Fa0/18, Fa0/19, Fa0/20, Fa0/21
                                                Fa0/22, Fa0/23, Fa0/24
10   Management                       active
20   Guest                            active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active
DistSW3#show interfaces trunk
Port        Mode         Encapsulation  Status        Native vlan
Fa0/1       on           802.1q         trunking      1
Gig0/1      on           802.1q         trunking      1
Gig0/2      on           802.1q         trunking      1

Port        Vlans allowed on trunk
Fa0/1       1-1005
Gig0/1      1-1005
Gig0/2      1-1005

Port        Vlans allowed and active in management domain
Fa0/1       1,10,20
Gig0/1      1,10,20
Gig0/2      1,10,20

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/1       10,20
Gig0/1      1,10,20
Gig0/2      1,10,20
DistSW3#show ip route
```

1. IP Addressing and VLAN Segmentation

To logically segment the network, each VLAN is assigned a unique IP subnet, allowing devices within a VLAN to communicate directly and inter-VLAN communication to be handled by a Layer 3 device.

IP addressing is essential for identifying and communicating with devices in a network. By assigning unique IP addresses to each device, the network can route data accurately and efficiently. It enables logical segmentation through subnetting, which helps organize the network into manageable sections. This structure not only improves performance and scalability but also simplifies configuration and troubleshooting. In hierarchical networks, distinct IP subnets for each layer (core, distribution, access) ensure clear traffic flow and better network design.

● VLAN Segmentation:

We created at least two VLANs:

VLAN 10 – Management/Engineering: 192.168.10.0/24

VLAN 20 – Guest/Other Users: 192.168.20.0/24

VLANs are configured on access switches, and inter-VLAN routing is enabled using sub-interfaces on a Layer 3 device to allow communication between VLANs.

VLAN segmentation improves network efficiency and security by logically grouping devices, regardless of their physical location. Each VLAN acts as a separate broadcast domain, which reduces broadcast traffic and enhances overall performance. VLANs help isolate sensitive systems or departments from others, allowing for better traffic control and network policy enforcement. This logical separation is especially useful in large networks, where management and guest traffic can be kept apart, minimizing the risk of unauthorized access or network congestion.

2. Security Policies and ACLs

Access Control Lists (ACLs) are used to control traffic between VLANs based on predefined policies, improving network security by allowing or denying specific types of traffic.

● ACL Configuration:

Block Guest VLAN from accessing the Management VLAN

Permit essential services (e.g., DNS, DHCP)

Deny all other unnecessary inter-VLAN traffic

Access Control Lists (ACLs) are used to enforce security policies by filtering traffic based on criteria such as IP addresses, protocols, or ports. ACLs control which devices or networks can communicate with each other, thus preventing unauthorized access and improving internal security. In a VLAN-enabled network, ACLs are vital for restricting inter-VLAN communication, ensuring that only necessary traffic is allowed. This helps protect critical network segments (e.g., the management VLAN) from less secure areas like guest or public networks.

3. Failover and Redundancy

To ensure high availability, a redundancy protocol (e.g., HSRP or VRRP) is implemented. This allows traffic to be automatically rerouted in case of a device or link failure.

Failover and redundancy are crucial for maintaining network availability and reliability. By using redundancy protocols such as HSRP or VRRP, the network can automatically switch to a backup device or link if the primary one fails. This prevents service interruptions and ensures continuous access to network resources. In enterprise or mission-critical environments, redundancy protects against hardware failures, cable cuts, or configuration errors, providing a robust and fault-tolerant infrastructure. It enhances user experience and minimizes the impact of unexpected outages.