Building an Enterprise Network
Part 2: Distribution Switches

Refer to the following YouTube Video: https://www.youtube.com/watch?v=PE-DsuJE58o
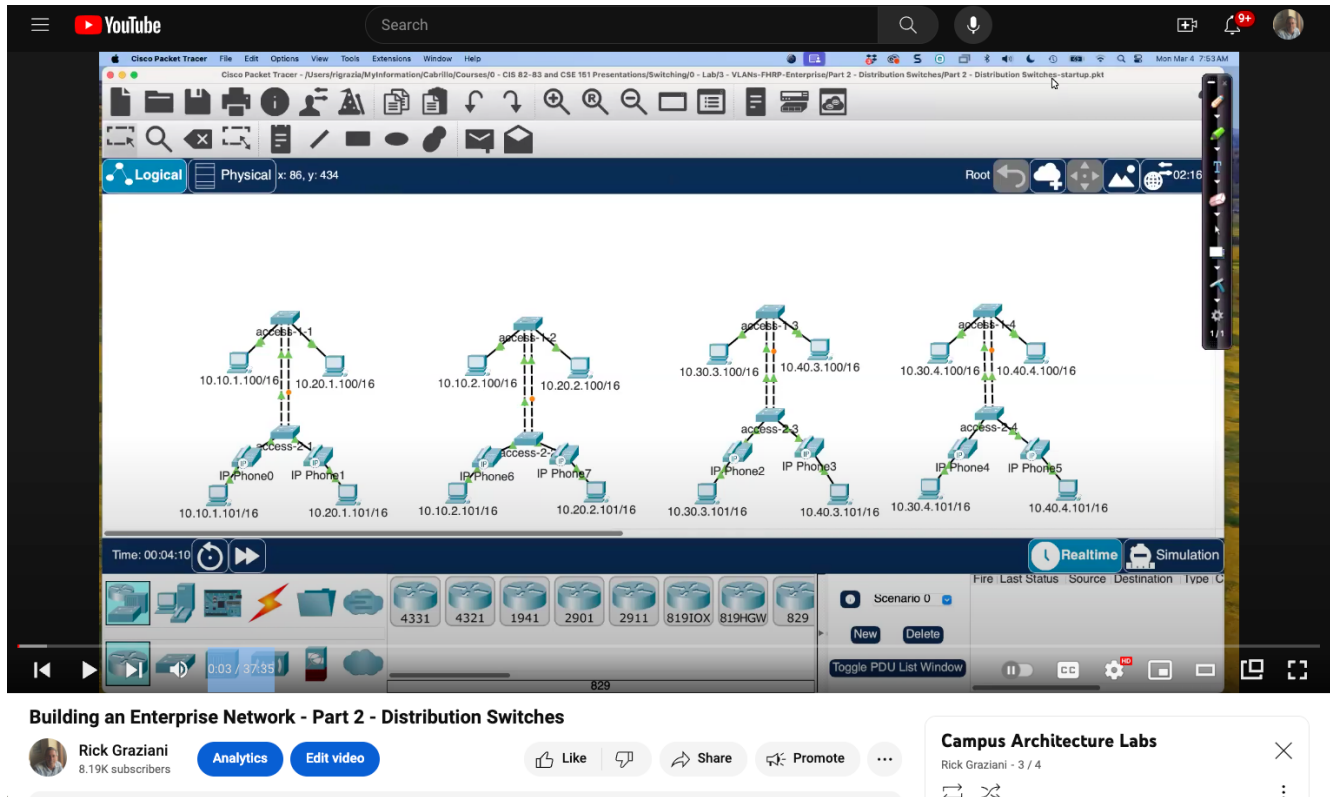
Topology from Previous Lab

Begin by using the topology you completed in the previous lab: Building an Enterprise Network - Part 1 – VLANS.

Adding Distribution, Layer 3 Switches

Adding the 3560 Switches

Add two 3650 switches, one switch centered switches in columns 1 and 2 and the other switch centered above column 3 and 4 switches:

- Add two 3650 switches as shown in topology
    - Hostnames: distribution-1 and distribution-2
- For both switches, add the Power Supply
    - Physical Tab > Drag and drop AC-Power-Supply to empty slot in lower right corner of switch

Making the Physical Connections

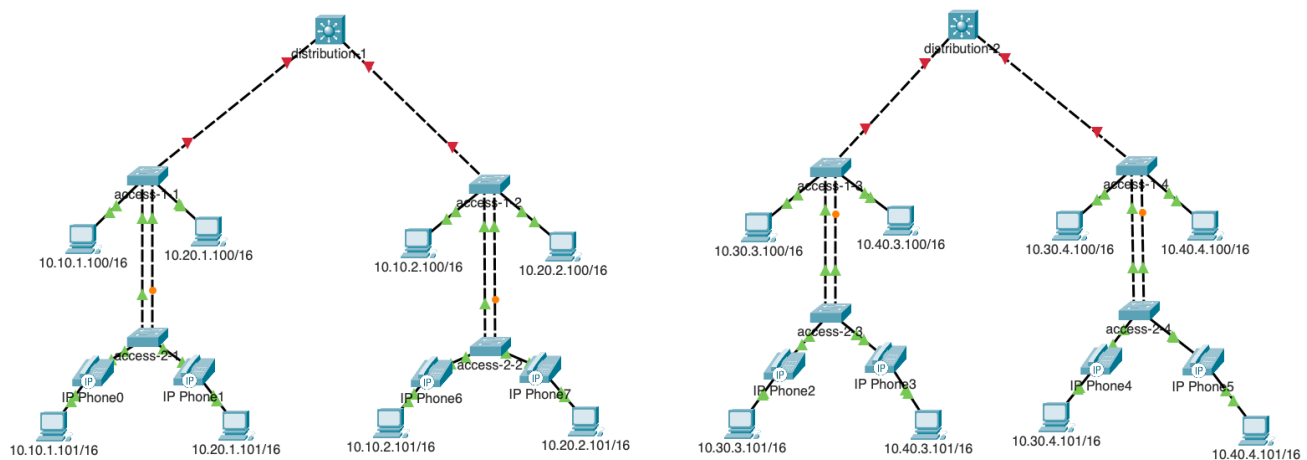Between the switch centered switches in columns 1 and 2, add the following cables:

- Ethernet cross-over cable: Access-1-1 G0/1 to Distribution-1 G1/0/1
- Ethernet cross-over cable: Access-1-2 G0/1 to Distribution-1 G1/0/2

Between the switch centered switches in columns 3 and 4, add the following cables:

- Ethernet cross-over cable: Access-1-3 G0/1 to Distribution-2 G1/0/1
- Ethernet cross-over cable: Access-1-3 G0/1 to Distribution-2 G1/0/2

Your Current Topology

Your current topology should look like this:

Configuring Basic IOS Commands

Distribution-1 Switch

On the switch centered switches in columns 1 and 2, configure the basic IOS commands.

```
Would you like to enter the initial configuration dialog? [yes/no]: no

Press RETURN to get started!

Switch> enable
```

```
Switch#
Switch# conf t
Switch(config)# hostname distribution-1
distribution-1(config)# no ip domain-lookup
distribution-1(config)# enable secret class

distribution-1(config)# line con 0
distribution-1(config-line)# logging synchronous
distribution-1(config-line)# exec-timeout 0 0
distribution-1(config-line)# exit

distribution-1(config)# line vty 0 4
distribution-1(config-line)# password cisco
distribution-1(config-line)# login
distribution-1(config-line)# transport input telnet
distribution-1(config-line)# exit
distribution-1(config)#
```

Distribution-2 Switch

On the switch centered switches in columns 1 and 2, configure the basic IOS commands.

```
Would you like to enter the initial configuration dialog? [yes/no]: no

Press RETURN to get started!

Switch> enable
Switch#
Switch# conf t
Switch(config)# hostname distribution-2
distribution-2(config)# no ip domain-lookup
distribution-2(config)# enable secret class

distribution-2(config)# line con 0
distribution-2(config-line)# logging synchronous
distribution-2(config-line)# exec-timeout 0 0
distribution-2(config-line)# exit

distribution-2(config)# line vty 0 4
distribution-2(config-line)# password cisco
distribution-2(config-line)# login
distribution-2(config-line)# transport input telnet
distribution-2(config-line)# exit
distribution-2(config)#
```

Packet Tracer Display Names for Switches

For both distribution switches, set the display name in Packet Tracer:
* **Global Settings > Display Name:** "Hostname"

Create VLANs

On both distribution switches, create the same VLANs as the access switches.

```
distribution-1(config)# vlan 10
distribution-1(config-vlan)# name admin
distribution-1(config-vlan)# exit
distribution-1(config)# vlan 20
distribution-1(config-vlan)# name HR
distribution-1(config-vlan)# exit
distribution-1(config)# vlan 30
distribution-1(config-vlan)# name Sales
distribution-1(config-vlan)# exit
distribution-1(config)# vlan 40
distribution-1(config-vlan)# name Engineering
distribution-1(config-vlan)# exit
distribution-1(config)# vlan 90
distribution-1(config-vlan)# name Voice
distribution-1(config-vlan)# vlan 100
distribution-1(config-vlan)# name Guest
distribution-1(config-vlan)# vlan 180
distribution-1(config-vlan)# name Management
distribution-1(config-vlan)# vlan 254
distribution-1(config-vlan)# name Native
distribution-1(config-vlan)# vlan 255
distribution-1(config-vlan)# name Parking-Lot
distribution-1(config-vlan)# exit
distribution-1(config)#
```

## Configure all Ports with Default Configuration

Configure the following default port configurations on both distribution switches.

```
distribution-1(config)# interface range g 1/0/1-24, g 1/1/1-4
distribution-1(config-if-range)# switchport mode access
distribution-1(config-if-range)# switchport access vlan 255
distribution-1(config-if-range)# shutdown
distribution-1(config-if-range)# exit
distribution-1(config)#
```

Configure Trunk Ports Between Distribution and Access Switches

Distribution Switches

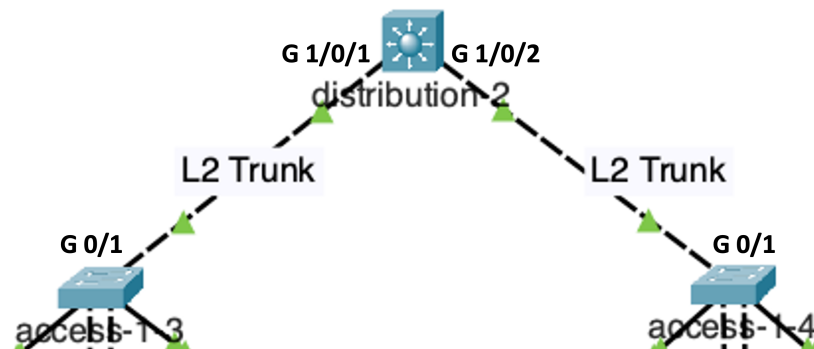Configure the following trunk links on <u>both</u> distribution switches.
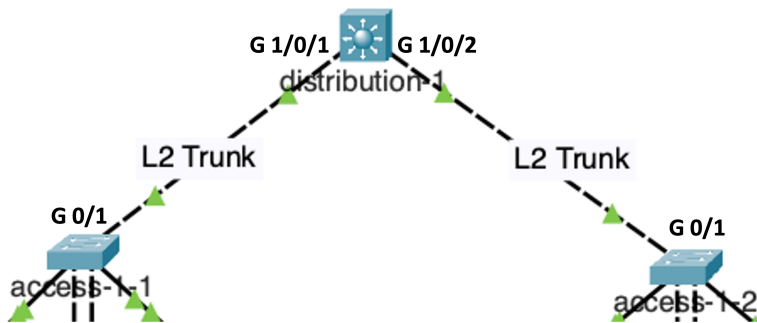

```
distribution-1(config)# interface range g 1/0/1-2
distribution-1(config-if-range)# no switchport access vlan 255
distribution-1(config-if-range)# switchport mode trunk
distribution-1(config-if-range)# switchport nonegotiate
distribution-1(config-if-range)# switchport trunk allowed vlan
1,10,20,30,40,90,100,180,254
distribution-1(config-if-range)# switchport trunk native vlan 254
distribution-1(config-if-range)# no shutdown

%LINK-5-CHANGED: Interface GigabitEthernet1/0/1, changed state to down

%LINK-5-CHANGED: Interface GigabitEthernet1/0/2, changed state to down
distribution-1(config-if-range)#
distribution-1(config-if-range)# exit
distribution-1(config)#
```



```
distribution-2(config)# interface range g 1/0/1-2
distribution-2(config-if-range)# no switchport access vlan 255
distribution-2(config-if-range)# switchport mode trunk
distribution-2(config-if-range)# switchport nonegotiate
distribution-2(config-if-range)# switchport trunk allowed vlan
1,10,20,30,40,90,100,180,254
distribution-2(config-if-range)# switchport trunk native vlan 254
distribution-2(config-if-range)# no shutdown

%LINK-5-CHANGED: Interface GigabitEthernet1/0/1, changed state to down
```

```
%LINK-5-CHANGED: Interface GigabitEthernet1/0/2, changed state to down
distribution-2(config-if-range)#
distribution-2(config-if-range)# exit
distribution-2(config)#
```

Access (Level-1) Switches

Configure the other end of the trunk links to the distribution switches, on access-1-1, access-1-2, access-1-3 and access-1-4 switches.
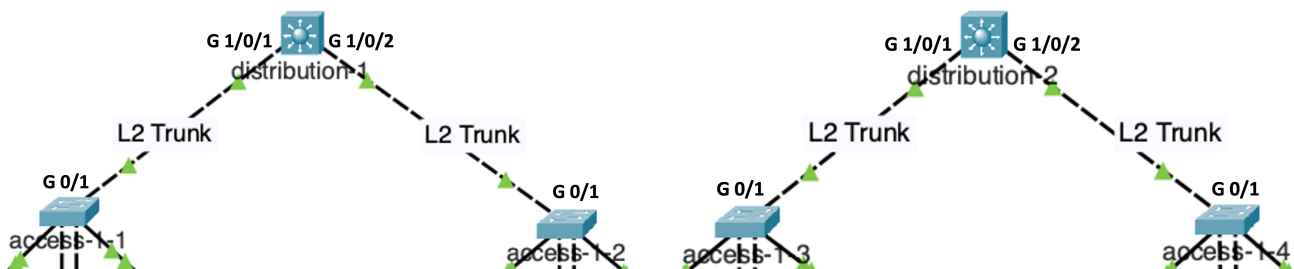
Repeat these commands on all four switches: access-1-1, access-1-2, access-1-3 and access-1-4

```
access-1-1(config)# interface g 0/1
access-1-1(config-if)# no switchport access vlan 255
access-1-1(config-if)# switchport mode trunk
access-1-1(config-if)# switchport nonegotiate
access-1-1(config-if)# switchport trunk allowed vlan 1,10,20,30,40,90,100,180,254
access-1-1(config-if)# switchport trunk native vlan 254
access-1-1(config-if)# no shutdown
access-1-1(config-if)# exit

%LINK-5-CHANGED: Interface GigabitEthernet0/1, changed state to up

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

access-1-1(config)#
```

Verify connectivity within VLAN

Now that there is a trunk link between column 1 and 2 switches, and column 3 and 4 switches, all devices in the same VLAN should now be able to communicate.
- 10.10.1.100 can ping 10.10.2.100
- 10.20.1.100 can ping 10.20.2.100
- 10.30.3.100 can ping 10.30.4.100
- 10.40.3.100 can ping 10.40.4.100

```
C:\> ping 10.10.2.100

Pinging 10.10.2.100 with 32 bytes of data:

Reply from 10.10.2.100: bytes=32 time<1ms TTL=128
Reply from 10.10.2.100: bytes=32 time=1ms TTL=128
Reply from 10.10.2.100: bytes=32 time<1ms TTL=128
Reply from 10.10.2.100: bytes=32 time<1ms TTL=128

Ping statistics for 10.10.2.100:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\> ping 10.10.2.101

Pinging 10.10.2.101 with 32 bytes of data:

Reply from 10.10.2.101: bytes=32 time<1ms TTL=128
Reply from 10.10.2.101: bytes=32 time<1ms TTL=128
Reply from 10.10.2.101: bytes=32 time<1ms TTL=128
Reply from 10.10.2.101: bytes=32 time<1ms TTL=128

Ping statistics for 10.10.2.101:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

Verify NO connectivity between VLANs (IP networks)

However, because we have not configured any layer 3 routing, there is still no reachability between devices on different IP networks, VLANs.
- 10.10.1.100 **cannot** ping 10.20.1.100
- 10.10.1.100 **cannot** ping 10.20.2.100

```
C:\> ping 10.20.1.100

Pinging 10.20.1.100 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 10.20.1.100:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

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```
C:\> ping 10.20.2.100

Pinging 10.20.2.100 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 10.20.2.100:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\>
```

Configuring the Distribution Switch as the Default Gateway

Switched Virtual Interfaces (SVIs) play an important role within the context of Layer 3 distribution layer switches. An SVI is a virtual interface with an IP address that is associated with a specific VLAN. An SVI on a Layer 3 switch enables it to perform routing functions between VLANs, IP networks, without the need for an external router. Therefore, the SVI typically is the default gateway for end-devices on the same VLAN, the same IP network.

These are the default gateways on the PCs.
- Via Distribution-1 switch:
  - Devices on a VLAN 10 port, 10.10.0.0/16 network have the default gateway 10.10.0.1
  - Devices on a VLAN 20 port, 10.20.0.0/16 network have the default gateway 10.20.0.1
- Via Distribution-2 switch:
  - Devices on a VLAN 30 port, 10.30.0.0/16 network have the default gateway 10.30.0.1
  - Devices on a VLAN 40 port, 10.40.0.0/16 network have the default gateway 10.40.0.1

SVIs on Distribution-1

First, we will configure the Layer 3, switch distribution-1 with SVIs (switched virtual interfaces) associated with the default gateway for VLAN 10 and VLAN 20, IP networks 10.10.0.0/16 and 10.20.0.0/16. Remember, we need to make sure that the IPv4 address matches the VLAN we have associated with that IPv4 network address.
- D1: interface vlan 10 – 10.10.0.1/16
- D1: interface vlan 20 – 10.20.0.1/16
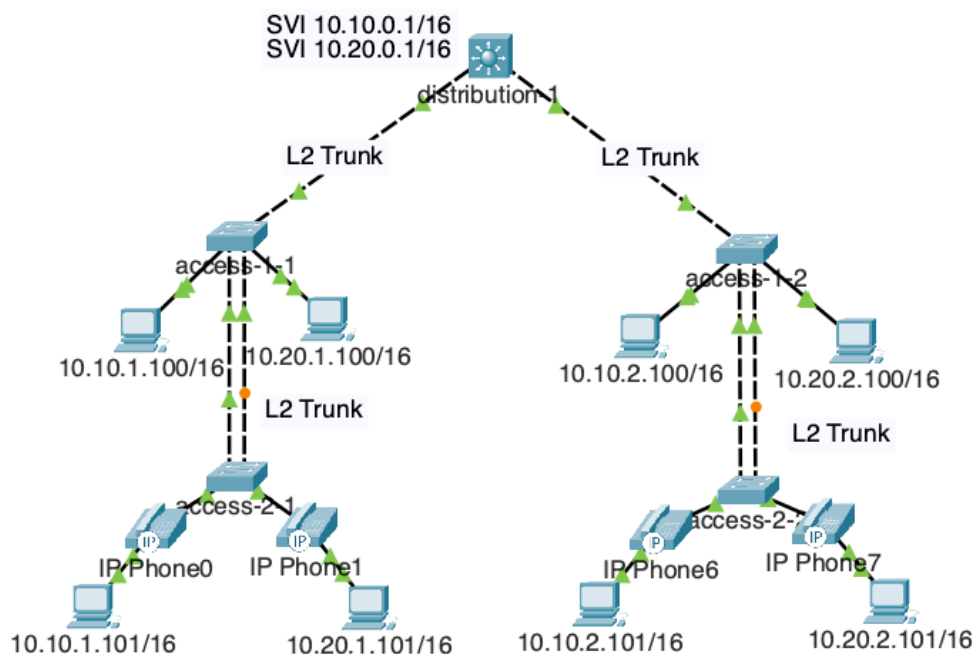
For end-devices to reach their respective default gateway (SVI) on the distribution switch, the distribution switch must have either an access port or trunk link that includes that VLAN. Therefore, the access layer switch can be connected to the distribution switch in one of two ways:
1. With a separate access VLAN port for each SVI it needs to reach on the distribution switch.
2. A trunk link that includes all the VLANs of the SVIs it needs to reach on the distribution switch.

In summary, an SVI IPv4 address is reachable by end-devices (PCs) via:
- A trunk link that includes the VLAN
- An access port that is on the same VLAN as the SVI

In our network, this has been accomplished with the trunk links between the distribution switches and the access switches, carrying all VLANs.
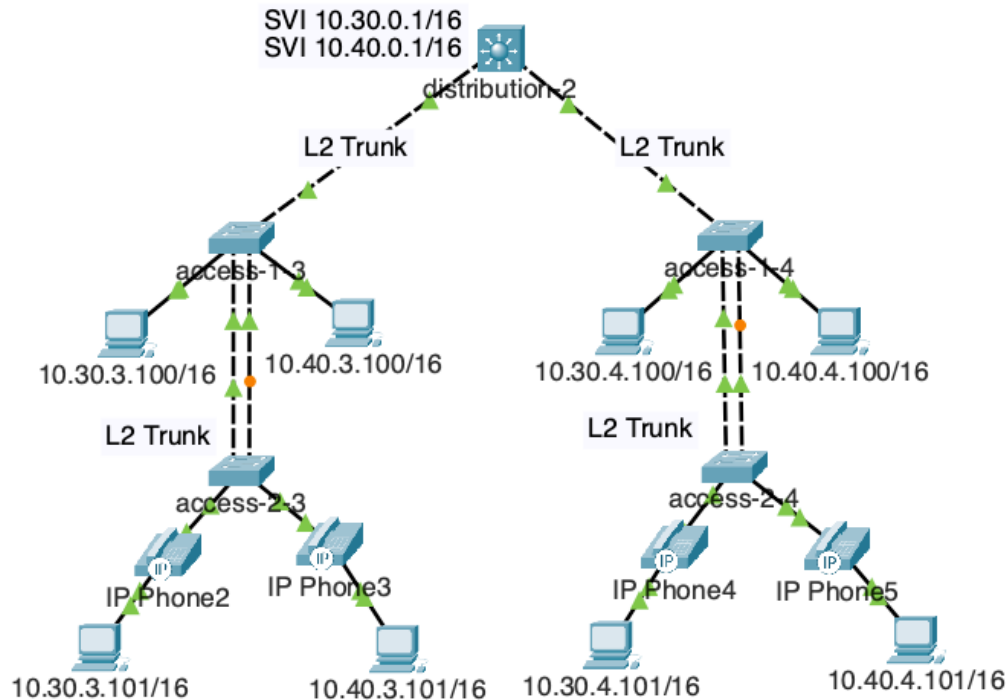
```
distribution-1(config)# interface vlan 10
distribution-1(config-if)# ip address 10.10.0.1 255.255.0.0
distribution-1(config-if)# no shutdown
distribution-1(config-if)# exit

distribution-1(config)# interface vlan 20
distribution-1(config-if)# ip address 10.20.0.1 255.255.0.0
distribution-1(config-if)# no shutdown

%LINK-5-CHANGED: Interface Vlan10, changed state to up

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

%LINK-5-CHANGED: Interface Vlan20, changed state to up

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

distribution-1(config-if)# exit
distribution-1(config)#
```

Next, we will configure the Layer 3, switch distribution-2 with SVIs (switched virtual interfaces) associated with the default gateway for VLAN 30 and VLAN 40, IP networks 10.30.0.0/16 and 10.40.0.0/16. Remember, we need to make sure that the IPv4 address matches the VLAN we have associated with that IPv4 network address.

- D2: interface vlan 30 – 10.30.0.1/16
- D2: interface vlan 40 – 10.40.0.1/16

```
distribution-2(config)# interface vlan 30
distribution-2(config-if)# ip address 10.30.0.1 255.255.0.0
distribution-2(config-if)# no shutdown
distribution-2(config-if)# exit

distribution-2(config-)# interface vlan 40
distribution-2(config-if)# ip address 10.40.0.1 255.255.0.0
distribution-2(config-if)# no shutdown

%LINK-5-CHANGED: Interface Vlan30, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan30, changed state to up

%LINK-5-CHANGED: Interface Vlan40, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan40, changed state to up

distribution-2(config-if)# exit
```
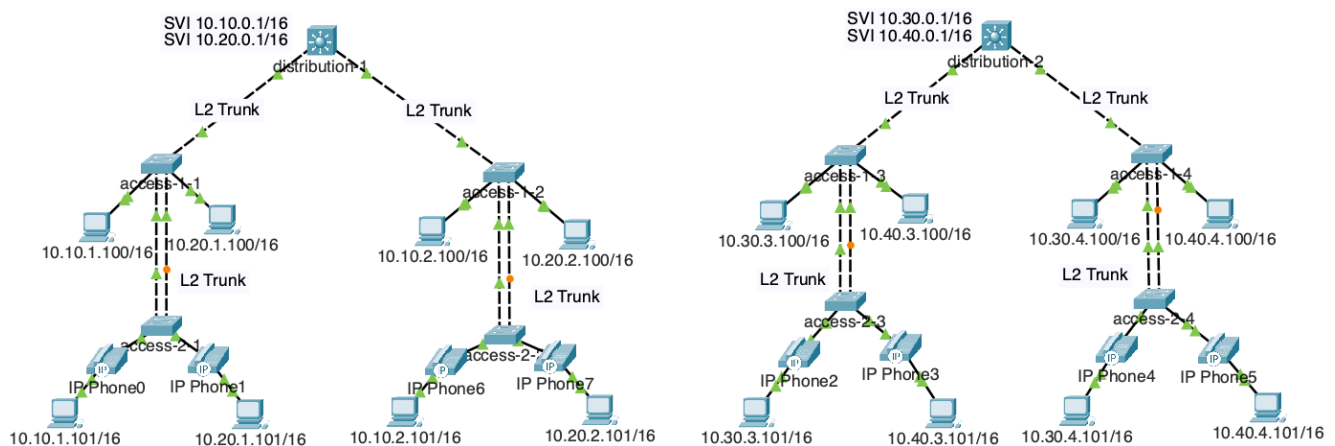
```
distribution-2(config)#
```

Routing on Distribution Switches

Verify No Inter-VLAN communications

We have configured the interfaces on the layer 3 switches that will be used as the default gateways, but we have not yet enabled routing on distribution-1 and distribution-2 switches.

Verify the IP addressing on 10.10.1.100 PC and that there is connectivity within its own IP network, VLAN, but not to another IP network, VLAN.

```
C:\>ipconfig

FastEthernet0 Connection:(default port)

    Connection-specific DNS Suffix..:
    Link-local IPv6 Address.........: FE80::20C:85FF:FEB5:6A86
    IPv6 Address....................: ::
    IPv4 Address....................: 10.10.1.100
    Subnet Mask.....................: 255.255.0.0
    Default Gateway.................: ::
                                      10.10.0.1

Bluetooth Connection:

    Connection-specific DNS Suffix..:
    Link-local IPv6 Address.........: ::
    IPv6 Address....................: ::
    IPv4 Address....................: 0.0.0.0
    Subnet Mask.....................: 0.0.0.0
    Default Gateway.................: ::
                                      0.0.0.0

C:\>ping 10.10.0.1
```

```
Pinging 10.10.0.1 with 32 bytes of data:

Reply from 10.10.0.1: bytes=32 time<1ms TTL=255
Reply from 10.10.0.1: bytes=32 time<1ms TTL=255
Reply from 10.10.0.1: bytes=32 time<1ms TTL=255
Reply from 10.10.0.1: bytes=32 time<1ms TTL=255

Ping statistics for 10.10.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 10.20.1.100

Pinging 10.20.1.100 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 10.20.1.100:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\>
```

Enable Routing on Layer 3 Distribution Switches

A router or layer 3 switch is just a computer. It doesn't do routing unless it is enabled (and has the software) to do routing. A "router" is enabled by default to do routing for IPv4. This means, by default it will route between any directly connected networks and any remote networks it learns via a static route or dynamic routing protocol.

This may not be the case for a layer 3 switch such as the Cisco 3650. Our layer 3 switches must be enabled, configured to route (forward) packets.

On both distribution switches use the **ip routing** command to enable IPv4 routing.

Note: Although a router routes IPv4 by default does require the command **ipv6 unicast routing** command to route, forward IPv6 packets. IPv6 routing on a router still require the command **ipv6 unicast routing**. Fun fact, this a similar command to ip routing was once required on routers to route IPv4, but it now happens by default.

```
distribution-1(config)# ip routing
distribution-1(config)# exit
distribution-1#
%SYS-5-CONFIG_I: Configured from console by console

distribution-1# 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

      10.0.0.0/16 is subnetted, 2 subnets
C        10.10.0.0 is directly connected, Vlan10
C        10.20.0.0 is directly connected, Vlan20

distribution-1#
```

Distribution-1 switch is directly connected to 10.10.0.0/16 via VLAN 10 and is directly connected to 10.20.0.0/16 via VLAN 20. Distribution-1 can route packets between devices on these two IP networks.

Note: You can use the **do** command before a **show** command in global configuration mode.

```
distribution-2(config)# ip routing
distribution-2(config)# do 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

      10.0.0.0/16 is subnetted, 2 subnets
C        10.30.0.0 is directly connected, Vlan30
C        10.40.0.0 is directly connected, Vlan40

distribution-2(config)#
```

Distribution-2 switch is directly connected to 10.30.0.0/16 via VLAN 30 and is directly connected to 10.40.0.0/16 via VLAN 40. Distribution-2 can route packets between devices on these two IP networks.

Verify Inter-VLAN communications

Now that we have configured enabled routing on bith distribution-1 and distribution-2 switches, verify connectivity between devices on different IP networks, VLANs.
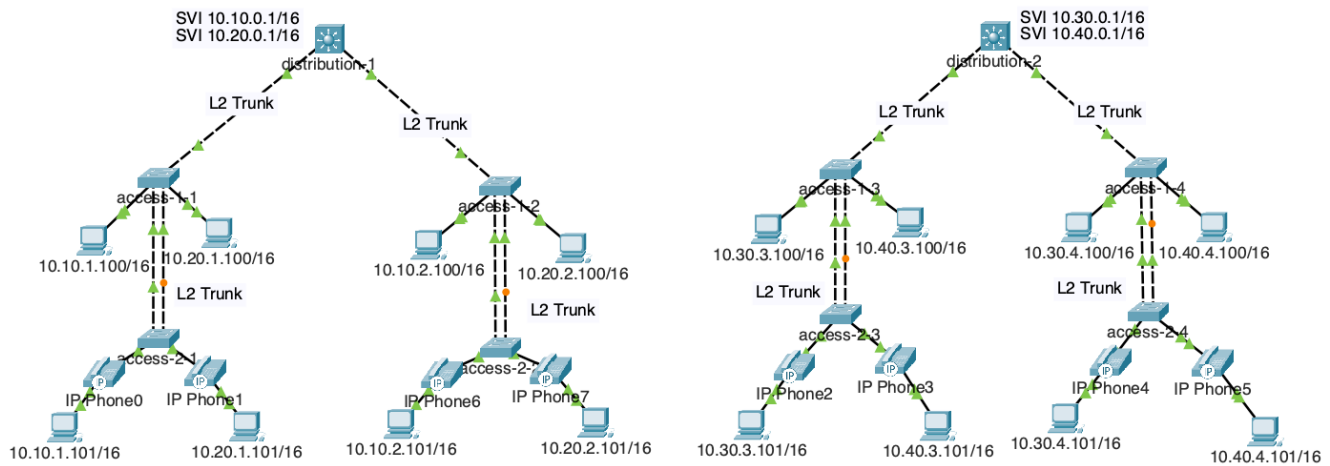
Note: Since we have not yet created and configured connectivity between the distribution switches, there is no reachability between devices in columns 1 and 2 with devices in columns 3 and 4.

```
C:\>ipconfig

FastEthernet0 Connection:(default port)

    Connection-specific DNS Suffix..:
    Link-local IPv6 Address.........: FE80::20C:85FF:FEB5:6A86
    IPv6 Address....................: ::
    IPv4 Address....................: 10.10.1.100
    Subnet Mask.....................: 255.255.0.0
    Default Gateway.................: ::
                                      10.10.0.1

C:\> ping 10.20.1.100

Pinging 10.20.1.100 with 32 bytes of data:

Reply from 10.20.1.100: bytes=32 time<1ms TTL=127
Reply from 10.20.1.100: bytes=32 time<1ms TTL=127
Reply from 10.20.1.100: bytes=32 time<1ms TTL=127
Reply from 10.20.1.100: bytes=32 time<1ms TTL=127

Ping statistics for 10.20.1.100:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\> ping 10.20.2.100

Pinging 10.20.2.100 with 32 bytes of data:

Request timed out.
Reply from 10.20.2.100: bytes=32 time<1ms TTL=127
Reply from 10.20.2.100: bytes=32 time<1ms TTL=127
Reply from 10.20.2.100: bytes=32 time=14ms TTL=127
```

```
Ping statistics for 10.20.2.100:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 14ms, Average = 4ms

C:\> arp -a
  Internet Address      Physical Address      Type
  10.10.0.1             000a.f3b9.0a01        dynamic

C:\>
```

SAVE AS A NEW PKT. FILE!