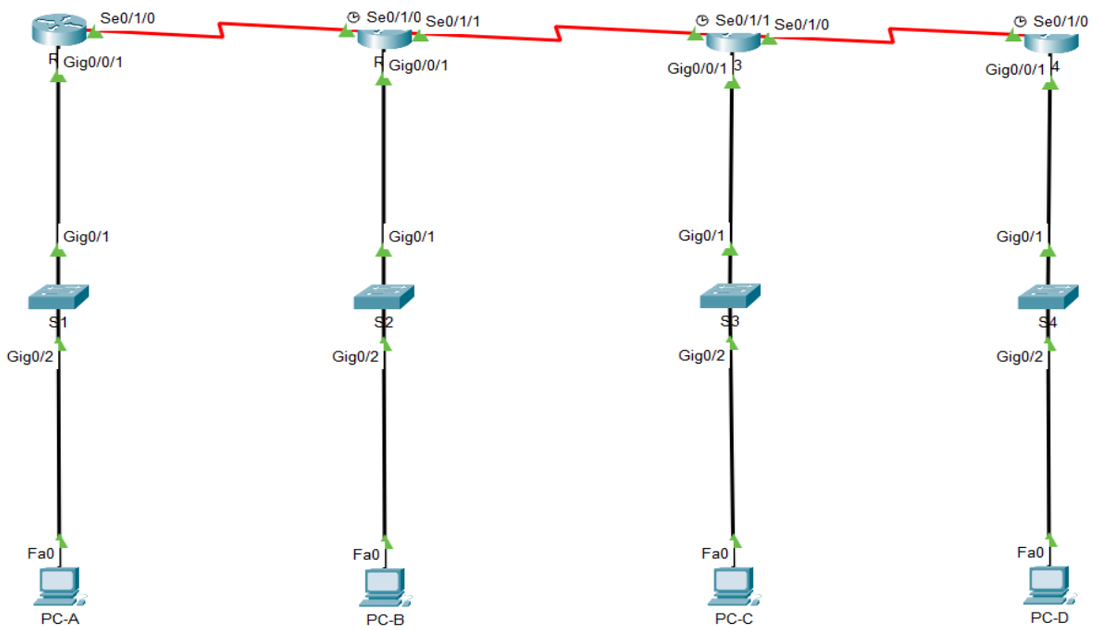
Lab – Implementing Dynamic Routing with DHCPv4 and DHCPv6

Topology



Addressing Table

Device	Interface	IP Address
R1	G0/0/1	192.168.10.1 255.255.255.0
		2001:db8:acad:1::a/64
		Fe80::1
	S0/1/0	203.165.10.1 255.255.255.252
		2001:db8:café:a::1/64
		Fe80::1
R2	G0/0/1	192.168.20.1 255.255.255.0
		2001:db8:acad:2::b/64
		Fe80::2
	S0/1/0	203.165.10.2 255.255.255.252
		2001:db8:café:a::2/64
		Fe80::2
	S0/1/1	203.165.20.5 255.255.255.252
		2001:db8:café:b::1/64
		Fe80::2
R3	G0/0/1	192.168.30.1 255.255.255.0
		2001:db8:acad:3::c/64
		Fe80::3
	S0/1/1	203.165.20.6 255.255.255.252
		2001:db8:café:b::2/64
		Fe80::3
	S0/1/0	203.165.30.9 255.255.255.252
		2003:db8:café:c::1/64
		Fe80::3
R4	G0/0/1	192.168.40.1 255.255.255.0
		2001:db8:acad:4::d/64
		Fe80::4
	S0/1/0	203.165.30.10 255.255.255.252
		2001:db8:café:c::2/64
		Fe80::4

PC-A	NIC	DHCPv4
	NIC	DHCPv6
PC-B	NIC	DHCPv4
	NIC	DHCPv6
PC-C	NIC	DHCPv4
	NIC	DHCPv6
PC-D	NIC	DHCPv4
	NIC	DHCPv6

Objectives

- **Part 1: Build the Network and Configure Basic Device Settings**
- **Part 2: Assign IP Address to All Interface**
- **Part 3: Configure and verify a DHCPv4 Server on All Routers**
- **Part 4: Configure and verify a Stateless DHCPv6 Server on all Routers**
- **Part 5: Configure and verify OSPF routing for all Routers**

Background / Scenario

Static and Default routing are the simplest forms of network routing and configured manually. They are fixed, meaning that they do not change dynamically to meet changing network conditions. They are either valid and made available to the routing table or invalid and not made available to the routing table. Static routes have an administrative distance of one by default. However, static and default routes can be configured with an administrator-defined administrative distance. This capability allows the administrator to put the static or default route in reserve, and only make it available to the routing table when routes with lower administrative distances (usually generated by dynamic routing protocols) are no longer valid.

Note: In this lab you will configure static, default routes for both IPv4 and IPv6 which may not reflect networking best practices.

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

Required Resources

- 4 Routers (4331)
- 4 Switches (2960)
- 4 PCs (Windows with a terminal emulation program, such as Tera Term)
- Console cables to configure the Cisco IOS devices via the console ports
- Ethernet cables as shown in the topology

Instructions

Part 1: Build the Network and Configure Basic Device Settings

In Part 1, you will set up the network topology and configure basic settings on the PC hosts and switches.

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

Attach the devices as shown in the topology diagram, and cable as necessary.

Step 2: Configure basic settings for each router.

a. Assign a device name to the router.

b. Disable DNS lookup to prevent the router from attempting to translate incorrectly entered commands as though they were host names.

c. Assign an **ip domain-name ccs-lab.com**

e. Enable IPv4 and IPv6 Routing

f. Configure message of the day

g. Set time-zone to **GMT 8**

h. Configure privilege exec mode password, set **class** as password

i. Configure line console and set **cisco** as password

j. Configure line vty and set **cisco** as password

k. Set **logging synchronous** for both line configuration

l. Configure CLI to exit after 3 minutes of being idle, apply it to both line configuration

m. Enable ssh connection in line vty

n. Set login local in line vty

o. Encrypt all plain text passwords

p. Use **admin** for ssh username and password

q. Set **crypto generate key rsa** to **1024** bits

r. Configure device to use current time settings

s. save the running configurations to startup configuration

Part 2: Assign IP Address to All Interfaces

In Part 2, you will assign all IP address to its respective Interfaces see the IP addressing table as reference.

```
R1(config)#int G0/0/1
R1(config-if)#ip address 192.168.10.1 255.255.255.0
R1(config-if)#ipv6 address 2001:db8:acad:1::a/64
R1(config-if)#ipv6 address fe80::1 link-local
R1(config-if)#no shut

R1(config-if)#int S0/1/0
R1(config-if)#ip address 203.165.10.1 255.255.255.252
R1(config-if)#ipv6 address 2001:db8:cafe:a::1/64
R1(config-if)#ipv6 address fe80::1 link-local
R1(config-if)#no shut
```

All PCs will receive their respective IPv4 and IPv6 address from the routers DHCPv4 and DHCPv6 service that will be in the next part.

Part 3: Configure and Verify a DHCPv4 server on all Routers

In Part 3, you will configure and verify a DHCPv4 server on all routers. The objective is to provide all PCs with dynamic IPv4, DNS server and Domain information.

Step 1: Examine the configuration of PC-A in more detail.

a. Issue the command **ipconfig /all** on PC-A and take a look at the output.

```
C:\>ipconfig /all

FastEthernet0 Connection:(default port)

Connection-specific DNS Suffix..:
Physical Address.................: 0002.1603.CE74
Link-local IPv6 Address.........: FE80::202:16FF:FE03:CE74
IPv6 Address....................: ::
IPv4 Address....................: 0.0.0.0
Subnet Mask.....................: 0.0.0.0
Default Gateway.................: ::
0.0.0.0
DHCP Servers....................: 192.168.40.1
DHCPv6 IAID.....................:
DHCPv6 Client DUID..............: 00-01-00-01-D2-49-5D-CE-00-02-16-03-CE-74
DNS Servers.....................: ::
0.0.0.0

Bluetooth Connection:

Connection-specific DNS Suffix..:
Physical Address.................: 0060.471D.4730
Link-local IPv6 Address.........: ::
IPv6 Address....................: ::
IPv4 Address....................: 0.0.0.0
Subnet Mask.....................: 0.0.0.0
Default Gateway.................: ::
0.0.0.0
DHCP Servers....................: 0.0.0.0
DHCPv6 IAID.....................:
DHCPv6 Client DUID..............: 00-01-00-01-D2-49-5D-CE-00-02-16-03-CE-74
DNS Servers.....................: ::0.0.0.0
```

b. Notice that there is no Primary DNS suffix. Also note that the DNS server addresses provided are “site local anycast” addresses, and not unicast addresses, as would be expected.

Step 2: Configure R1 to provide DHCPv4 for PC-A.

a. Exclude the first one hundred useable addresses from each address pool.

```
R1(config)# ip dhcp excluded-address 192.168.10.1 192.168.1.100
```

b. Create the DHCP pool (Use a unique name for each pool).

```
R1(config)# ip dhcp pool R1_Client_LAN
```

c. Specify the network that this DHCP server is supporting.

```
R1(dhcp-config)# network 192.168.1.0 255.255.255.192
```

d. Configure the domain name as ccs-lab1.com

```
R1(dhcp-config)# domain-name ccs-lab1.com
```

e. Configure the appropriate default gateway for each DHCP pool.

```
R1(dhcp-config)# default-router 192.168.10.1
```

f. Configure the lease time for 2 days 12 hours and 30 minutes.

```
R1(dhcp-config)# lease 2 12 30
```

The Packet Tracer software doesn’t support all IOS commands and features but some will run in GNS3.

g. Examine the output of **ipconfig /all** and notice the changes.

```
C:\>ipconfig /all

FastEthernet0 Connection:(default port)

   Connection-specific DNS Suffix..: ccs-lab1.com
                                   :
   Physical Address................: 0007.EC00.D2E8
   Link-local IPv6 Address.........: FE80::207:ECFF:FE00:D2E8
   IPv6 Address....................: ::
   IPv4 Address....................: 192.168.10.101
   Subnet Mask.....................: 255.255.255.0
   Default Gateway.................: ::
                                     192.168.10.1
   DHCP Servers....................: 192.168.10.1
   DHCPv6 IAID.....................: 1092558971
   DHCPv6 Client DUID..............:
00-01-00-01-53-2C-90-4B-00-07-EC-00-D2-E8
   DNS Servers.....................: ::
                                     0.0.0.0
```

h. Test connectivity by pinging R1's G0/0/1 interface IP address.

i. Next, configure the DHCPv4 Pool on R2 using the pool name R2_Client_LAN and the calculated network, default-router and use the same domain name and lease time from the previous DHCP pool.

```
R1(config)# ip dhcp excluded-address 192.168.20.1 192.168.1.100
R1(config)# ip dhcp pool R2_Client_LAN
R1(dhcp-config)# network 192.168.20.0 255.255.255.240
R1(dhcp-config)# default-router 192.168.20.1
R1(dhcp-config)# domain-name ccs-lab2.com
R1(dhcp-config)# lease 2 12 30
```

j. Do the same for the rest of the remaining routers, use **R3_Client_LAN** and **ccs-lab3.com** for R3, **R4_Client_LAN** and **ccs-lab4.com** for R4

Part 4: Configure and verify a Stateless DHCPv6 Server on all Routers

a. Create an IPv6 DHCP pool on R1 named R1-STATELESS. As a part of that pool, assign the DNS server address as 2001:db8:acad::254 and the domain name as stateless1.com.

```
R1(config)# ipv6 dhcp pool R1-STATELESS
R1(config-dhcp)# dns-server 2001:db8:acad::254
R1(config-dhcp)# domain-name STATELESS1.com
```

b. Configure the G0/0/1 interface on R1 to provide the OTHER config flag to the R1 LAN, and specify the DHCP pool you just created as the DHCP resource for this interface.

```
R1(config)# interface g0/0/1
R1(config-if)# ipv6 nd other-config-flag
R1(config-if)# ipv6 dhcp server R1-STATELESS
```

c. Save the running configuration to the startup configuration file.

```
R1# copy running-config startup-config
```

d. Restart PC-A.

e. Examine the output of **ipconfig /all** and notice the changes.

```
C:\>ipconfig /all

FastEthernet0 Connection:(default port)

   Connection-specific DNS Suffix..: ccs-lab1.com
                                   : STATELESS1.com
```

```
   Physical Address.................: 0007.EC00.D2E8
   Link-local IPv6 Address.........: FE80::207:ECFF:FE00:D2E8
   IPv6 Address....................:
2001:DB8:ACAD:1:207:ECFF:FE00:D2E8
   IPv4 Address....................: 192.168.10.101
   Subnet Mask.....................: 255.255.255.0
   Default Gateway.................: FE80::1
                                     192.168.10.1
   DHCP Servers....................: 192.168.10.1
   DHCPv6 IAID.....................: 1092558971
   DHCPv6 Client DUID..............:
00-01-00-01-53-2C-90-4B-00-07-EC-00-D2-E8
   DNS Servers.....................: 2001:DB8:ACAD::254
                                     0.0.0.0

Bluetooth Connection:

   Connection-specific DNS Suffix..: ccs-lab1.com
                                   : STATELESS1.com
   Physical Address.................: 0002.1701.E169
   Link-local IPv6 Address.........: ::
   IPv6 Address....................: ::
   IPv4 Address....................: 0.0.0.0
   Subnet Mask.....................: 0.0.0.0
   Default Gateway.................: ::
                                     0.0.0.0
   DHCP Servers....................: 0.0.0.0
   DHCPv6 IAID.....................: 1092558971
   DHCPv6 Client DUID..............:
00-01-00-01-53-2C-90-4B-00-07-EC-00-D2-E8
   DNS Servers.....................: ::
                                     0.0.0.0
```

Note: for GNS3 VPCs to obtain IPv4 via DHCP use **ip dhcp** command, for obtaining ipv6 via dhcpv6 use **ip auto** command.

```
PC1> ip dhcp
DDORA IP 192.168.10.101/24 GW 192.168.10.1

PC1> ip auto
GLOBAL SCOPE      : 2001:db8:acad:1:2050:79ff:fe66:6800/64
ROUTER LINK-LAYER : ca:01:05:83:00:08

PC1> sh ip

NAME        : PC1[1]
IP/MASK     : 192.168.10.101/24
GATEWAY     : 192.168.10.1
DNS         :
DHCP SERVER : 192.168.10.1
DHCP LEASE  : 217730, 217800/108900/190575
DOMAIN NAME : ccs-lab1.com
MAC         : 00:50:79:66:68:00
LPORT       : 10004
RHOST:PORT  : 127.0.0.1:10005
MTU:        : 1500
```

Part 5: Configure and verify OSPF routing for all Routers

In Part 5, you will configure and verify DHCPv4 and DHCPv6 ospf routing, allowing all PCs to send and receive packets from different networks.

Step 1: Configure IPv4 and IPv6 Static Routing in R1.

There are few ways to implement IPv4 and IPv6 dynamic routing, we can use RIPv2, EIGRP, OSPF and other dynamic routing protocol.

For this particular laboratory we will implement OSPF routing protocols. There are OSPFv2 and OSPFv3, while OSPFv2 supports IPV4 it does not support IPv6, OSPFv3 however supports both, OSPFv3 is supported in version 15.x and up in cisco ios but due to limitation present in both GNS3 and Packet tracer which prevents us from using the more efficient commands, we will implement both ospfv2 and ospfv3 in an inefficient manner.

a. Configure OSPF IPv4 and IPv6 routing for R1 and save changes

```
R1#conf t
R1(config)#router ospf 1
R1(config-router)#router-id 1.1.1.1
R1(config-router)#network 203.165.10.0 0.0.0.3 area 0
R1(config-router)#network 203.165.20.0 0.0.0.3 area 0
R1(config-router)#network 203.165.30.0 0.0.0.3 area 0
R1(config-router)#network 192.168.10.0 0.0.0.255 area 0
R1(config-router)#network 192.168.20.0 0.0.0.255 area 0
R1(config-router)#network 192.168.30.0 0.0.0.255 area 0
R1(config-router)#network 192.168.40.0 0.0.0.255 area 0
R1(config-router)#end

R1#conf t
R1(config)#ipv6 router ospf 1
R1(config-rtr)#router-id 1.1.1.1
R1(config-rtr)#int g0/0/1
R1(config-if)#ipv6 ospf 1 area 0
R1(config-if)#int s0/1/0
R1(config-if)#ipv6 ospf 1 area 0
R1(config-if)#end
```

b. Configure OSPF IPv4 and IPv6 routing for R2 and save changes

```
R2#conf t
R2(config)#router ospf 1
R2(config-router)#router-id 1.1.1.1
R2(config-router)#network 203.165.10.0 0.0.0.3 area 0
R2(config-router)#network 203.165.20.0 0.0.0.3 area 0
R2(config-router)#network 203.165.30.0 0.0.0.3 area 0
R2(config-router)#network 192.168.10.0 0.0.0.255 area 0
R2(config-router)#network 192.168.20.0 0.0.0.255 area 0
R2(config-router)#network 192.168.30.0 0.0.0.255 area 0
R2(config-router)#network 192.168.40.0 0.0.0.255 area 0
R2(config-router)#end

R2#conf t
R2(config)#ipv6 router ospf 1
R2(config-rtr)#router-id 1.1.1.1
R2(config-rtr)#int g0/0/1
R2(config-if)#ipv6 ospf 1 area 0
R2(config-if)#int s0/1/0
R2(config-if)#ipv6 ospf 1 area 0
R2(config-if)#int s0/1/1
R2(config-if)#ipv6 ospf 1 area 0
R2(config-if)#end
```

c. Configure OSPF IPv4 and IPv6 routing for R3 and save changes

```
R3#conf t
R3(config)#router ospf 1
R3(config-router)#router-id 1.1.1.1
R3(config-router)#network 203.165.10.0 0.0.0.3 area 0
R3(config-router)#network 203.165.20.0 0.0.0.3 area 0
R3(config-router)#network 203.165.30.0 0.0.0.3 area 0
R3(config-router)#network 192.168.10.0 0.0.0.255 area 0
R3(config-router)#network 192.168.20.0 0.0.0.255 area 0
R3(config-router)#network 192.168.30.0 0.0.0.255 area 0
R3(config-router)#network 192.168.40.0 0.0.0.255 area 0
```

```
R3(config-router)#end

R3#conf t
R3(config)#ipv6 router ospf 1
R3(config-rtr)#router-id 1.1.1.1
R3(config-rtr)#int g0/0/1
R3(config-if)#ipv6 ospf 1 area 0
R3(config-if)#int s0/1/0
R3(config-if)#ipv6 ospf 1 area 0
R3(config-if)#int s1/1
R3(config-if)#ipv6 ospf 1 area 0
R3(config-if)#end
```

d. Configure OSPF IPv4 and IPv6 routing for R4 and save changes

```
R4#conf t
R4(config)#router ospf 1
R4(config-router)#router-id 1.1.1.1
R4(config-router)#network 203.165.10.0 0.0.0.3 area 0
R4(config-router)#network 203.165.20.0 0.0.0.3 area 0
R4(config-router)#network 203.165.30.0 0.0.0.3 area 0
R4(config-router)#network 192.168.10.0 0.0.0.255 area 0
R4(config-router)#network 192.168.20.0 0.0.0.255 area 0
R4(config-router)#network 192.168.30.0 0.0.0.255 area 0
R4(config-router)#network 192.168.40.0 0.0.0.255 area 0
R4(config-router)#end

R4#conf t
R4(config)#ipv6 router ospf 1
R4(config-rtr)#router-id 1.1.1.1
R4(config-rtr)#int g0/0
R4(config-if)#ipv6 ospf 1 area 0
R4(config-if)#int s1/0
R4(config-if)#ipv6 ospf 1 area 0
R4(config-if)#end
```

Step 2: Verify connectivity to other networks.

a. Open cmd in PC-A ping other PCs from other networks.

```
PC1> ping 2001:db8:acad:3:2050:79ff:fe66:6802

2001:db8:acad:3:2050:79ff:fe66:6802 icmp6_seq=1 ttl=58 time=61.582 ms
2001:db8:acad:3:2050:79ff:fe66:6802 icmp6_seq=2 ttl=58 time=35.414 ms
2001:db8:acad:3:2050:79ff:fe66:6802 icmp6_seq=3 ttl=58 time=45.823 ms
2001:db8:acad:3:2050:79ff:fe66:6802 icmp6_seq=4 ttl=58 time=45.611 ms
2001:db8:acad:3:2050:79ff:fe66:6802 icmp6_seq=5 ttl=58 time=46.327 ms

PC1> ping 192.168.20.1
84 bytes from 192.168.20.1 icmp_seq=1 ttl=254 time=31.111 ms
84 bytes from 192.168.20.1 icmp_seq=2 ttl=254 time=26.971 ms
84 bytes from 192.168.20.1 icmp_seq=3 ttl=254 time=22.015 ms
84 bytes from 192.168.20.1 icmp_seq=4 ttl=254 time=17.603 ms
84 bytes from 192.168.20.1 icmp_seq=5 ttl=254 time=19.735 ms

PC1> ping 192.168.20.101
192.168.20.101 icmp_seq=1 timeout
192.168.20.101 icmp_seq=2 timeout
84 bytes from 192.168.20.101 icmp_seq=3 ttl=62 time=25.033 ms
84 bytes from 192.168.20.101 icmp_seq=4 ttl=62 time=36.371 ms
84 bytes from 192.168.20.101 icmp_seq=5 ttl=62 time=24.312 ms
```

b. access other routers using ssh connection thru command prompt or terminal from PC-A

```
C:\>ssh -l admin 192.168.20.1
```

```
Password: admin


Unauthorized Users are Prohibited!

R2>en
Password: class
R2#
```

Note: secure ssh command does not work for built-in gns3 vpcs, use virtual machine