



CY4049 - Network Protocols and Standards Fall 24BCY-5A

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Implementation of Multiprotocol Label Switching (MPLS)

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Abstract

This project aims to highlight the fundamental differences between traditional IP routing and MPLS (Multiprotocol Label Switching) through practical implementation. Using GNS3, an MPLS network was configured to highlight its efficiency improvements, including faster packet forwarding, reduced lookup times, and enhanced traffic engineering. The project also demonstrates the implementation of VRFs and OSPF to manage traffic effectively.

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1. Introduction

MPLS is a versatile solution for improving the performance of IP networks by enabling label-based switching instead of relying solely on IP lookups. This project focuses on implementing an MPLS network to demonstrate its capabilities, such as traffic engineering and efficient forwarding, in comparison to traditional IP routing.

2. Network Topology

The network topology used in this project involves Provider (P) and Provider Edge (PE) routers, along with Customer Edge (CE) routers. These routers were interconnected to form an MPLS network.

Figure 1: MPLS Network Topology

3. Policy Implementation

Policies were defined to control communication between various customer banks (Bank A, Bank B, and Bank C). The configuration's ensured traffic was routed based on predefined rules:

- Bank B cannot communicate with Bank C.
- Other communications follow the policy defined by the labels.

Figure 2: Policy Configuration Overview

4. MPLS Configuration

4.1 OSPF Configuration

OSPF was used to establish connectivity within P and PE routers. The loopback addresses of PE routers were configured to represent customer sites.

Figure 15: OSPF Connectivity Proof within P and PE Routers

4.2 MPLS Neighbor Discovery

MPLS neighbors were displayed to verify the correct setup of label-switched paths (LSPs).

Figure 17: Displaying MPLS Neighbors

4.3 Virtual Routing and Forwarding (VRFs)

VRFs were configured on PE routers to isolate customer traffic. Interfaces were assigned to VRFs based on customer-specific requirements.

Figures 20 & 21: VRF Configuration on PE Routers

5. Verification and Testing

5.1 Static Routes for Customer Edges

Static routes were defined for customer edge routers to direct traffic efficiently through the MPLS network.

Figure 26: Static Route Configuration

5.2 BGP Redistribution

BGP was implemented on PE routers and redistributed with static routes to ensure proper route propagation.

Figure 32: BGP Configuration Verification

5.3 Ping Tests

Ping tests were conducted to validate connectivity according to the defined policy.

- Figure 37: Ping Test - Bank A to All
- Figure 38: Ping Test - Bank C to Bank C
- Figure 39: Ping Test - Bank B to Bank A
- Figure 41: Communication Restriction - Bank B to Bank C

6. Conclusion

This project successfully demonstrated the configuration and operational differences between traditional IP routing and MPLS. By implementing OSPF, VRFs, and BGP within the MPLS framework, significant improvements in traffic management and forwarding efficiency were observed. The project highlights MPLS's potential to optimize network performance in modern enterprise networks.

7. References

- Figures from the provided report were directly analyzed and used for explanation.
- RFC 3031 - MPLS Architecture

Topology

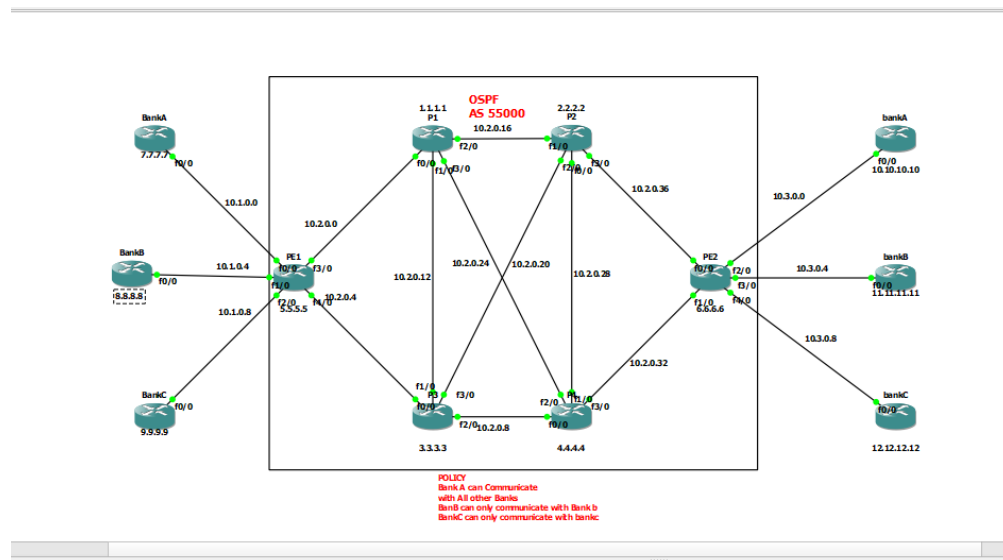


Figure 1

Policy

POLICY
**Bank A can Communicate
with All other Banks**
BankB can only communicate with Bank b
BankC can only communicate with bankc

Figure 2

Ip-Configuration of each router

```
BankA
IP CEF switching is enabled
IP CEF switching turbo vector
IP CEF turbo switching turbo vector

BankA(config-if)#do sh ip int br
Interface      IP-Address      OK? Method Status      Prot
ocol
FastEthernet0/0 10.1.0.1        YES manual up          up
FastEthernet1/0 unassigned       YES unset  administratively down down
FastEthernet2/0 unassigned       YES unset  administratively down down
FastEthernet3/0 unassigned       YES unset  administratively down down
FastEthernet4/0 unassigned       YES unset  administratively down down
FastEthernet5/0 unassigned       YES unset  administratively down down
FastEthernet6/0 unassigned       YES unset  administratively down down
Loopback0       7.7.7.7         YES manual up          up
BankA(config-if)#
```

Figure 3

```
BankB
by a different version of the system image.
Overwrite the previous NVRAM configuration?[confirm]
Building configuration...
[OK]
BankB(config-if)#do sh ip int br
Interface      IP-Address      OK? Method Status      Prot
ocol
FastEthernet0/0 10.1.0.5        YES manual up          up
FastEthernet1/0 unassigned       YES unset  administratively down down
FastEthernet2/0 unassigned       YES unset  administratively down down
FastEthernet3/0 unassigned       YES unset  administratively down down
FastEthernet4/0 unassigned       YES unset  administratively down down
FastEthernet5/0 unassigned       YES unset  administratively down down
FastEthernet6/0 unassigned       YES unset  administratively down down
Loopback0       8.8.8.8         YES manual up          up
BankB(config-if)#
```

Figure 4

```
BankC
by a different version of the system image.
Overwrite the previous NVRAM configuration?[confirm]
Building configuration...
[OK]
BankC(config-if)#do sh ip int br
Interface      IP-Address      OK? Method Status      Prot
ocol
FastEthernet0/0 10.1.0.9        YES manual up          up
FastEthernet1/0 unassigned       YES unset  administratively down down
FastEthernet2/0 unassigned       YES unset  administratively down down
FastEthernet3/0 unassigned       YES unset  administratively down down
FastEthernet4/0 unassigned       YES unset  administratively down down
FastEthernet5/0 unassigned       YES unset  administratively down down
FastEthernet6/0 unassigned       YES unset  administratively down down
Loopback0       9.9.9.9         YES manual up          up
BankC(config-if)#
```

Figure 5

```
PE1
by a different version of the system image.
Overwrite the previous NVRAM configuration?[confirm]
Building configuration...
[OK]
PE1(config-if)#do sh ip int br
Interface IP-Address OK? Method Status Prot
ocol
FastEthernet0/0 10.1.0.2 YES manual up up
FastEthernet1/0 10.1.0.6 YES manual up up
FastEthernet2/0 10.1.0.10 YES manual up up
FastEthernet3/0 10.2.0.1 YES manual up up
FastEthernet4/0 10.2.0.5 YES manual up up
FastEthernet5/0 unassigned YES unset administratively down down
FastEthernet6/0 unassigned YES unset administratively down down
Loopback0 5.5.5.5 YES manual up up
PE1(config-if)#
```

Figure 6

```
P1
P1(config-if)#
*Dec 2 21:07:32.231: %LINK-3-UPDOWN: Interface FastEthernet3/0, changed state to up
*Dec 2 21:07:33.231: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet3/0, changed state to up
P1(config-if)#do sh ip int br
Interface IP-Address OK? Method Status Prot
ocol
FastEthernet0/0 10.2.0.2 YES manual up up
FastEthernet1/0 10.2.0.13 YES manual up up
FastEthernet2/0 10.2.0.17 YES manual up up
FastEthernet3/0 10.2.0.25 YES manual up up
FastEthernet4/0 unassigned YES unset administratively down down
FastEthernet5/0 unassigned YES unset administratively down down
FastEthernet6/0 unassigned YES unset administratively down down
Loopback0 1.1.1.1 YES manual up up
P1(config-if)#
```

Figure 7

```
P2
by a different version of the system image.
Overwrite the previous NVRAM configuration?[confirm]
Building configuration...
[OK]
P2(config-if)#do sh ip int br
Interface IP-Address OK? Method Status Prot
ocol
FastEthernet0/0 10.2.0.29 YES manual up up
FastEthernet1/0 10.2.0.18 YES manual up up
FastEthernet2/0 10.2.0.22 YES manual up up
FastEthernet3/0 10.2.0.37 YES manual up up
FastEthernet4/0 unassigned YES unset administratively down down
FastEthernet5/0 unassigned YES unset administratively down down
FastEthernet6/0 unassigned YES unset administratively down down
Loopback0 2.2.2.2 YES manual up up
P2(config-if)#
```

Figure 8

```
P3
by a different version of the system image.
Overwrite the previous NVRAM configuration?[confirm]
Building configuration...
[OK]
P3(config-if)#do sh ip int br
Interface      IP-Address      OK? Method Status      Prot
ocol
FastEthernet0/0 10.2.0.6        YES manual up          up
FastEthernet1/0 10.2.0.13       YES manual up          up
FastEthernet2/0 10.2.0.9        YES manual up          up
FastEthernet3/0 10.2.0.21       YES manual up          up
FastEthernet4/0 unassigned      YES unset  administratively down down
FastEthernet5/0 unassigned      YES unset  administratively down down
FastEthernet6/0 unassigned      YES unset  administratively down down
Loopback0      3.3.3.3         YES manual up          up
P3(config-if)#
```

Figure 9

```
P4
*Dec  2 21:12:52.563: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet2/0, changed state to up
P4(config-if)#do sh ip int br
Interface      IP-Address      OK? Method Status      Prot
ocol
FastEthernet0/0 10.2.0.10       YES manual up          up
FastEthernet1/0 10.2.0.30       YES manual up          up
FastEthernet2/0 10.2.0.26       YES manual up          up
FastEthernet3/0 10.2.0.37       YES manual up          up
FastEthernet4/0 unassigned      YES unset  administratively down down
FastEthernet5/0 unassigned      YES unset  administratively down down
FastEthernet6/0 unassigned      YES unset  administratively down down
Loopback0      4.4.4.4         YES manual up          up
P4(config-if)#do wr mem
Warning: Attempting to overwrite an NVRAM configuration previously written
by a different version of the system image.
```

Figure 10

```
PE2
% Invalid input detected at '^' marker.
PE2(config-if)#exit
PE2(config)#do sh ip int br
Interface      IP-Address      OK? Method Status      Prot
ocol
FastEthernet0/0 10.2.0.38       YES manual up          up
FastEthernet1/0 10.2.0.34       YES manual up          up
FastEthernet2/0 10.3.0.1        YES manual up          up
FastEthernet3/0 10.3.0.5        YES manual up          up
FastEthernet4/0 10.3.0.9        YES manual up          up
FastEthernet5/0 unassigned      YES unset  administratively down down
FastEthernet6/0 unassigned      YES unset  administratively down down
Loopback0      6.6.6.6         YES manual up          up
PE2(config)#wr mem
```

Figure 11

```
bankA
by a different version of the system image.
Overwrite the previous NVRAM configuration?[confirm]
Building configuration...
[OK]
bankA(config-if)#do sh ip int br
Interface      IP-Address      OK? Method Status      Prot
ocol
FastEthernet0/0 10.3.0.2        YES manual administratively down down
FastEthernet1/0 unassigned      YES unset  administratively down down
FastEthernet2/0 unassigned      YES unset  administratively down down
FastEthernet3/0 unassigned      YES unset  administratively down down
FastEthernet4/0 unassigned      YES unset  administratively down down
FastEthernet5/0 unassigned      YES unset  administratively down down
FastEthernet6/0 unassigned      YES unset  administratively down down
Loopback0       10.10.10.10     YES manual up          up
bankA(config-if)#
```

Figure 12

```
bankB
by a different version of the system image.
Overwrite the previous NVRAM configuration?[confirm]
Building configuration...
[OK]
bankB(config-if)#do sh ip int br
Interface      IP-Address      OK? Method Status      Prot
ocol
FastEthernet0/0 10.3.0.6        YES manual administratively down down
FastEthernet1/0 unassigned      YES unset  administratively down down
FastEthernet2/0 unassigned      YES unset  administratively down down
FastEthernet3/0 unassigned      YES unset  administratively down down
FastEthernet4/0 unassigned      YES unset  administratively down down
FastEthernet5/0 unassigned      YES unset  administratively down down
FastEthernet6/0 unassigned      YES unset  administratively down down
Loopback0       11.11.11.11     YES manual up          up
bankB(config-if)#
```

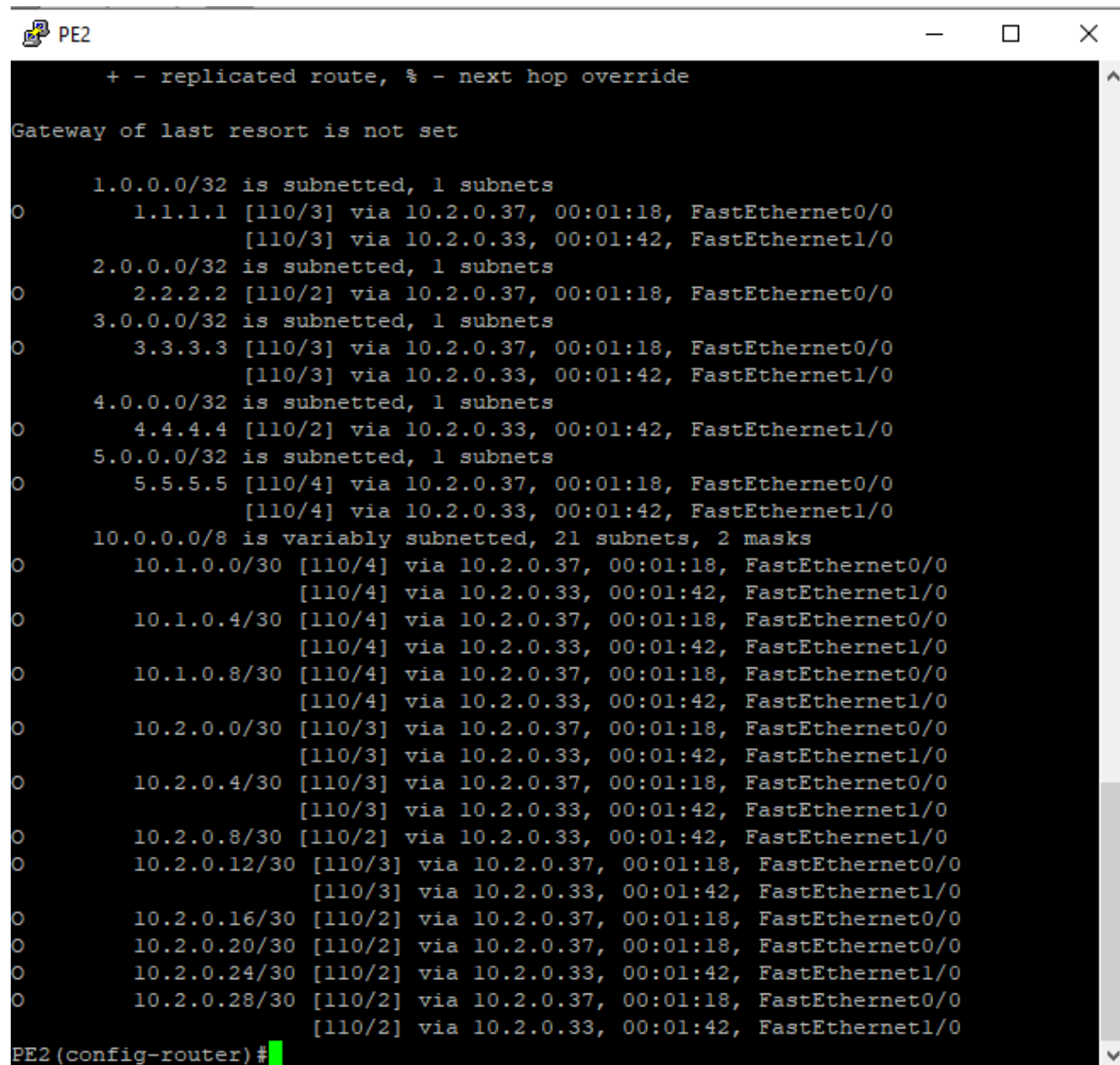
Figure 13

```
bankC
by a different version of the system image.
Overwrite the previous NVRAM configuration?[confirm]
Building configuration...
[OK]
bankC(config-if)#do sh ip int br
Interface      IP-Address      OK? Method Status      Prot
ocol
FastEthernet0/0 10.3.0.10       YES manual up          up
FastEthernet1/0 unassigned      YES unset  administratively down down
FastEthernet2/0 unassigned      YES unset  administratively down down
FastEthernet3/0 unassigned      YES unset  administratively down down
FastEthernet4/0 unassigned      YES unset  administratively down down
FastEthernet5/0 unassigned      YES unset  administratively down down
FastEthernet6/0 unassigned      YES unset  administratively down down
Loopback0       12.12.12.12     YES manual up          up
bankC(config-if)#
```

Figure 14

OSPF Connectivity Proof within P and PE Routers

Loop Back for PE2 is 6.6.6.6

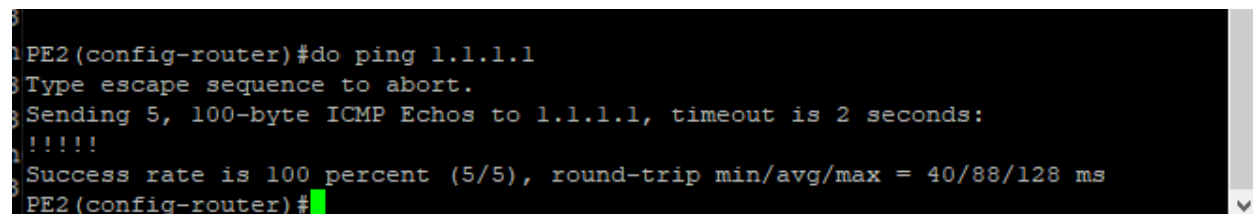


```
PE2
+ - replicated route, % - next hop override

Gateway of last resort is not set

  1.0.0.0/32 is subnetted, 1 subnets
O    1.1.1.1 [110/3] via 10.2.0.37, 00:01:18, FastEthernet0/0
      [110/3] via 10.2.0.33, 00:01:42, FastEthernet1/0
  2.0.0.0/32 is subnetted, 1 subnets
O    2.2.2.2 [110/2] via 10.2.0.37, 00:01:18, FastEthernet0/0
  3.0.0.0/32 is subnetted, 1 subnets
O    3.3.3.3 [110/3] via 10.2.0.37, 00:01:18, FastEthernet0/0
      [110/3] via 10.2.0.33, 00:01:42, FastEthernet1/0
  4.0.0.0/32 is subnetted, 1 subnets
O    4.4.4.4 [110/2] via 10.2.0.33, 00:01:42, FastEthernet1/0
  5.0.0.0/32 is subnetted, 1 subnets
O    5.5.5.5 [110/4] via 10.2.0.37, 00:01:18, FastEthernet0/0
      [110/4] via 10.2.0.33, 00:01:42, FastEthernet1/0
 10.0.0.0/8 is variably subnetted, 21 subnets, 2 masks
O    10.1.0.0/30 [110/4] via 10.2.0.37, 00:01:18, FastEthernet0/0
      [110/4] via 10.2.0.33, 00:01:42, FastEthernet1/0
O    10.1.0.4/30 [110/4] via 10.2.0.37, 00:01:18, FastEthernet0/0
      [110/4] via 10.2.0.33, 00:01:42, FastEthernet1/0
O    10.1.0.8/30 [110/4] via 10.2.0.37, 00:01:18, FastEthernet0/0
      [110/4] via 10.2.0.33, 00:01:42, FastEthernet1/0
O    10.2.0.0/30 [110/3] via 10.2.0.37, 00:01:18, FastEthernet0/0
      [110/3] via 10.2.0.33, 00:01:42, FastEthernet1/0
O    10.2.0.4/30 [110/3] via 10.2.0.37, 00:01:18, FastEthernet0/0
      [110/3] via 10.2.0.33, 00:01:42, FastEthernet1/0
O    10.2.0.8/30 [110/2] via 10.2.0.33, 00:01:42, FastEthernet1/0
O    10.2.0.12/30 [110/3] via 10.2.0.37, 00:01:18, FastEthernet0/0
      [110/3] via 10.2.0.33, 00:01:42, FastEthernet1/0
O    10.2.0.16/30 [110/2] via 10.2.0.37, 00:01:18, FastEthernet0/0
O    10.2.0.20/30 [110/2] via 10.2.0.37, 00:01:18, FastEthernet0/0
O    10.2.0.24/30 [110/2] via 10.2.0.33, 00:01:42, FastEthernet1/0
O    10.2.0.28/30 [110/2] via 10.2.0.37, 00:01:18, FastEthernet0/0
      [110/2] via 10.2.0.33, 00:01:42, FastEthernet1/0
PE2(config-router)#
```

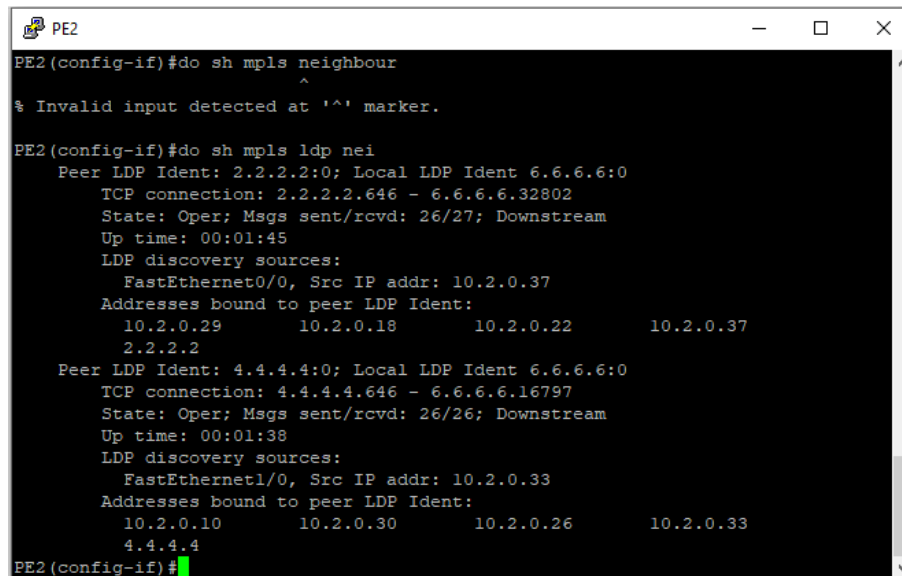
Figure 15



```
PE2(config-router)#do ping 1.1.1.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 40/88/128 ms
PE2(config-router)#
```

Figure 16

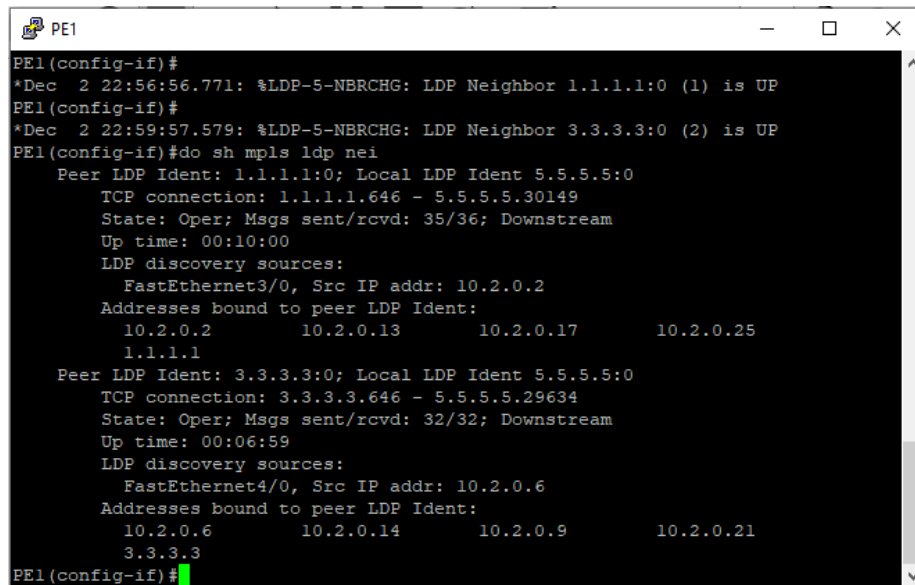
MPLS Implementation displaying MPLS neighbors.



```
PE2
PE2(config-if)#do sh mpls neighbour
^
% Invalid input detected at '^' marker.

PE2(config-if)#do sh mpls ldp nei
  Peer LDP Ident: 2.2.2.2:0; Local LDP Ident 6.6.6.6:0
    TCP connection: 2.2.2.2.646 - 6.6.6.6.32802
    State: Oper; Msgs sent/rcvd: 26/27; Downstream
    Up time: 00:01:45
    LDP discovery sources:
      FastEthernet0/0, Src IP addr: 10.2.0.37
    Addresses bound to peer LDP Ident:
      10.2.0.29      10.2.0.18      10.2.0.22      10.2.0.37
      2.2.2.2
  Peer LDP Ident: 4.4.4.4:0; Local LDP Ident 6.6.6.6:0
    TCP connection: 4.4.4.4.646 - 6.6.6.6.16797
    State: Oper; Msgs sent/rcvd: 26/26; Downstream
    Up time: 00:01:38
    LDP discovery sources:
      FastEthernet1/0, Src IP addr: 10.2.0.33
    Addresses bound to peer LDP Ident:
      10.2.0.10      10.2.0.30      10.2.0.26      10.2.0.33
      4.4.4.4
PE2(config-if)#
```

Figure 17



```
PE1
PE1(config-if)#
*Dec  2 22:56:56.771: %LDP-5-NBRCHG: LDP Neighbor 1.1.1.1:0 (1) is UP
PE1(config-if)#
*Dec  2 22:59:57.579: %LDP-5-NBRCHG: LDP Neighbor 3.3.3.3:0 (2) is UP
PE1(config-if)#do sh mpls ldp nei
  Peer LDP Ident: 1.1.1.1:0; Local LDP Ident 5.5.5.5:0
    TCP connection: 1.1.1.1.646 - 5.5.5.5.30149
    State: Oper; Msgs sent/rcvd: 35/36; Downstream
    Up time: 00:10:00
    LDP discovery sources:
      FastEthernet3/0, Src IP addr: 10.2.0.2
    Addresses bound to peer LDP Ident:
      10.2.0.2      10.2.0.13      10.2.0.17      10.2.0.25
      1.1.1.1
  Peer LDP Ident: 3.3.3.3:0; Local LDP Ident 5.5.5.5:0
    TCP connection: 3.3.3.3.646 - 5.5.5.5.29634
    State: Oper; Msgs sent/rcvd: 32/32; Downstream
    Up time: 00:06:59
    LDP discovery sources:
      FastEthernet4/0, Src IP addr: 10.2.0.6
    Addresses bound to peer LDP Ident:
      10.2.0.6      10.2.0.14      10.2.0.9      10.2.0.21
      3.3.3.3
PE1(config-if)#
```

Figure 18

```
P1
*Dec 2 22:54:53.059: %LDP-5-NBRCHG: LDP Neighbor 2.2.2.2:0 (2) is UP
P1(config-if)#
*Dec 2 22:56:03.663: %LDP-5-NBRCHG: LDP Neighbor 3.3.3.3:0 (3) is UP
P1(config-if)#
*Dec 2 22:57:43.891: %LDP-5-NBRCHG: LDP Neighbor 4.4.4.4:0 (4) is UP
P1(config-if)#do sh mpls ldp nei
  Peer LDP Ident: 5.5.5.5:0; Local LDP Ident 1.1.1.1:0
    TCP connection: 5.5.5.5.30149 - 1.1.1.1.646
    State: Oper; Msgs sent/rcvd: 39/39; Downstream
    Up time: 00:12:40
    LDP discovery sources:
      FastEthernet0/0, Src IP addr: 10.2.0.1
    Addresses bound to peer LDP Ident:
      10.1.0.2      10.1.0.6      10.1.0.10      10.2.0.1
      10.2.0.5      5.5.5.5
  Peer LDP Ident: 2.2.2.2:0; Local LDP Ident 1.1.1.1:0
    TCP connection: 2.2.2.2.52589 - 1.1.1.1.646
    State: Oper; Msgs sent/rcvd: 37/36; Downstream
    Up time: 00:10:44
    LDP discovery sources:
      FastEthernet2/0, Src IP addr: 10.2.0.18
    Addresses bound to peer LDP Ident:
      10.2.0.29      10.2.0.18      10.2.0.22      10.2.0.37
      2.2.2.2
  Peer LDP Ident: 3.3.3.3:0; Local LDP Ident 1.1.1.1:0
    TCP connection: 3.3.3.3.33596 - 1.1.1.1.646
    State: Oper; Msgs sent/rcvd: 35/35; Downstream
    Up time: 00:09:33
    LDP discovery sources:
      FastEthernet1/0, Src IP addr: 10.2.0.14
    Addresses bound to peer LDP Ident:
      10.2.0.6      10.2.0.14      10.2.0.9      10.2.0.21
      3.3.3.3
  Peer LDP Ident: 4.4.4.4:0; Local LDP Ident 1.1.1.1:0
    TCP connection: 4.4.4.4.29964 - 1.1.1.1.646
    State: Oper; Msgs sent/rcvd: 34/34; Downstream
    Up time: 00:07:53
    LDP discovery sources:
      FastEthernet3/0, Src IP addr: 10.2.0.26
    Addresses bound to peer LDP Ident:
      10.2.0.10      10.2.0.30      10.2.0.26      10.2.0.33
      4.4.4.4
P1(config-if)#
```

Figure 19

Ip Vrfs on Router PE1 and on PE2

```
PE1
PE1(config-vrf)#route-target export 55000:300
PE1(config-vrf)#do sh ip vrf
  Name                Default RD      Interfaces
  Bank-A              55000:100
  Bank-B              55000:200
  Bank-C              55000:300
PE1(config-vrf)#do sh ip vrf detail
VRF Bank-A (VRF Id = 1); default RD 55000:100; default VPNID <not set>
  No interfaces
  VRF Table ID = 1
    Export VPN route-target communities
      RT:55000:100      RT:55000:200      RT:55000:300
    Import VPN route-target communities
      RT:55000:100      RT:55000:200      RT:55000:300
    No import route-map
    No export route-map
    VRF label distribution protocol: not configured
    VRF label allocation mode: per-prefix
VRF Bank-B (VRF Id = 2); default RD 55000:200; default VPNID <not set>
  No interfaces
  VRF Table ID = 2
    Export VPN route-target communities
      RT:55000:200
    Import VPN route-target communities
      RT:55000:200
    No import route-map
    No export route-map
    VRF label distribution protocol: not configured
    VRF label allocation mode: per-prefix
VRF Bank-C (VRF Id = 3); default RD 55000:300; default VPNID <not set>
  No interfaces
  VRF Table ID = 3
    Export VPN route-target communities
      RT:55000:300
    Import VPN route-target communities
      RT:55000:300
    No import route-map
    No export route-map
    VRF label distribution protocol: not configured
```

Figure 20

PE2

```
PE2
PE2(config-vrf)#do sh ip vrf
      Name                               Default RD      Interfaces
-----
Bank-A                               55000:100
Bank-B                               55000:200
Bank-C                               55000:300
PE2(config-vrf)#do sh ip vrf detail
VRF Bank-A (VRF Id = 1); default RD 55000:100; default VPNID <not set>
  No interfaces
  VRF Table ID = 1
  Export VPN route-target communities
    RT:55000:100
  Import VPN route-target communities
    RT:55000:100
  No import route-map
  No export route-map
  VRF label distribution protocol: not configured
  VRF label allocation mode: per-prefix

VRF Bank-B (VRF Id = 2); default RD 55000:200; default VPNID <not set>
  No interfaces
  VRF Table ID = 2
  Export VPN route-target communities
    RT:55000:200
  Import VPN route-target communities
    RT:55000:200
  No import route-map
  No export route-map
  VRF label distribution protocol: not configured
  VRF label allocation mode: per-prefix

VRF Bank-C (VRF Id = 3); default RD 55000:300; default VPNID <not set>
  No interfaces
  VRF Table ID = 3
  Export VPN route-target communities
    RT:55000:300
  Import VPN route-target communities
```

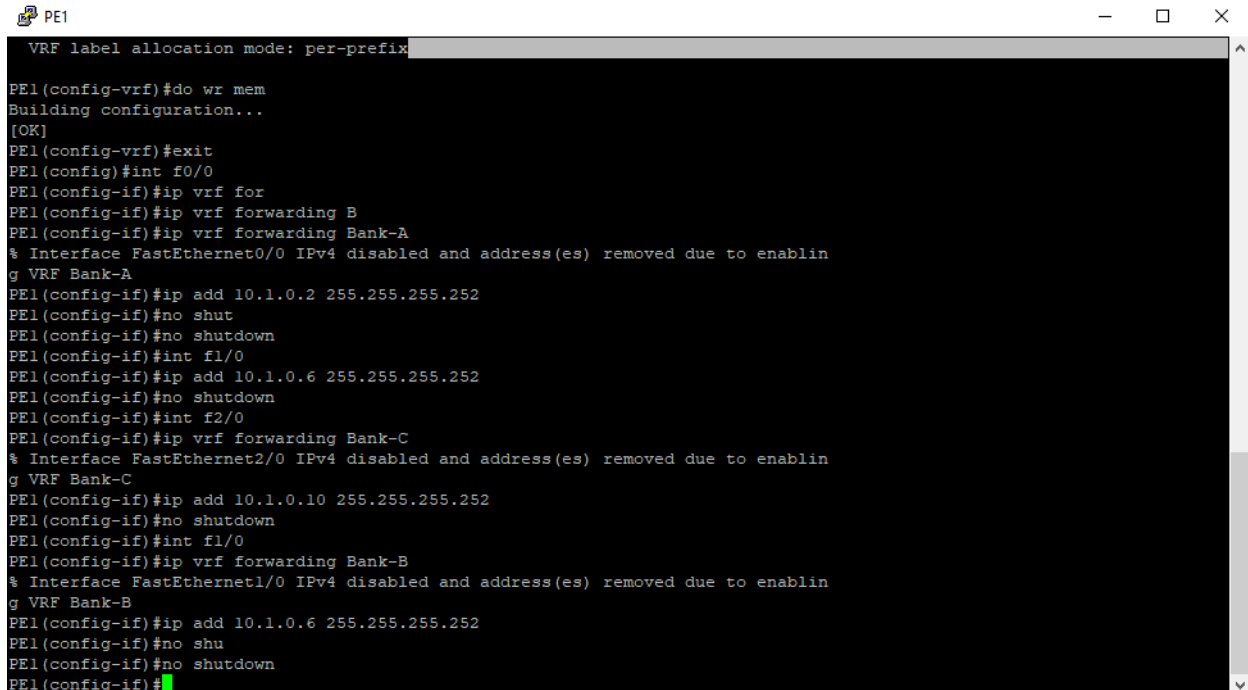
Figure 21

Assigning interface vrfs

```
PE1
VRF label allocation mode: per-prefix

PE1(config-vrf)#do wr mem
Building configuration...
[OK]
PE1(config-vrf)#exit
PE1(config)#int f0/0
PE1(config-if)#ip vrf for
PE1(config-if)#ip vrf forwarding B
PE1(config-if)#ip vrf forwarding Bank-A
% Interface FastEthernet0/0 IPv4 disabled and address(es) removed due to enabling VRF Bank-A
PE1(config-if)#ip add 10.1.0.2 255.255.255.252
PE1(config-if)#no shut
PE1(config-if)#no shutdown
PE1(config-if)#int f1/0
PE1(config-if)#ip add 10.1.0.6 255.255.255.252
PE1(config-if)#no shutdown
PE1(config-if)#int f2/0
PE1(config-if)#ip vrf forwarding Bank-C
% Interface FastEthernet2/0 IPv4 disabled and address(es) removed due to enabling VRF Bank-C
PE1(config-if)#ip add 10.1.0.10 255.255.255.252
PE1(config-if)#no shutdown
PE1(config-if)#int f1/0
PE1(config-if)#ip vrf forwarding Bank-B
% Interface FastEthernet1/0 IPv4 disabled and address(es) removed due to enabling VRF Bank-B
PE1(config-if)#ip add 10.1.0.6 255.255.255.252
PE1(config-if)#no shut
PE1(config-if)#no shutdown
PE1(config-if)#
```

Figure 22

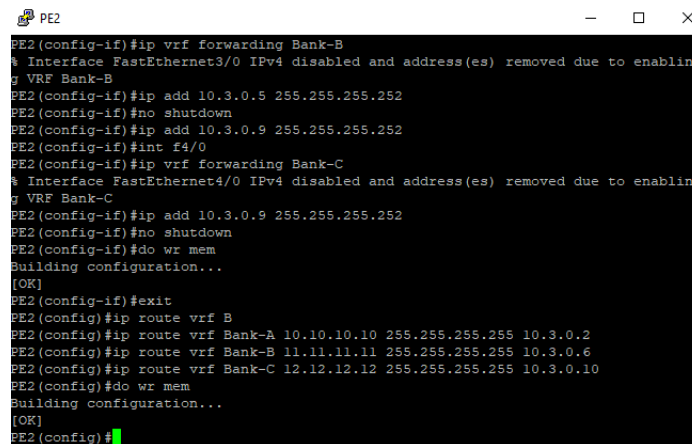


```
PE1
VRF label allocation mode: per-prefix

PE1(config-vrf)#do wr mem
Building configuration...
[OK]
PE1(config-vrf)#exit
PE1(config)#int f0/0
PE1(config-if)#ip vrf for
PE1(config-if)#ip vrf forwarding B
PE1(config-if)#ip vrf forwarding Bank-A
% Interface FastEthernet0/0 IPv4 disabled and address(es) removed due to enablin
g VRF Bank-A
PE1(config-if)#ip add 10.1.0.2 255.255.255.252
PE1(config-if)#no shut
PE1(config-if)#no shutdown
PE1(config-if)#int f1/0
PE1(config-if)#ip add 10.1.0.6 255.255.255.252
PE1(config-if)#no shutdown
PE1(config-if)#int f2/0
PE1(config-if)#ip vrf forwarding Bank-C
% Interface FastEthernet2/0 IPv4 disabled and address(es) removed due to enablin
g VRF Bank-C
PE1(config-if)#ip add 10.1.0.10 255.255.255.252
PE1(config-if)#no shutdown
PE1(config-if)#int f1/0
PE1(config-if)#ip vrf forwarding Bank-B
% Interface FastEthernet1/0 IPv4 disabled and address(es) removed due to enablin
g VRF Bank-B
PE1(config-if)#ip add 10.1.0.6 255.255.255.252
PE1(config-if)#no shu
PE1(config-if)#no shutdown
PE1(config-if)#
```

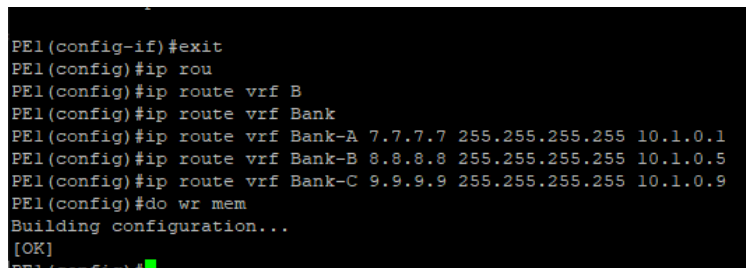
Figure 23

Defining Routes for Costumer Edges to travel in Vrfs



```
PE2
PE2(config-if)#ip vrf forwarding Bank-B
% Interface FastEthernet3/0 IPv4 disabled and address(es) removed due to enablin
g VRF Bank-B
PE2(config-if)#ip add 10.3.0.5 255.255.255.252
PE2(config-if)#no shutdown
PE2(config-if)#ip add 10.3.0.9 255.255.255.252
PE2(config-if)#int f4/0
PE2(config-if)#ip vrf forwarding Bank-C
% Interface FastEthernet4/0 IPv4 disabled and address(es) removed due to enablin
g VRF Bank-C
PE2(config-if)#ip add 10.3.0.9 255.255.255.252
PE2(config-if)#no shutdown
PE2(config-if)#do wr mem
Building configuration...
[OK]
PE2(config-if)#exit
PE2(config)#ip route vrf B
PE2(config)#ip route vrf Bank-A 10.10.10.10 255.255.255.255 10.3.0.2
PE2(config)#ip route vrf Bank-B 11.11.11.11 255.255.255.255 10.3.0.6
PE2(config)#ip route vrf Bank-C 12.12.12.12 255.255.255.255 10.3.0.10
PE2(config)#do wr mem
Building configuration...
[OK]
PE2(config)#
```

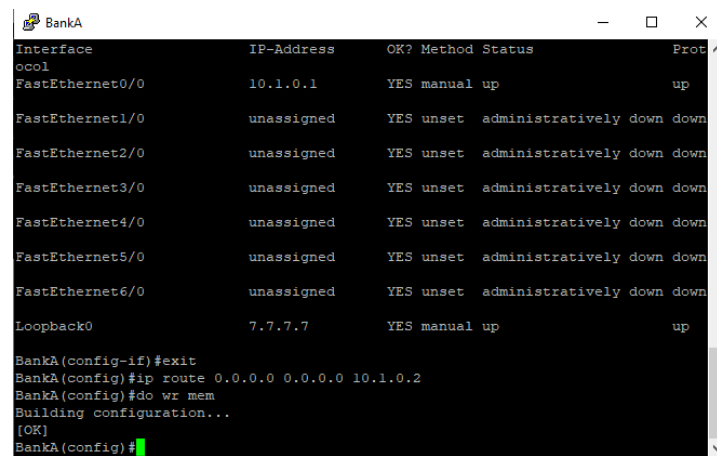
Figure 24



```
PE1(config-if)#exit
PE1(config)#ip rou
PE1(config)#ip route vrf B
PE1(config)#ip route vrf Bank
PE1(config)#ip route vrf Bank-A 7.7.7.7 255.255.255.255 10.1.0.1
PE1(config)#ip route vrf Bank-B 8.8.8.8 255.255.255.255 10.1.0.5
PE1(config)#ip route vrf Bank-C 9.9.9.9 255.255.255.255 10.1.0.9
PE1(config)#do wr mem
Building configuration...
[OK]
PE1(config)#
```

Figure 25

Defining Static Routes for Costumer Edges

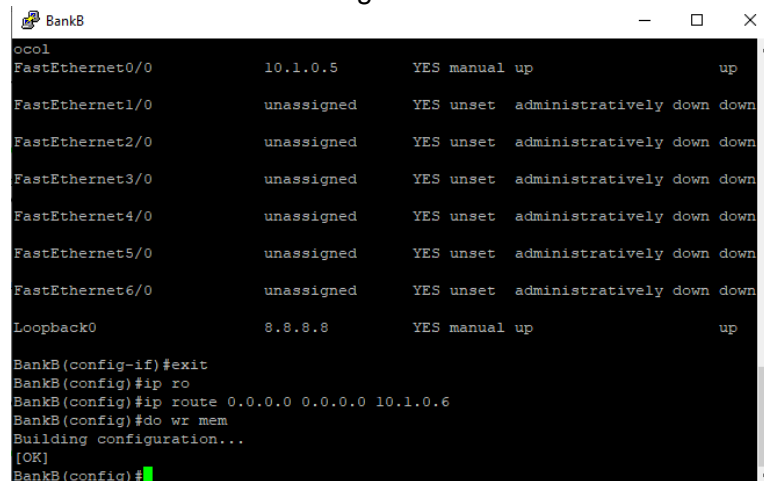


BankA

Interface	IP-Address	OK?	Method	Status	Prot
oCol					
FastEthernet0/0	10.1.0.1	YES	manual	up	up
FastEthernet1/0	unassigned	YES	unset	administratively down	down
FastEthernet2/0	unassigned	YES	unset	administratively down	down
FastEthernet3/0	unassigned	YES	unset	administratively down	down
FastEthernet4/0	unassigned	YES	unset	administratively down	down
FastEthernet5/0	unassigned	YES	unset	administratively down	down
FastEthernet6/0	unassigned	YES	unset	administratively down	down
Loopback0	7.7.7.7	YES	manual	up	up

```
BankA(config-if)#exit
BankA(config)#ip route 0.0.0.0 0.0.0.0 10.1.0.2
BankA(config)#do wr mem
Building configuration...
[OK]
BankA(config)#
```

Figure 26

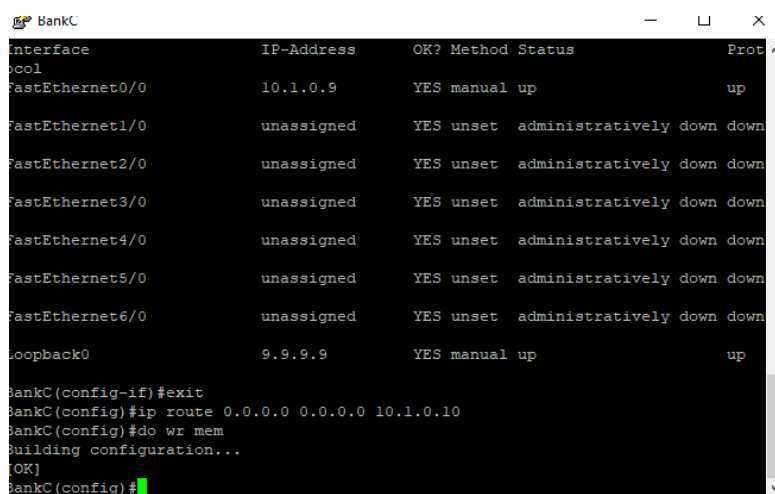


BankB

oCol					
FastEthernet0/0	10.1.0.5	YES	manual	up	up
FastEthernet1/0	unassigned	YES	unset	administratively down	down
FastEthernet2/0	unassigned	YES	unset	administratively down	down
FastEthernet3/0	unassigned	YES	unset	administratively down	down
FastEthernet4/0	unassigned	YES	unset	administratively down	down
FastEthernet5/0	unassigned	YES	unset	administratively down	down
FastEthernet6/0	unassigned	YES	unset	administratively down	down
Loopback0	8.8.8.8	YES	manual	up	up

```
BankB(config-if)#exit
BankB(config)#ip ro
BankB(config)#ip route 0.0.0.0 0.0.0.0 10.1.0.6
BankB(config)#do wr mem
Building configuration...
[OK]
BankB(config)#
```

Figure 27



BankC

Interface	IP-Address	OK?	Method	Status	Prot
oCol					
FastEthernet0/0	10.1.0.9	YES	manual	up	up
FastEthernet1/0	unassigned	YES	unset	administratively down	down
FastEthernet2/0	unassigned	YES	unset	administratively down	down
FastEthernet3/0	unassigned	YES	unset	administratively down	down
FastEthernet4/0	unassigned	YES	unset	administratively down	down
FastEthernet5/0	unassigned	YES	unset	administratively down	down
FastEthernet6/0	unassigned	YES	unset	administratively down	down
Loopback0	9.9.9.9	YES	manual	up	up

```
BankC(config-if)#exit
BankC(config)#ip route 0.0.0.0 0.0.0.0 10.1.0.10
BankC(config)#do wr mem
Building configuration...
[OK]
BankC(config)#
```

Figure 28

```
bankA
Interface      IP-Address      OK? Method Status      Prot
FastEthernet0/0  10.3.0.2        YES manual administratively down down
FastEthernet1/0  unassigned      YES unset  administratively down down
FastEthernet2/0  unassigned      YES unset  administratively down down
FastEthernet3/0  unassigned      YES unset  administratively down down
FastEthernet4/0  unassigned      YES unset  administratively down down
FastEthernet5/0  unassigned      YES unset  administratively down down
FastEthernet6/0  unassigned      YES unset  administratively down down
Loopback0       10.10.10.10     YES manual up          up

bankA(config-if)#exit
bankA(config)#ip route 0.0.0.0 0.0.0.0 10.3.0.1
bankA(config)#do wr mem
Building configuration...
[OK]
bankA(config)#
```

Figure 29

```
bankB
FastEthernet1/0  unassigned      YES unset  administratively down down
FastEthernet2/0  unassigned      YES unset  administratively down down
FastEthernet3/0  unassigned      YES unset  administratively down down
FastEthernet4/0  unassigned      YES unset  administratively down down
FastEthernet5/0  unassigned      YES unset  administratively down down
FastEthernet6/0  unassigned      YES unset  administratively down down
Loopback0       11.11.11.11     YES manual up          up

bankB(config-if)#exit
bankB(config)#ip route 0.0.0.0 0.0.0.0 10.3.0.5
bankB(config)#wr mem
^
% Invalid input detected at '^' marker.

bankB(config)#do wr mem
Building configuration...
[OK]
bankB(config)#
```

Figure 30

```
bankC
Interface      IP-Address      OK? Method Status      Prot
FastEthernet0/0  10.3.0.10       YES manual up          up
FastEthernet1/0  unassigned      YES unset  administratively down down
FastEthernet2/0  unassigned      YES unset  administratively down down
FastEthernet3/0  unassigned      YES unset  administratively down down
FastEthernet4/0  unassigned      YES unset  administratively down down
FastEthernet5/0  unassigned      YES unset  administratively down down
FastEthernet6/0  unassigned      YES unset  administratively down down
Loopback0       12.12.12.12     YES manual up          up

bankC(config-if)#exit
bankC(config)#ip route 0.0.0.0 0.0.0.0 10.3.0.9
bankC(config)#do wr mem
Building configuration...
[OK]
bankC(config)#
```

Figure 31

Implementing BGP on pe routers And Re distributing them with static routes

PE1

```
PE1(config)#ip route vrf Bank-A 7.7.7.7 255.255.255.255 10.1.0.1
PE1(config)#ip route vrf Bank-B 8.8.8.8 255.255.255.255 10.1.0.5
PE1(config)#ip route vrf Bank-C 9.9.9.9 255.255.255.255 10.1.0.9
PE1(config)#do wr mem
Building configuration...
[OK]
PE1(config)#router bgp 55000
PE1(config-router)#
PE1(config-router)#nei
PE1(config-router)#neighbor 6.6.6.6 rem
PE1(config-router)#neighbor 6.6.6.6 remo
PE1(config-router)#neighbor 6.6.6.6 remote-as 55000
PE1(config-router)#nei 6.6.6.6 upd
PE1(config-router)#nei 6.6.6.6 update-source loo
PE1(config-router)#nei 6.6.6.6 update-source loopback 0
PE1(config-router)#add
PE1(config-router)#address-family vpnv4
PE1(config-router-af)#nei
PE1(config-router-af)#neighbor 6.6.6.6 ac
PE1(config-router-af)#neighbor 6.6.6.6 activate
PE1(config-router-af)#neighbor 6.6.6.6 next
PE1(config-router-af)#neighbor 6.6.6.6 next-hop-
PE1(config-router-af)#neighbor 6.6.6.6 next-hop-s
PE1(config-router-af)#neighbor 6.6.6.6 next-hop-self
PE1(config-router-af)#neighbor 6.6.6.6 sen
PE1(config-router-af)#neighbor 6.6.6.6 send-community b
PE1(config-router-af)#neighbor 6.6.6.6 send-community both
PE1(config-router-af)#add
PE1(config-router-af)#exit
PE1(config-router)#add
PE1(config-router)#address-family ipv4 vrf B
PE1(config-router)#address-family ipv4 vrf Bank-A
PE1(config-router-af)#red
PE1(config-router-af)#redistribute st
PE1(config-router-af)#redistribute static
PE1(config-router-af)#redistribute conn
PE1(config-router-af)#redistribute connected
PE1(config-router-af)#address-family ipv4 vrf Bank-B
PE1(config-router-af)#redistribute static
PE1(config-router-af)#redistribute connected
PE1(config-router-af)#address-family ipv4 vrf Bank-C
PE1(config-router-af)#redistribute static
PE1(config-router-af)#redistribute connected
PE1(config-router-af)#
```

Figure 32

PE2

```
PE2(config)#router bgp 55000
PE2(config-router)#ne
PE2(config-router)#nei
PE2(config-router)#neighbor 5.5.5.5 remote-as 55000
PE2(config-router)#neighbor 5.5.5.5 upd
PE2(config-router)#neighbor 5.5.5.5 update-source
*Dec 2 23:52:50.083: %BGP-5-ADJCHANGE: neighbor 5.5.5.5 Up
PE2(config-router)#neighbor 5.5.5.5 update-source lo
PE2(config-router)#neighbor 5.5.5.5 update-source loo
PE2(config-router)#neighbor 5.5.5.5 update-source loopback 0
PE2(config-router)#add
PE2(config-router)#address-family vpvv4
PE2(config-router-af)#nei 5.5.5.5 act
PE2(config-router-af)#nei 5.5.5.5 activate
PE2(config-router-af)#nei 5.5.5.5 activate
*Dec 2 23:53:54.391: %BGP-5-ADJCHANGE: neighbor 5.5.5.5 Down Capability changed
*Dec 2 23:53:54.395: %BGP_SESSION-5-ADJCHANGE: neighbor 5.5.5.5 IPv4 Unicast to
pology base removed from session Capability changed
PE2(config-router-af)#nei 5.5.5.5 activate
*Dec 2 23:53:55.447: %BGP-5-ADJCHANGE: neighbor 5.5.5.5 Up
PE2(config-router-af)#nei 5.5.5.5 nei
PE2(config-router-af)#nei 5.5.5.5 ne
PE2(config-router-af)#nei 5.5.5.5 next-hop-s
PE2(config-router-af)#nei 5.5.5.5 next-hop-self
PE2(config-router-af)#nei 5.5.5.5 sen
PE2(config-router-af)#nei 5.5.5.5 send-community both
PE2(config-router-af)#exit
PE2(config-router)#add
PE2(config-router)#address-family ipv4 vrf Bank-A
PE2(config-router-af)#red
PE2(config-router-af)#redistribute st
PE2(config-router-af)#redistribute static
PE2(config-router-af)#redistribute con
PE2(config-router-af)#redistribute connected
PE2(config-router-af)#address-family ipv4 vrf Bank-B
PE2(config-router-af)#redistribute static
PE2(config-router-af)#redistribute connected
PE2(config-router-af)#address-family ipv4 vrf Bank-C
PE2(config-router-af)#redistribute static
PE2(config-router-af)#redistribute connected
PE2(config-router-af)#do wr mem
Building configuration...
[OK]
PE2(config-router-af)#
```

Figure 33

Confirmation Of Routes Successfully Vpn has been implemented.

```
PE1
PE1(config-router-af)#
*Dec 3 00:09:25.163: %BGP-5-ADJCHANGE: neighbor 6.6.6.6 Down Peer closed the session
*Dec 3 00:09:25.167: %BGP_SESSION-5-ADJCHANGE: neighbor 6.6.6.6 IPv4 Unicast topology base remov
*Dec 3 00:09:26.167: %BGP-5-ADJCHANGE: neighbor 6.6.6.6 Up
PE1(config-router-af)#do wr mem
Building configuration...
[OK]
PE1(config-router-af)#end
PE1#sh
*Dec 3 00:12:24.019: %SYS-5-CONFIG_I: Configured from console by console
PE1#sh ip route vrf B
PE1#sh ip route vrf Bank-A

Routing Table: Bank-A
Codes: L - local, C - connected, S - static, 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
       i - IS-IS, su - IS-IS summary, 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, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set

    7.0.0.0/32 is subnetted, 1 subnets
    S      7.7.7.7 [1/0] via 10.1.0.1
    8.0.0.0/32 is subnetted, 1 subnets
    B      8.8.8.8 [20/0] via 10.1.0.5 (Bank-B), 00:07:01
    9.0.0.0/32 is subnetted, 1 subnets
    B      9.9.9.9 [20/0] via 10.1.0.9 (Bank-C), 00:06:52
    10.0.0.0/8 is variably subnetted, 9 subnets, 2 masks
    C      10.1.0.0/30 is directly connected, FastEthernet0/0
    L      10.1.0.2/32 is directly connected, FastEthernet0/0
    B      10.1.0.4/30 is directly connected (Bank-B), 00:06:59, FastEthernet1/0
    L      10.1.0.6/32 is directly connected, FastEthernet1/0
    B      10.1.0.8/30 is directly connected (Bank-C), 00:06:50, FastEthernet2/0
    L      10.1.0.10/32 is directly connected, FastEthernet2/0
    B      10.3.0.0/30 [200/0] via 6.6.6.6, 00:01:38
    B      10.3.0.8/30 [200/0] via 6.6.6.6, 00:01:28
    B      10.10.10.10/32 [200/0] via 6.6.6.6, 00:01:43
    12.0.0.0/32 is subnetted, 1 subnets
    B      12.12.12.12 [200/0] via 6.6.6.6, 00:01:18
PE1#
```

Figure 34

```
PE1#sh ip route vrf Bank-B

Routing Table: Bank-B
Codes: L - local, C - connected, S - static, 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
       i - IS-IS, su - IS-IS summary, 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, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set

    7.0.0.0/32 is subnetted, 1 subnets
    B      7.7.7.7 [20/0] via 10.1.0.1 (Bank-A), 00:10:57
    8.0.0.0/32 is subnetted, 1 subnets
    S      8.8.8.8 [1/0] via 10.1.0.5
    10.0.0.0/8 is variably subnetted, 5 subnets, 2 masks
    B      10.1.0.0/30 is directly connected (Bank-A), 00:10:50, FastEthernet0/0
    L      10.1.0.2/32 is directly connected, FastEthernet0/0
    C      10.1.0.4/30 is directly connected, FastEthernet1/0
    L      10.1.0.6/32 is directly connected, FastEthernet1/0
    B      10.3.0.8/30 [200/0] via 6.6.6.6, 00:04:54
PE1#
```

Figure 35

```

PE1#sh ip route vrf Bank-C

Routing Table: Bank-C
Codes: L - local, C - connected, S - static, 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
       i - IS-IS, su - IS-IS summary, 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, H - NHRP, l - LISP
       + - replicated route, % - next hop override

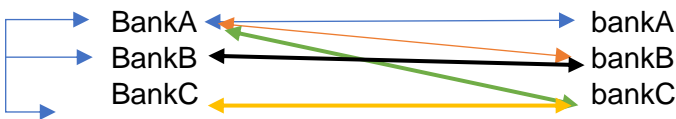
Gateway of last resort is not set

  7.0.0.0/32 is subnetted, 1 subnets
B       7.7.7.7 [20/0] via 10.1.0.1 (Bank-A), 00:11:25
  9.0.0.0/32 is subnetted, 1 subnets
S       9.9.9.9 [1/0] via 10.1.0.9
 10.0.0.0/8 is variably subnetted, 5 subnets, 2 masks
B       10.1.0.0/30 is directly connected (Bank-A), 00:11:18, FastEthernet0/0
L       10.1.0.2/32 is directly connected, FastEthernet0/0
C       10.1.0.8/30 is directly connected, FastEthernet2/0
L       10.1.0.10/32 is directly connected, FastEthernet2/0
B       10.3.0.8/30 [200/0] via 6.6.6.6, 00:05:10
 12.0.0.0/32 is subnetted, 1 subnets
B       12.12.12.12 [200/0] via 6.6.6.6, 00:05:12
PE1#

```

Figure 36

Plan for Implementation



Ping test according to policy A to All

```

BankA
 6 * * *
 7 * * *
 8 * * *
 9 * * *
10 * * *
11 * * *
12 * * *
13 *
   10.3.0.2 140 msec 172 msec
BankA#traceroute 10.10.10.10
Type escape sequence to abort.
Tracing the route to 10.10.10.10
VRF info: (vrf in name/id, vrf out name/id)
 1 10.1.0.2 88 msec 104 msec 84 msec
 2 10.2.0.6 [MPLS: Labels 20/21 Exp 0] 168 msec 204 msec 220 msec
 3 10.2.0.22 [MPLS: Labels 23/21 Exp 0] 168 msec 188 msec 180 msec
 4 10.3.0.1 [MPLS: Label 21 Exp 0] 128 msec 180 msec 132 msec
 5 10.3.0.2 212 msec 184 msec 192 msec
BankA#ping 10.10.10.10
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.10.10.10, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 136/173/212 ms
BankA#

```

Figure 37

BankA-bankC

```
BankA#ping 12.12.12.12
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 12.12.12.12, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 128/176/224 ms
BankA#
```

Figure 38

BankC-bankC

```
bankC
FastEthernet6/0      unassigned      YES unset  administratively down down
Loopback0           12.12.12.12      YES manual up          up

bankC(config-if)#exit
bankC(config)#ip route 0.0.0.0 0.0.0.0 10.3.0.9
bankC(config)#do wr mem
Building configuration...
[OK]
bankC(config)#int f0/0
bankC(config-if)#no sh
bankC(config-if)#no shutdown
bankC(config-if)#exit
bankC(config)#ping 12.12.12.12
^
% Invalid input detected at '^' marker.

bankC(config)#do ping 12.12.12.12
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 12.12.12.12, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 4/7/8 ms
bankC(config)#
```

Figure 38

bankB-BankA

```
bankB
bankB(config-if)#shutdown
bankB(config-if)#
*Dec 3 00:33:43.071: %LINK-5-CHANGED: Interface FastEthernet0/0, changed state
to administratively down
*Dec 3 00:33:44.071: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthern
et0/0, changed state to down
bankB(config-if)#int f1/0
bankB(config-if)#ip add 10.3.0.6 255.255.255.252
bankB(config-if)#no shu
bankB(config-if)#no shutdown
bankB(config-if)#
*Dec 3 00:34:13.883: %LINK-3-UPDOWN: Interface FastEthernet1/0, changed state t
o up
*Dec 3 00:34:14.883: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthern
et1/0, changed state to up
bankB(config-if)#end
bankB#
*Dec 3 00:42:47.391: %SYS-5-CONFIG_I: Configured from console by console
bankB#ping 7.7.7.7
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 7.7.7.7, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 132/172/216 ms
bankB#
```

Figure 39

bankb – BankB

```
bankB
et0/0, changed state to down
bankB(config-if)#int f1/0
bankB(config-if)#ip add 10.3.0.6 255.255.255.252
bankB(config-if)#no shu
bankB(config-if)#no shutdown
bankB(config-if)#
*Dec 3 00:34:13.883: %LINK-3-UPDOWN: Interface FastEthernet1/0, changed state to up
*Dec 3 00:34:14.883: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet1/0, changed state to up
bankB(config-if)#end
bankB#
*Dec 3 00:42:47.391: %SYS-5-CONFIG_I: Configured from console by console
bankB#ping 7.7.7.7
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 7.7.7.7, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 132/172/216 ms
bankB#ping 8.8.8.8
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 8.8.8.8, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 180/208/224 ms
bankB#
```

Figure 40

And As per the policy bankB cannot communicate with Bank C

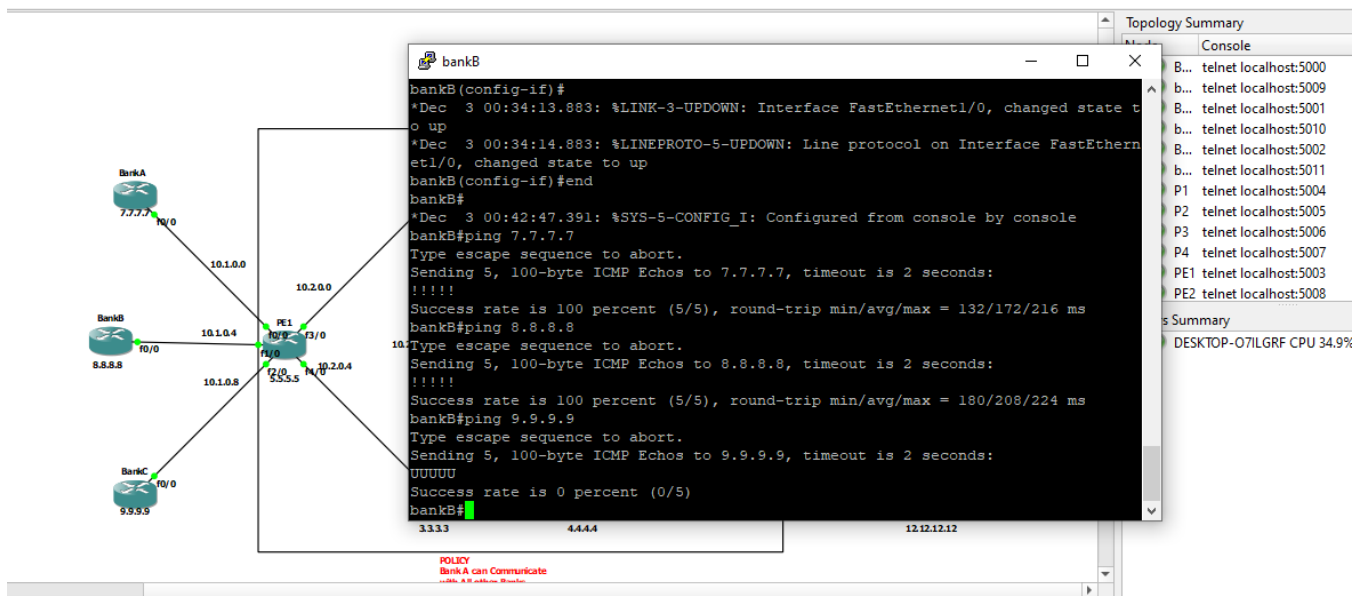
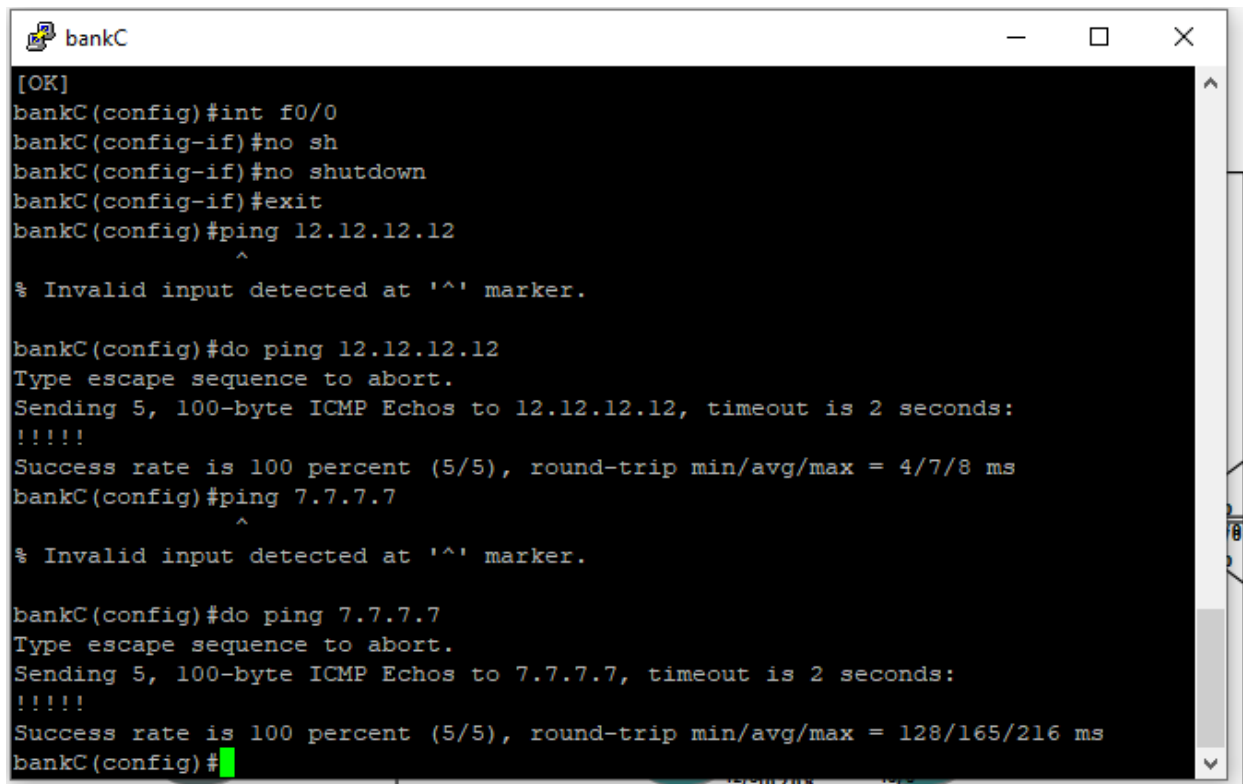


Figure 41

bankC- BankA



```
[OK]
bankC(config)#int f0/0
bankC(config-if)#no sh
bankC(config-if)#no shutdown
bankC(config-if)#exit
bankC(config)#ping 12.12.12.12
^
% Invalid input detected at '^' marker.

bankC(config)#do ping 12.12.12.12
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 12.12.12.12, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 4/7/8 ms
bankC(config)#ping 7.7.7.7
^
% Invalid input detected at '^' marker.

bankC(config)#do ping 7.7.7.7
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 7.7.7.7, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 128/165/216 ms
bankC(config)#
```

Figure 42