Configuring VRF Lite

This chapter describes how to configure VPN Routing and Forwarding Lite (VRF Lite) for the ML-Series cards. For additional information about the Cisco IOS commands used in this chapter, refer to the *Cisco IOS Command Reference* publication. This chapter contains the following major sections:

Note If you have already configured bridging, you may now proceed with configuring VRF Lite as an optional step.

Understanding VRF Lite

VRF is an extension of IP routing that provides multiple routing instances. It provides a separate IP routing and forwarding table to each VPN and is used in concert with MP-iBGP (Multi-Protocol internal BGP) between provider equipment (PE) routers to provide Layer 3 MPLS-VPN. However, ML-Series VRF implementation is without MP-iBGP. With VRF Lite, the ML Series is considered a PE-extension or a customer equipment (CE)-extension. VRF Lite is considered a PE-extension since its has VRF (but without MP-iBGP), and it is considered a CE-extension since this CE can have multiple VRFs and serves many customer with one CE box.

Under VRF Lite, an ML-Series CE can have multiple interfaces/subinterfaces with PE for different customers (while a normal CE is only for one customer). It holds VRFs (routing information) locally and it does not distribute the VRFs to its connected PE(s). It uses VRF information to direct traffic to the correct interfaces/subinterfaces when it receives traffic from customers' routers or from Internet service provider (ISP) PE router(s).

Configuring VRF Lite
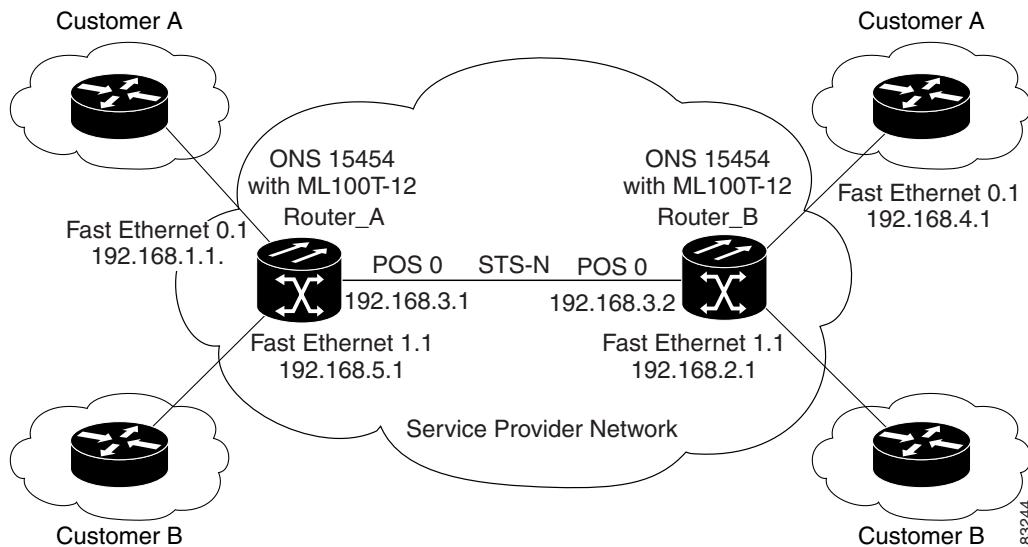
Perform the following procedure to configure VRF Lite:

	Command	Purpose
Step 1	Router(config)# **ip vrf** *vrf-name*	Enters VRF configuration mode and assigns a VRF name.
Step 2	Router(config-vrf)# **rd** *route-distinguisher*	Creates a VPN route distinguisher.
Step 3	Router(config-vrf)# **route-target** {**import** | **export** | **both**} *route-distinguisher*	Creates a list of import and/or export route target communities for the specified VRF.
Step 4	**Router(config-vrf)# import map** *route-map*	(Optional) Associates the specified route map with the VRF.
Step 5	Router(config-vrf)# **exit**	Exits the current configuration mode and enters global configuration mode.
Step 6	Router(config)# **interface type number**	Specifies an interface and enters interface configuration mode.
Step 7	Router(config-vrf)# **ip vrf forwarding** *vrf-name*	Associates a VRF with an interface or subinterface.
Step 8	Router(config-if)# **end**	Exits to privileged EXEC mode.
Step 9	Router# **copy running-config startup-config**	(Optional) Saves configuration changes to NVRAM.

Example 12-1   Configuring a VRF (customer_a) with a route-distinguisher of 1:1 to Fast Ethernet Interface 0.1

```
Router(config)# ip vrf customer_a
Router(config-vrf)# rd 1:1
Router(config-vrf)# route-target both 1:1
Router(config)# interface fastEthernet 0.1
Router(config-subif)# ip vrf forwarding customer_a
```

VRF Lite Configuration Example

Figure 12-1 shows an example of a VRF Lite configuration. The configurations for Router A and Router B are provided in Example 12-2 and Example 12-3 on page 12-4, respectively. The associated routing tables are shown in Example 12-4 on page 12-5 through Example 12-9 on page 12-7.

Figure 12-1   VRF Lite—Sample Network Scenario

Example 12-2   Router A Configuration

```
hostname Router_A
!
ip vrf customer_a
 rd 1:1
 route-target export 1:1
 route-target import 1:1
!
ip vrf customer_b
 rd 2:2
 route-target export 2:2
 route-target import 2:2
!
bridge 1 protocol ieee
bridge 2 protocol ieee
bridge 3 protocol ieee
!
!
interface FastEthernet0
 no ip address
!
interface FastEthernet0.1
 encapsulation dot1Q 2
 ip vrf forwarding customer_a
 ip address 192.168.1.1 255.255.255.0
 bridge-group 2
!
interface FastEthernet1
 no ip address
!
interface FastEthernet1.1
 encapsulation dot1Q 3
 ip vrf forwarding customer_b
 ip address 192.168.2.1 255.255.255.0
 bridge-group 3
!
interface POS0
```

```
 no ip address
 crc 32
 no cdp enable
 pos flag c2 1
!
interface POS0.1
 encapsulation dot1Q 1 native
 ip address 192.168.50.1 255.255.255.0
 bridge-group 1
!
interface POS0.2
 encapsulation dot1Q 2
 ip vrf forwarding customer_a
 ip address 192.168.100.1 255.255.255.0
 bridge-group 2
!
interface POS0.3
 encapsulation dot1Q 3
 ip vrf forwarding customer_b
 ip address 192.168.200.1 255.255.255.0
 bridge-group 3
!
router ospf 1
 log-adjacency-changes
 network 192.168.50.0 0.0.0.255 area 0
!
router ospf 2 vrf customer_a
 log-adjacency-changes
 network 192.168.1.0 0.0.0.255 area 0
 network 192.168.100.0 0.0.0.255 area 0
!
router ospf 3 vrf customer_b
 log-adjacency-changes
 network 192.168.2.0 0.0.0.255 area 0
 network 192.168.200.0 0.0.0.255 area 0
!
```

Example 12-3   Router_B Configuration

```
hostname Router_B
!
ip vrf customer_a
rd 1:1
 route-target export 1:1
 route-target import 1:1
!
ip vrf customer_b
 rd 2:2
 route-target export 2:2
 route-target import 2:2
!
bridge 1 protocol ieee
bridge 2 protocol ieee
bridge 3 protocol ieee
!
!
interface FastEthernet0
 no ip address
!
interface FastEthernet0.1
 encapsulation dot1Q 2
 ip vrf forwarding customer_a
 ip address 192.168.4.1 255.255.255.0
```

```
 bridge-group 2
!
interface FastEthernet1
 no ip address
!
interface FastEthernet1.1
 encapsulation dot1Q 3
 ip vrf forwarding customer_b
 ip address 192.168.5.1 255.255.255.0
 bridge-group 3
!
interface POS0
 no ip address
 crc 32
 no cdp enable
 pos flag c2 1
!
interface POS0.1
 encapsulation dot1Q 1 native
 ip address 192.168.50.2 255.255.255.0
 bridge-group 1
!
interface POS0.2
 encapsulation dot1Q 2
 ip vrf forwarding customer_a
 ip address 192.168.100.2 255.255.255.0
 bridge-group 2
!
interface POS0.3
 encapsulation dot1Q 3
 ip vrf forwarding customer_b
 ip address 192.168.200.2 255.255.255.0
 bridge-group 3
!
router ospf 1
 log-adjacency-changes
 network 192.168.50.0 0.0.0.255 area 0
!
router ospf 2 vrf customer_a
 log-adjacency-changes
 network 192.168.4.0 0.0.0.255 area 0
 network 192.168.100.0 0.0.0.255 area 0
!
router ospf 3 vrf customer_b
 log-adjacency-changes
 network 192.168.5.0 0.0.0.255 area 0
 network 192.168.200.0 0.0.0.255 area 0
!
```

Example 12-4 Router_A Global Routing Table

```
Router_A# sh 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    192.168.50.0/24 is directly connected, POS0.1
```

Example 12-5   Router_A customer_a VRF Routing Table

```
Router_A# show ip route vrf customer_a
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

O    192.168.4.0/24 [110/2] via 192.168.100.2, 00:15:35, POS0.2
C    192.168.1.0/24 is directly connected, FastEthernet0.1
C    192.168.100.0/24 is directly connected, POS0.2
```

Example 12-6   Router_A customer_b VRF Routing Table

```
Router_A# show ip route vrf customer_b
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    192.168.200.0/24 is directly connected, POS0.3
O    192.168.5.0/24 [110/2] via 192.168.200.2, 00:10:32, POS0.3
C    192.168.2.0/24 is directly connected, FastEthernet1.1
```

Example 12-7   Router_B Global Routing Table

```
Router_B# sh 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    192.168.50.0/24 is directly connected, POS0.1
```

Example 12-8   Router_B customer_a VRF Routing Table

```
Router_B# sh ip route vrf customer_a
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    192.168.4.0/24 is directly connected, FastEthernet0.1
O    192.168.1.0/24 [110/2] via 192.168.100.1, 00:56:24, POS0.2
C    192.168.100.0/24 is directly connected, POS0.2
```

Example 12-9   Router_B customer_b VRF Routing Table

```
Router_B# show ip route vrf customer_b
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    192.168.200.0/24 is directly connected, POS0.3
C    192.168.5.0/24 is directly connected, FastEthernet1.1
O    192.168.2.0/24 [110/2] via 192.168.200.1, 00:10:51, POS0.3
```

Monitoring and Verifying VRF Lite

Table 12-1 shows the privileged EXEC commands for monitoring and verifying VRF Lite.

Table 12-1   Commands for Monitoring and Verifying VRF Lite

Command	Purpose
Router# **show ip vrf**	Displays the set of VRFs and interfaces
Router# **show ip route vrf** *vrf-name*	Displays the IP routing table for a VRF
Router# **show ip protocols vrf** *vrf-name*	Displays the routing protocol information for a VRF
Router# **ping vrf** *vrf-name ip-address*	Pings an IP address that has a specific VRF