AMVS

Advanced MPLS VPN Solutions

Volume 2

Version 1.0

Student Guide

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MPLS VPN Topologies

Overview

This chapter describes the most commonly used MPLS VPN topologies and the design and implementation issues associated with them.

It includes the following topics:

- Simple VPN with optimal Intra-VPN routing
- Using BGP as the PE-CE routing protocol
- Overlapping Virtual Private Networks
- Central Services VPN solutions
- Hub-and-Spoke VPN solutions
- Managed CE Router Service

Objectives

Upon completion of this chapter, you will be able to perform the following tasks:

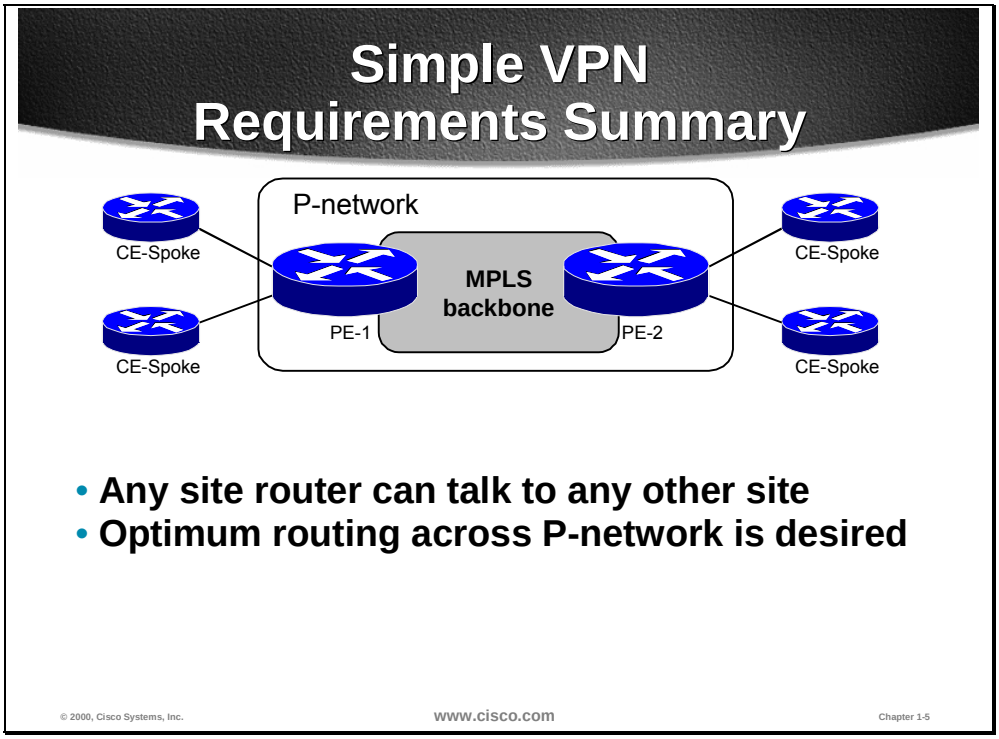
- Design and implement simple VPN solutions with optimal intra-VPN routing
- Design and implement various routing protocols within VPNs
- Design and implement central services VPN topologies
- Design and implement hub-and-spoke VPN topologies
- Design and implement VPN topology required for managed router services

Simple VPN with Optimal Intra-VPN Routing

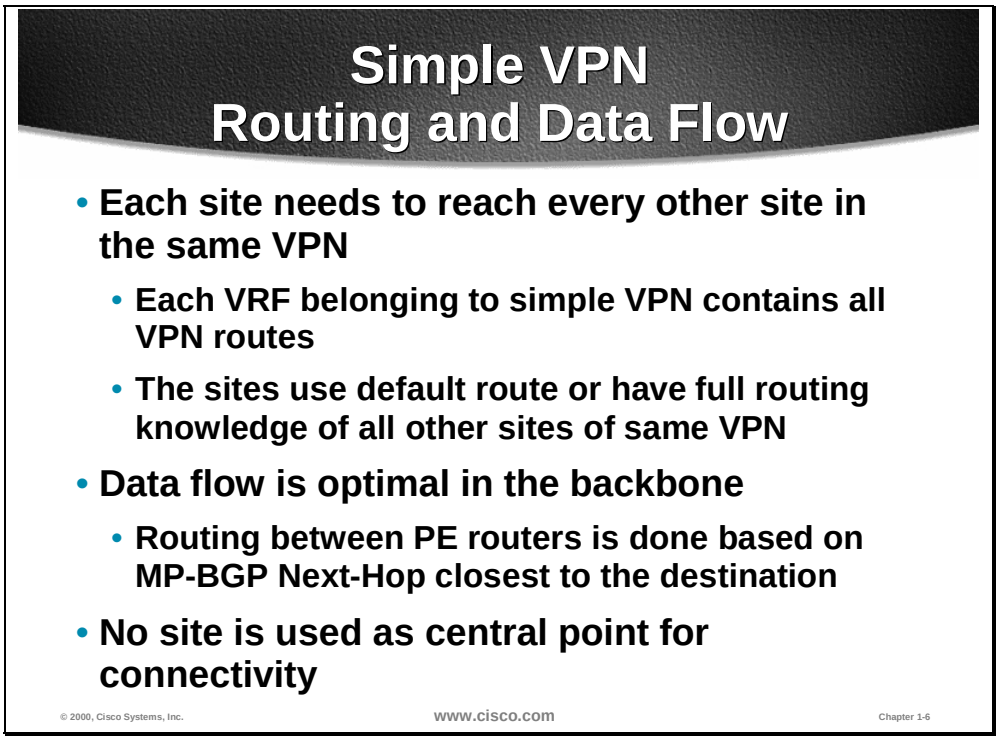
Objectives

Upon completion of this section, you will be able to perform the following tasks:

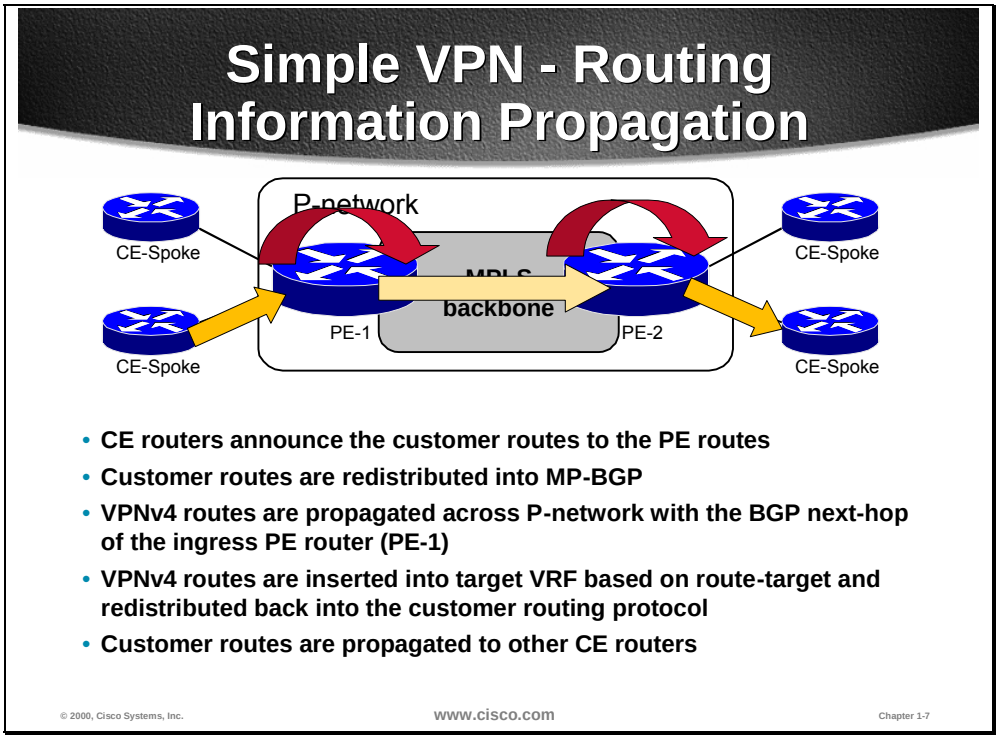
- Describe the requirements of simple VPN solutions
- Describe the routing model of these solutions
- Describe the optimal intra-VPN routing data flow
- Select the optimal PE-CE routing protocol based on user requirements
- Integrate the selected PE-CE routing protocol with the MPLS VPN backbone MP-BGP routing



In contrast with other VPN technologies, MPLS VPN supports optimum any-to-any connectivity between customer sites (equivalent to the full mesh of overlay VPN networks) without the end customer having to manually configure anything. The provider only needs to configure the VPN in the Provider Edge (PE) routers. The so-called “hub-and-spoke” topology, which was primarily used to reduce the cost of the network, is no longer needed. The interconnection of CE sites is done automatically by using BGP and an IGP to find the shortest path.



MPLS VPN architecture by default provides optimal routing between CE sites. A CE site can have full internal routing for its VPN or just a default route pointing to the PE router. The PE routers, however, need to have full routing information for the MPLS VPN network in order to provide connectivity and optimal routing. A MP-BGP next-hop address is used to find a label for a VPN destination network and the backbone IGP provides the optimal routing towards the next-hop address.



When a Customer Edge (CE) router announces a network through an IGP, the PE router will redistribute and export it into Multiprotocol BGP, converting an IPv4 address into a VPNv4 address. The following list contains the most significant changes that happen with redistribution and export:

- IPv4 Network Layer Reachability Information (NLRI) is converted into VPNv4 NLRI by pre-pending a route distinguisher (for example, a route distinguisher 12:13 could be prepended to an IPv4 prefix 10.0.0.0/8 resulting in a VPNv4 prefix 12:13:10:10.0.0.0/8)

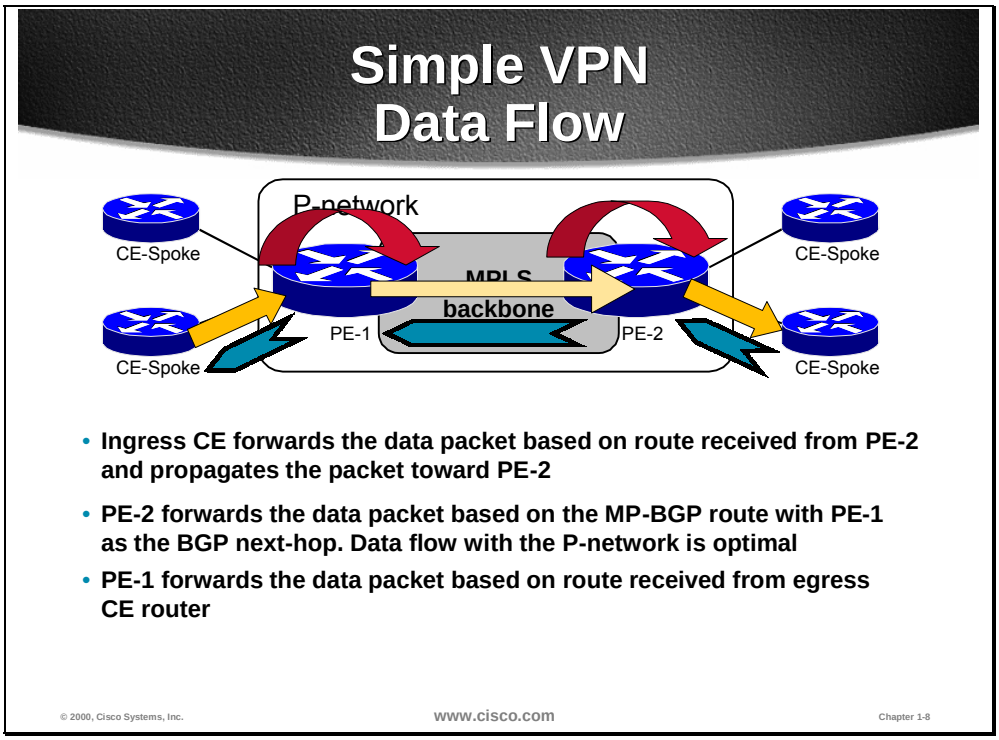
Note NLRI is a BGP term for a prefix (address and subnet mask)

- VPNv4 NLRI also contains a label that will be used to identify the outgoing interface or the VRF where a routing lookup should be performed
- A *route target* extended community is added based on the VRF configuration

The PE router will forward VPN_IPv4 networks to all other PE routers that will use the route target community to identify the VRFs where this information has to be imported. The received VPN label will be used as the second label and the BGP next-hop label (learned via LDP) will be used as the top label for packets going to CE routers connected to distant PE routers.

The PE router will then redistribute the VPN_IPv4 network into the IGP used between the PE and the CE and send it to the CE router.

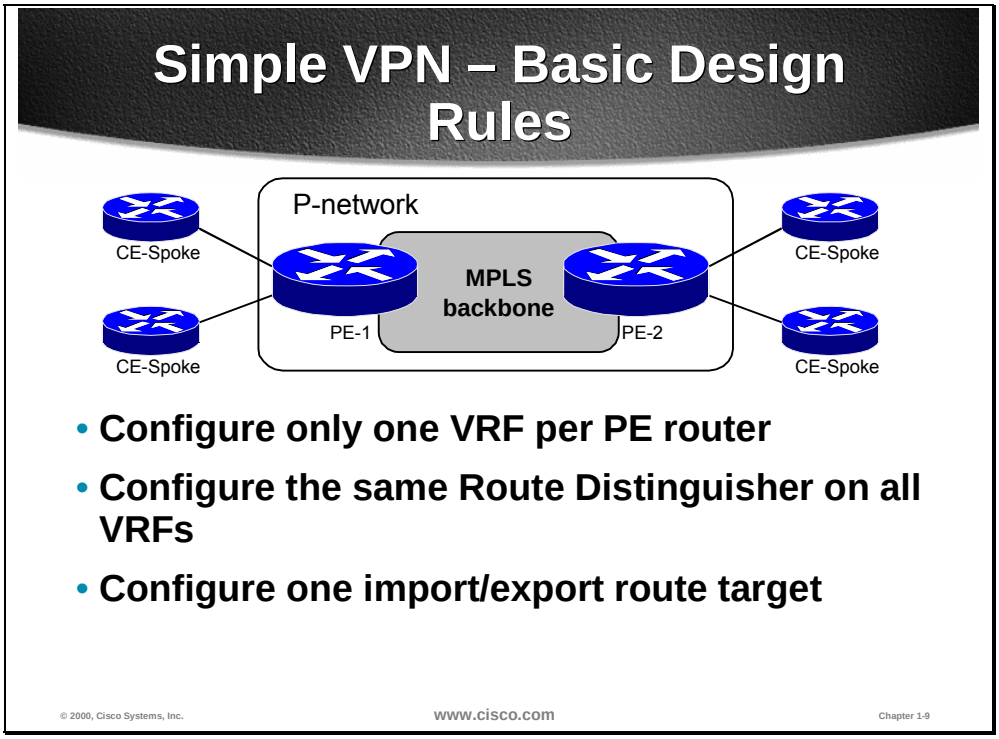
The MPLS VPN core network is not visible to the CE routers. The BGP part of the routing information propagation is only seen as slower convergence.



In the slide above, the CE router finds the destination in its IP routing table (learned through IGP or based on a static default route). PE-2 has learned about the destination through MP-BGP and labels each packet from the CE router with the VPN label (second label) and the next-hop label (top label).

The core routers are doing label switching based on the top label. The last core router before PE-1 will pop the top label (penultimate hop popping). PE-1 will identify the outgoing interface or the VRF by looking at the second label, which at this time is the top and only label. The packet sent to the CE is no longer labeled.

Note Please refer to **MPLS VPN Technology** lesson for more information on MPLS VPN packet forwarding.



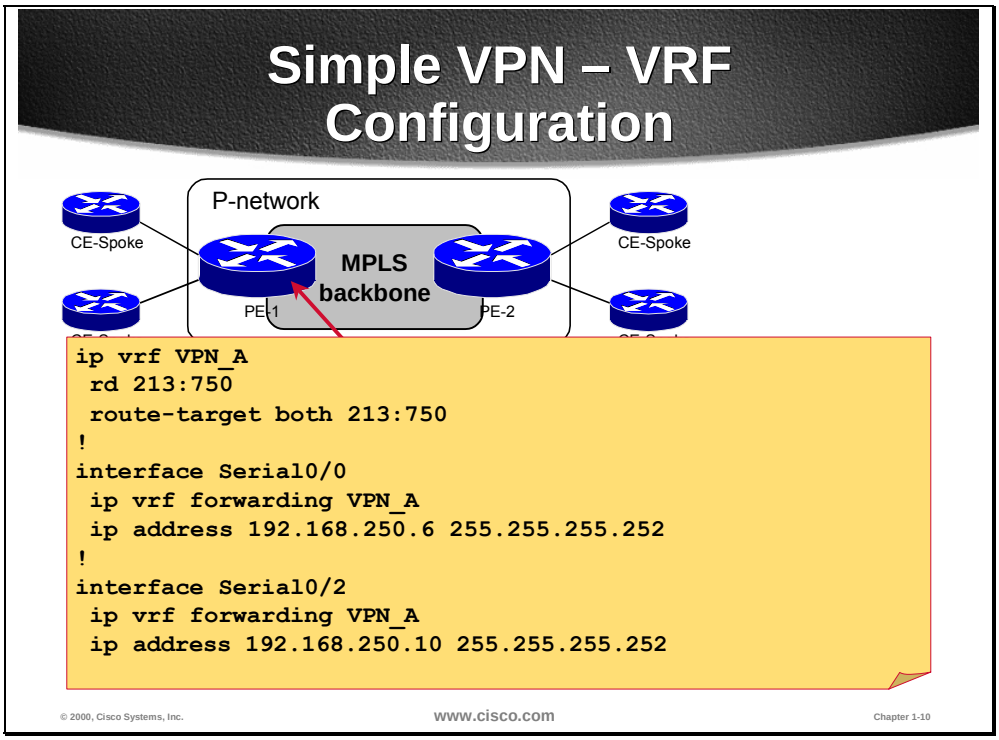
To optimize performance, reduce configuration efforts and conserve memory on the PE router on which you should minimize the number of VRFs per router.

Using one VRF per VPN per PE router will reduce memory requirements and CPU load. This is possible because the routing requirements for all CE routers in the same VPN are the same. Using one VRF per VPN can also improve convergence between CE routers connected to the same PE router.

Using the same route distinguisher for VRFs that are used for the same VPN will also conserve memory.

Only one route target is needed for a simple VPN. Any additional route targets are unnecessary and will consume at least 64 bits per routing update.

Using the same route distinguisher and route target for a simple VPN helps to ease the management, monitoring, and troubleshooting of the MPLS VPN network.



In the example above, we have two interfaces in the same VRF. We are using the same numbering scheme for route distinguishers and route targets.

Note There is no routing configuration in this example. This example only shows how to create a virtual router (VRF – virtual routing and forwarding instance) and to assign interfaces to it.

