

chapter 5 inter vlan routing cnacad

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Introduction

In the world of enterprise networking, the ability to segment traffic and control communication between those segments is essential. This segmentation is achieved through Virtual Local Area Networks (VLANs), and the process that allows devices in different VLANs to talk to each other is known as inter VLAN routing. If you are studying for the CNACAD certification, you will encounter this concept in depth. Chapter 5 of the CNACAD curriculum focuses on inter VLAN routing, exploring the techniques, configurations, and best practices required to design and implement efficient, secure, and scalable routing between VLANs. This article will walk you through the fundamentals of inter VLAN routing, detail the key concepts covered in chapter 5, and provide practical guidance that aligns with the CNACAD framework.

Understanding VLANs and the Need for Inter VLAN Routing

Virtual Local Area Networks create logical boundaries within a physical network, isolating broadcast domains and improving security. Each VLAN operates as a separate Layer 2 domain, meaning that devices in one VLAN cannot communicate with devices in another without additional routing. Inter VLAN routing bridges these separate domains, enabling controlled data exchange while preserving the benefits of segmentation.

Typical reasons for implementing inter VLAN routing include:

- Segregating departmental traffic (e.g., Finance, HR, Engineering)
- Separating management and user networks
- Implementing security zones for guest access
- Optimizing bandwidth by reducing broadcast traffic
- Facilitating policy enforcement through ACLs and QoS

Layer 3 Switching vs. Router on a Stick

Chapter 5 of the CNACAD material introduces two primary methods for inter VLAN routing: Layer 3 switching and the router on a stick approach. Both achieve the same outcome—routing between VLANs—but differ in implementation and performance.

Layer 3 Switching

Layer 3 switches combine the speed of a switch with the routing capabilities of a router. They use Virtual Routing and Forwarding (VRF) tables to perform routing decisions within the switch fabric, resulting in lower latency and higher throughput. Key advantages include:

- Fast packet forwarding due to hardware acceleration
- Reduced need for dedicated routers
- Simplified network architecture
- Built in support for advanced features like MPLS and EVPN

However, Layer 3 switches require a higher initial investment and may be overkill for small networks.

Router on a Stick

The router on a stick model uses a single router interface that carries traffic for multiple VLANs via subinterfaces. Each subinterface is assigned a unique VLAN ID and an IP address that serves as the default gateway for that VLAN. This method is cost effective and straightforward but can become a bottleneck in high traffic environments.

CNACAD Chapter 5 Overview

Chapter 5 of the CNACAD curriculum is structured to guide students through the design, configuration, and troubleshooting of inter VLAN routing. The chapter is divided into the following sections:

1. Fundamentals of Inter VLAN Routing
2. Design Considerations and Topology Choices
3. Layer 3 Switch Configuration
4. Router on a Stick Implementation
5. Security Enhancements: ACLs, HSRP, and VRRP
6. Performance Tuning and Monitoring
7. Case Studies and Lab Exercises

Each section builds upon the previous one, culminating in a comprehensive understanding that aligns with the CNACAD exam objectives.

Designing an Inter VLAN Routing Solution

Before diving into configurations, it is crucial to establish a clear design. The design phase ensures that the routing solution meets business requirements, performance expectations, and security policies.

Identify VLANs and Their Purpose

Document the number of VLANs, their IDs, and the devices that will belong to each. Consider future growth and potential re-assignment of VLANs.

Choose the Routing Method

Decide between Layer 3 switching or router on a stick based on:

- Network size and traffic volume
- Budget constraints
- Existing infrastructure compatibility
- Desired scalability

Plan IP Addressing Schemes

Assign a unique subnet to each VLAN. Use private address ranges (e.g., 10.0.0.0/8, 172.16.0.0/12) and ensure that subnets do not overlap. Keep subnet masks consistent to simplify routing tables.

Define Default Gateways

For each VLAN, designate the IP address of the router or Layer 3 switch interface that will serve as the default gateway. This address is typically the first usable IP in the subnet.

Incorporate Redundancy

Plan for high availability using protocols such as HSRP (Hot Standby Router Protocol) or VRRP (Virtual Router Redundancy Protocol). These protocols provide failover capabilities for default gateways.

Configuring a Layer 3 Switch for Inter VLAN Routing

Below is a step by step guide that aligns with the CNACAD chapter 5 lab exercises.

1. Create VLANs

```
```bash
Switch(config)# vlan 10
Switch(config-vlan)# name Finance
Switch(config-vlan)# exit
Switch(config)# vlan 20
Switch(config-vlan)# name HR
Switch(config-vlan)# exit
```
```

2. Assign Ports to VLANs

```
```bash
Switch(config)# interface FastEthernet0/1
Switch(config-if)# switchport mode access
Switch(config-if)# switchport access vlan 10
Switch(config-if)# exit
Switch(config)# interface FastEthernet0/2
Switch(config-if)# switchport mode access
Switch(config-if)# switchport access vlan 20
Switch(config-if)# exit
```
```

3. Enable Routing on the Switch

```
```bash
Switch(config)# ip routing
```
```

4. Create VLAN Interfaces (SVIs)

```
```bash
Switch(config)# interface Vlan10
Switch(config-if)# ip address 10.10.10.1 255.255.255.0
Switch(config-if)# no shutdown
Switch(config-if)# exit
Switch(config)# interface Vlan20
Switch(config-if)# ip address 10.20.20.1 255.255.255.0
Switch(config-if)# no shutdown
Switch(config-if)# exit
```
```

5. Verify Routing Table

```
```bash
Switch# show ip route
```
```

At this point, the switch will route traffic between VLAN 10 and VLAN 20 using the SVIs as gateways.

Configuring Router on a Stick

For environments where a dedicated router is preferred, the router on a stick method is ideal. The following steps illustrate a typical Cisco configuration.

1. Configure Trunk Port on the Switch

```
``bash
Switch(config)# interface GigabitEthernet0/24
Switch(config-if)# switchport mode trunk
Switch(config-if)# switchport trunk allowed vlan 10,20
Switch(config-if)# exit
``
```

2. Set Up Subinterfaces on the Router

```
``bash
Router(config)# interface GigabitEthernet0/0.10
Router(config-subif)# encapsulation dot1Q 10
Router(config-subif)# ip address 10.10.10.1 255.255.255.0
Router(config-subif)# exit
Router(config)# interface GigabitEthernet0/0.20
Router(config-subif)# encapsulation dot1Q 20
Router(config-subif)# ip address 10.20.20.1 255.255.255.0
Router(config-subif)# exit
``
```

3. Verify Connectivity

Ping from a host in VLAN 10 to the router's subinterface IP in VLAN 20 and vice versa to confirm routing works.

Securing Inter VLAN Routing

Once routing is operational, security becomes paramount. The CNACAD chapter 5 covers several mechanisms to safeguard inter VLAN traffic.

Access Control Lists (ACLs)

ACLs can filter traffic between VLANs, allowing only specific protocols or IP ranges. For example, to restrict Finance VLAN (VLAN 10) from accessing HR VLAN (VLAN 20), you could apply a standard ACL on the router or Layer 3 switch:

```
``bash
Router(config)# access-list 10 deny 10.10.10.0 0.0.0.255 10.20.20.0 0.0.0.255
Router(config)# access-list 10 permit any
Router(config)# interface GigabitEthernet0/0.10
Router(config-if)# ip access-group 10 in
``
```

Hot Standby Router Protocol (HSRP)

HSRP provides a virtual IP address that hosts use as their default gateway. If the active router fails, the standby

router takes over automatically. Sample configuration:

```
``bash
Router(config)# interface GigabitEthernet0/0.10
Router(config-if)# standby 1 ip 10.10.10.254
Router(config-if)# standby 1 priority 110
Router(config-if)# standby 1 preempt
``
```

Virtual Router Redundancy Protocol (VRRP)

VRRP is an alternative to HSRP, offering similar redundancy features. The configuration syntax differs slightly but follows the same principles.

Port Security and VLAN Membership Control

Implement port security on access ports to limit the number of MAC addresses and enforce VLAN membership. This reduces the risk of rogue devices accessing sensitive VLANs.

Performance Tuning and Monitoring

Efficient inter VLAN routing requires ongoing performance monitoring and fine tuning. CNACAD chapter 5 emphasizes the following best practices:

- Use SNMP and NetFlow to collect traffic statistics and identify bottlenecks.
- Monitor CPU and memory utilization on Layer 3 switches and routers.
- Configure Quality of Service (QoS) to prioritize critical traffic across VLANs.
- Regularly update firmware and apply security patches.

Tools such as Cisco Prime, SolarWinds Network Performance Monitor, or open source alternatives like Zabbix can provide comprehensive visibility into inter VLAN traffic patterns.

Case Study: A Medium Sized Enterprise

Consider a company with 200 employees divided into three departments: Finance, Engineering, and Guest. The network design includes:

- VLAN 10 – Finance (10.10.10.0/24)

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