Implementation of Inter-VLAN Routing using Router-on-a-Stick

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***Abstract*—With the increasing complexity of enterprise and institutional networks, efficient traffic segmentation has become essential. This project demonstrates the implementation of Inter-VLAN routing using the Router-on-a-Stick method in Cisco Packet Tracer. Multiple VLANs were configured on a Layer 2 switch, and a single router interface was logically divided into subinterfaces, each mapped to a different VLAN. This setup enabled communication between hosts across VLANs while conserving physical resources. The project illustrates trunking, IP configuration, and routing between isolated VLANs, thereby enhancing network scalability, security, and performance.**

***Index Terms*—VLAN, Inter-VLAN Routing, Router-on-a-Stick, Cisco Packet Tracer, Trunking, Subinterfaces, Layer 2 Switching, Layer 3 Routing.**

I. Introduction

In traditional networks, broadcast traffic can congest the network and affect performance. VLANs (Virtual Local Area Networks) are used to logically segment a LAN into different broadcast domains. However, hosts in separate VLANs cannot communicate without routing. This project addresses the challenge by implementing Inter-VLAN Routing using a Router-on-a-Stick configuration.

This technique utilizes a single physical router interface subdivided into logical subinterfaces, each assigned to a different VLAN. The method is cost-effective, requires minimal hardware, and is ideal for institutions and small enterprises. Our simulation in Cisco Packet Tracer demonstrates how effective VLAN-based communication can be achieved.

II. Objectives

- To create multiple VLANs and assign hosts to each.
- To configure a trunk link between the switch and the router.
- To set up subinterfaces on a single router port for each VLAN.
- To verify communication between devices in different VLANs.
- To demonstrate logical segmentation and Layer 3 routing capabilities.

III. Methodology

A. VLAN Creation and Port Assignment

Multiple VLANs were created on a Cisco Layer 2 switch:

- VLAN 10 – Students
- VLAN 20 – Faculty
- VLAN 30 – Guest

Each VLAN was assigned to specific switch ports connected to PCs using the following commands:

```
Switch(config)# vlan 10
Switch(config-vlan)# name Sales
Switch(config)# interface fastethernet 0/1
Switch(config-if)# switchport access vlan 10
```

B. Trunk Link Configuration

The link between the switch and router was set to trunk mode using IEEE 802.1Q:

```
Switch(config)# interface fastethernet 0/24
Switch(config-if)# switchport mode trunk
```

C. Router Subinterface Setup

The router interface was logically divided into subinterfaces:

```
Router(config)# interface Gig0/0.10
Router(config-subif)# encapsulation dot1Q 10
Router(config-subif)# ip address 192.168.10.1
255.255.255.0
```

This was repeated for VLANs 20 and 30 using subinterfaces .20 and .30.

D. IP Configuration and Testing

Each PC was assigned a static IP. ICMP tests (using ping) were used to verify inter-VLAN communication via the router.

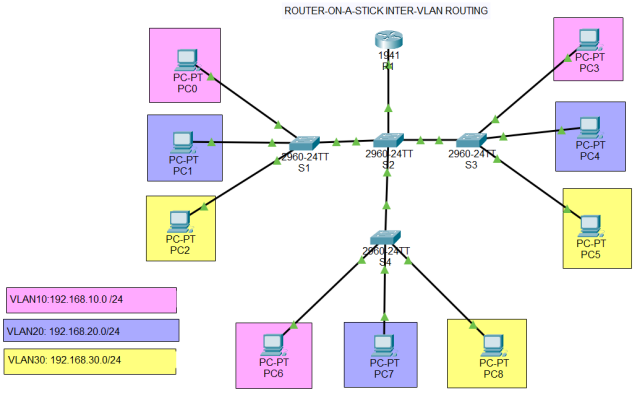

Fig. 1. Network Topology Diagram

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	PC0	PC4	ICMP		0.000	N	0	(edit)	(delete)
	Successful	PC2	PC5	ICMP		0.000	N	1	(edit)	(delete)
	Successful	PC0	PC0	ICMP		0.000	N	2	(edit)	(delete)

Fig. 2. Result

IV. Results

The simulation achieved the following:

- Each VLAN had isolated broadcast domains.
- Devices in different VLANs communicated successfully.
- Trunking efficiently carried tagged VLAN traffic.
- Subinterfaces routed packets correctly to corresponding VLANs.

TABLE I
Test VLAN Setup

VLAN	Subnet	Gateway IP	Result
10	192.168.10.0/24	192.168.10.1	Successful
20	192.168.20.0/24	192.168.20.1	Successful
30	192.168.30.0/24	192.168.30.1	Successful

V. Conclusion

This project successfully demonstrated Inter-VLAN routing using the Router-on-a-Stick approach in Cisco Packet Tracer. It provided hands-on understanding of VLANs, trunk links, router subinterfaces, and Layer 3 routing. The solution is both scalable and cost-efficient, suitable for enterprise and campus environments. The logical separation and unified communication achieved contribute significantly to network organization, security, and performance optimization.

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