HOTEL MANAGEMENT NETWORK SYSTEM

ITDX 33-Mini Project Report

BTECH - IT

TEAM

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ABSTRACT:

This project outlines the design and implementation of a modern, multi-floor hotel network infrastructure that leverages Software-Defined Networking (SDN) to enhance scalability, efficiency, and centralized management. The network spans three floors, each housing different departments, and is connected through three routers located in the IT department's server room. Traditional network elements, such as VLAN segmentation, DHCP for dynamic IP allocation, and OSPF for routing, are integrated with SDN's centralized control and automation capabilities to create a flexible and secure environment. Each department is assigned a unique VLAN and IP subnet, and devices, including laptops, phones, and printers, are dynamically managed across wired and wireless networks. SDN controller at the core, all routing, VLAN assignments, IP management, and security policies are centrally managed, eliminating the need for manual configurations on individual devices. SDN's programmability enables automated adjustments to routing paths, VLAN allocation, and bandwidth distribution, optimizing network performance and resource use. Enhanced security features are also implemented; port security is dynamically controlled by the SDN controller to restrict unauthorized device access, particularly in sensitive areas like the IT department. Additionally, centralized SSH access enables secure remote management of network devices.

CHAPTER 1

INTRODUCTION:

This project focuses on developing a robust and efficient network infrastructure for a multi-floor hotel, designed to meet the demands of modern connectivity and secure data management across various departments. The network covers three floors, each with distinct departments: Reception, Store, and Logistics on the first floor; Finance, HR, and Sales on the second; and IT and Admin on the third. Each department is allocated a unique VLAN and IP subnet, ensuring data separation and efficient traffic management. Routers located in the IT department's server room connect each floor, with OSPF used for dynamic routing and reliable inter-departmental communication.

To enhance control, scalability, and security, the network incorporates Software-Defined Networking (SDN), which enables centralized management through an SDN controller. The controller automates configurations for VLAN assignments, DHCP, and routing paths, significantly reducing manual configurations and enabling real-time adjustments based on network conditions. Security is prioritized with policies like port security on specific devices, enforced dynamically through the controller to restrict unauthorized access.

The project also includes wireless networks on each floor for seamless connectivity of laptops and mobile devices, while wired access is configured for department printers and other essential devices. By integrating SDN, this network design combines traditional networking with modern SDN capabilities, offering streamlined management, enhanced performance, and improved security for hotel operations.

CHAPTER 2

LITERATURE SURVEY:

- Serve including students, faculty, and staff, with a need to support academic activities and administrative functions. Where in hotel networking Primarily serve guests, with a focus on providing convenient and reliable internet access.
- More complex, often featuring multiple layers of network infrastructure to support various departments, research activities, and large-scale events. Hotel network Typically have simpler network structures, designed for easy management and scalability.
- Use multi-layered security systems, including firewalls, intrusion detection, and secure access protocols like 802.1X.
- Includes basic measures like network isolation (e.g., separating guest and staff networks) and secure payment processing.

Challenge:

Balancing ease of access with security and ensuring consistent Wi-Fi coverage in diverse physical environments.

CHAPTER 3

EXISTING SYSTEM :

The project described in *"Intelligent Traffic Engineering in Software-Defined Vehicular Networking Based on Multi-Path Routing"* focuses on enhancing traffic management within vehicular networks through a novel approach that integrates Software-Defined Networking (SDN) with traditional Vehicular Ad Hoc Networks (VANETs). This integration forms Software-Defined Vehicular Networking (SDVN), an architecture designed to address the challenges of high mobility and frequent route reconfigurations that are typical in vehicular environments. The SDVN architecture is structured with three levels: the infrastructure layer for network devices, the management layer that provides centralized control via an SDN controller, and an application layer that manages traffic flow and optimizes resource allocation. By utilizing a centralized SDN controller, this design enables dynamic reconfiguration of routes based on real-time conditions, greatly enhancing the efficiency and responsiveness of the network. A key innovation of this project is the use of a modified wave routing algorithm for multi-path routing, which allows for multiple paths to be formed, reducing traffic congestion and increasing data transmission reliability. Dynamic path reconfiguration further optimizes traffic flow by adjusting routes to avoid congested or overloaded paths, ensuring stable connections and reducing delays. This SDVN-based traffic engineering approach provides significant improvements over traditional VANETs by efficiently managing network resources, balancing loads across multiple paths, and supporting the growing demands of intelligent transportation systems (ITS) and smart city infrastructure.

CHAPTER 4

PEOPOSED SYSTEM:

Our proposed system is a comprehensive, SDN-based network infrastructure tailored for a multi-floor hotel environment, designed to address the specific needs of efficient management, scalability, security, and seamless inter-departmental communication. This network spans three floors, with each floor hosting specific departments. Departments on the first floor include Reception, Store, and Logistics; the second floor Finance, HR, and Sales; and the third floor is home to IT and Admin. Each department is assigned a distinct VLAN and IP subnet to ensure network segmentation, security, and efficient traffic flow.

At the core of our system is an SDN controller that centralizes the management of all network configurations, including VLAN assignments, IP addressing, routing policies, and security controls. This controller provides real-time oversight and control of network resources, allowing dynamic adjustments to configurations as new devices connect or conditions change within the network. By leveraging SDN, our system enables dynamic VLAN allocation, automated routing with OSPF, and centralized IP address management, simplifying network administration and minimizing manual configuration needs.

Wireless connectivity is available on each floor for mobile devices such as laptops and phones, while wired connections support fixed assets like printers in each department. Security is further enhanced through port security configurations managed by the SDN controller, restricting unauthorized devices from accessing sensitive parts of the network

The SDN controller dynamically balances network load, optimizes traffic flow, and mitigates potential congestion by adjusting routing paths in real-time. Overall, this proposed system offers a future-ready, highly adaptable network solution that enhances operational efficiency, improves security, and meets the dynamic demands of hotel operations.

CHAPTER 4.1

ALGORITHM:

The Algorithms to focus on would be OSPF (Open Shortest Path First) for routing and DHCP (Dynamic Host Configuration Protocol) for IP address management.

OSPF (Open Shortest Path First)

OSPF is designed to efficiently manage the routing of packets in IP networks. It uses Dijkstra's algorithm to calculate the shortest path for data packets to travel across a network.

How OSPF Works:

- **Link-State Advertisements (LSAs)**: Routers using OSPF periodically send out LSAs to inform other routers about the state of their links (interfaces). Each router builds a link-state database from these advertisements, reflecting the entire network topology.
- **Routing Decisions**: When a packet needs to be routed, OSPF uses the link-state database to determine the shortest path to the destination based on cost metrics (like bandwidth).
- **Areas**: OSPF supports hierarchical network design by dividing networks into areas. This helps optimize routing efficiency and reduces the overhead of LSAs.

Application in the Project:

- **Location**: OSPF is configured on each of the three routers connecting the different floors of the hotel.
- **Purpose**:
  - It enables inter-VLAN routing, allowing devices in different VLANs (e.g., Reception, Store, Finance) to communicate with each other effectively.

    - As the hotel network grows (e.g., adding more floors or departments), OSPF will dynamically adjust the routing paths without manual reconfiguration.

DHCP (Dynamic Host Configuration Protocol)

How DHCP Works:

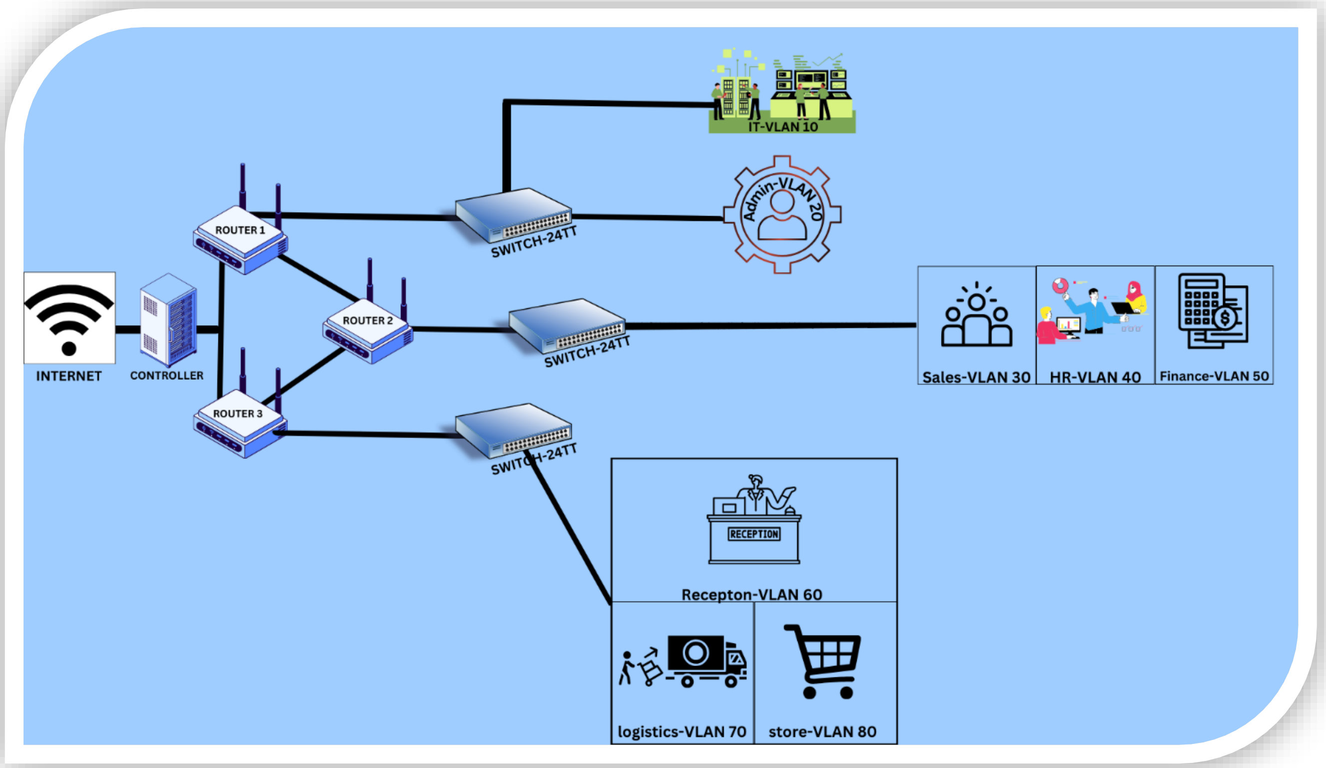
- **Lease Process**: When a device (DHCP client) connects to the network, it sends a DHCPDISCOVER message. The DHCP server responds with a DHCPOFFER message that contains an available IP address and lease duration.
- **Acknowledgment**: The client requests the offered address with a DHCPREQUEST message, and the server confirms with a DHCPACK message.
- **Lease Time**: DHCP leases the IP address for a specified duration, after which the client must renew the lease to continue using the address.

Application in the Project:

- **Location**: Each router in project acts as a DHCP server for its respective VLANs.
- **Purpose**:
    - Automatically assigns IP addresses to devices (like laptops, phones, and printers) within their respective VLANs (e.g., Reception, Finance).
    - Simplifies network management, allowing devices to join the network without manual IP configuration. This is particularly important in a dynamic environment like a hotel, where devices frequently connect and disconnect.

CHAPTER 4.2

ARCHITECTURE DIAGRAM:



CHAPTER 5

IMPLEMENTATION:

1. Setting Up the SDN Controller

First, we will need to select and set up an SDN controller. Ryu is a good choice for this project due to its user-friendly interface and extensive documentation. To begin, you'll download and install Ryu on a server or a dedicated machine that will serve as your controller.

After installation, you will create a simple Ryu application that manages VLAN configurations and enables inter-switch communication. This application will be responsible for processing incoming traffic and making real-time decisions about how that traffic is handled across the network. The basic structure of the application includes event handlers for switch features and flow management.

2. Establishing OpenFlow Switches

In this project, we will replace traditional Layer 3 switches with OpenFlow switches, which can be controlled programmatically via the SDN controller. To simulate this environment, we can use Mininet, a network emulator that allows us to create a virtual network topology.

You'll set up Mininet to mirror the hotel's physical structure, establishing a tree topology with OpenFlow-enabled switches corresponding to each floor of the hotel. When configuring Mininet, you will specify that it should connect to the Ryu SDN controller, ensuring that all switches in your simulated network are under its control.

3. Dynamic VLAN Management

With the SDN controller and OpenFlow switches in place, the next step is to implement dynamic VLAN management. This feature allows the network to adapt to changing conditions and user needs. In your Ryu application, you will add functionality to manage VLANs based on traffic patterns.

For example, if you notice an increase in traffic from a particular department, the application can dynamically create a new VLAN or adjust existing VLAN configurations to better distribute network resources. This responsiveness improves the overall performance and reliability of the network.

4. Implementing Network Policies and Security

Next, we'll define network policies within the SDN framework. These policies might include rules for traffic prioritization, access control, and security measures. For instance, you can set up Quality of Service (QoS) rules to prioritize critical applications used by the Finance department while limiting bandwidth for less critical traffic.

You'll also configure security policies to restrict access to sensitive data. This can be accomplished by implementing access control lists (ACLs) in the Ryu application, which will check the source and destination of packets to determine whether to allow or deny traffic.

CHAPTER 5.1

CODE:

VLAN and DHCP Configuration:

Router Configuration: Below are the commands to configure the routers and set up DHCP pools.

- **Router 1 (First Floor)**:

Router1> enable

Router1# configure terminal

Router1(config)# vlan 80

Router1(config-vlan)# name Reception

Router1(config-vlan)# exit

Router1(config)# vlan 70

Router1(config-vlan)# name Store

Router1(config-vlan)# exit

Router1(config)# vlan 60

Router1(config-vlan)# name Logistics

Router1(config-vlan)# exit

Router1(config)# ip dhcp pool Reception

Router1(dhcp-config)# network 192.168.8.0 255.255.255.0

Router1(dhcp-config)# default-router 192.168.8.1

Router1(dhcp-config)# exit

Router1(config)# ip dhcp pool Store

Router1(dhcp-config)# network 192.168.7.0 255.255.255.0

Router1(dhcp-config)# default-router 192.168.7.1

Router1(dhcp-config)# exit

Router1(config)# ip dhcp pool Logistics

Router1(dhcp-config)# network 192.168.6.0 255.255.255.0

Router1(dhcp-config)# default-router 192.168.6.1

Router1(dhcp-config)# exit

- **Router 2 (Second Floor)**:

Router2> enable

Router2# configure terminal

Router2(config)# vlan 50

Router2(config-vlan)# name Finance

Router2(config-vlan)# exit

Router2(config)# vlan 40

Router2(config-vlan)# name HR

Router2(config-vlan)# exit

Router2(config)# vlan 30

Router2(config-vlan)# name Sales

Router2(config-vlan)# exit

Router2(config)# ip dhcp pool Finance

Router2(dhcp-config)# network 192.168.5.0 255.255.255.0

Router2(dhcp-config)# default-router 192.168.5.1

Router2(dhcp-config)# exit

Router2(config)# ip dhcp pool HR

Router2(dhcp-config)# network 192.168.4.0 255.255.255.0

Router2(dhcp-config)# default-router 192.168.4.1

Router2(dhcp-config)# exit

Router2(config)# ip dhcp pool Sales

Router2(dhcp-config)# network 192.168.3.0 255.255.255.0

Router2(dhcp-config)# default-router 192.168.3.1

Router2(dhcp-config)# exit

- **Router 3 (Third Floor)**:

bash

Copy code

Router3> enable

Router3# configure terminal

Router3(config)# vlan 20

Router3(config-vlan)# name Admin

Router3(config-vlan)# exit

Router3(config)# vlan 10

Router3(config-vlan)# name IT

Router3(config-vlan)# exit

Router3(config)# ip dhcp pool Admin

Router3(dhcp-config)# network 192.168.2.0 255.255.255.0

Router3(dhcp-config)# default-router 192.168.2.1

Router3(dhcp-config)# exit

Router3(config)# ip dhcp pool IT

Router3(dhcp-config)# network 192.168.1.0 255.255.255.0

Router3(dhcp-config)# default-router 192.168.1.1

Router3(dhcp-config)# exit

Port Security Configuration on Switches

Switch 3 (IT Department):

Switch3> enable

Switch3# configure terminal

Switch3(config)# interface fa0/1

Switch3(config-if)# switchport mode access

Switch3(config-if)# switchport port-security

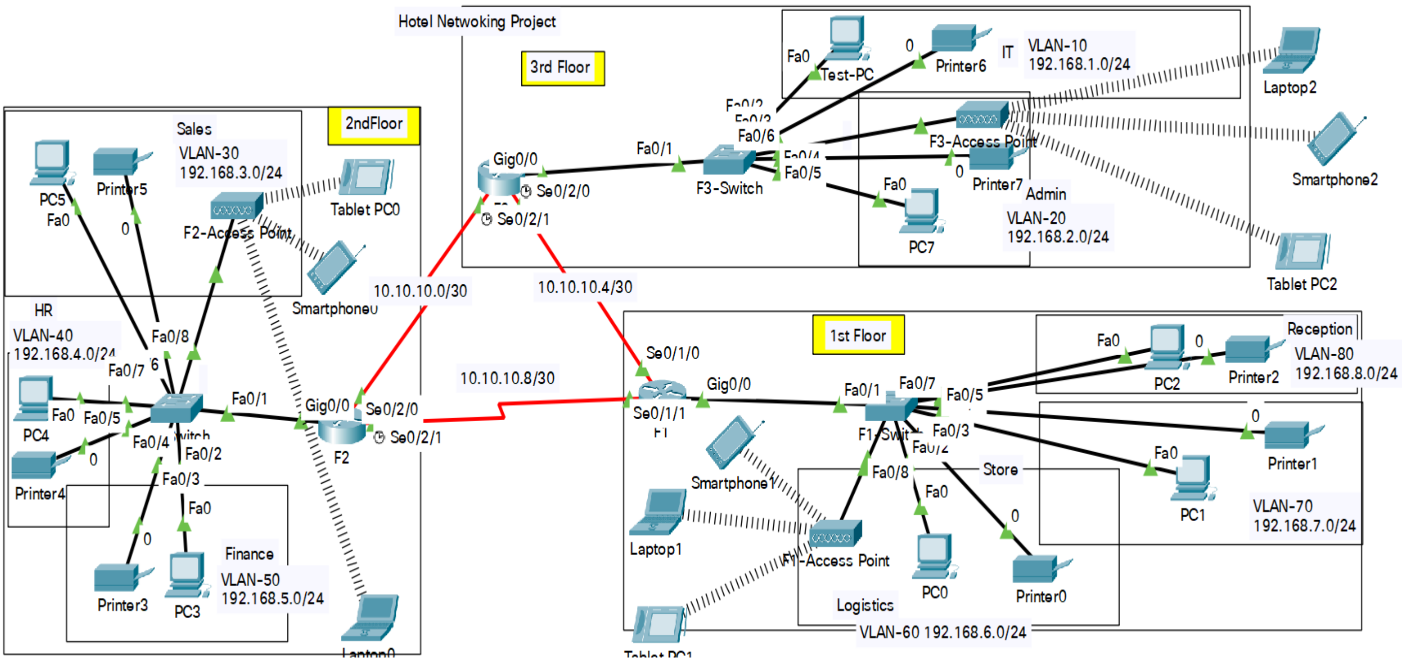
Switch3(config-if)# switchport port-security maximum 1

Switch3(config-if)# switchport port-security violation shutdown

Switch3(config-if)# switchport port-security mac-address sticky

CHAPTER 5.2

PICTURE:



CHAPTER 6

CONCLUSION AND FUTURE WORK:

Software-Defined Networking (SDN) into the hotel network project demonstrates a significant advancement in network management by enhancing flexibility, security, and efficiency. By leveraging an SDN controller like Ryu, the project allows for dynamic management of VLANs, streamlined configuration, and improved traffic flow across the hotel's various departments. The use of virtualized environments with tools such as Mininet not only facilitates testing and validation of the network design but also provides a platform for real-time monitoring of network performance. Looking to the future, further enhancements could include the implementation of advanced security protocols to safeguard sensitive data, the exploration of machine learning algorithms to optimize network performance and predict traffic patterns, and the integration of IoT devices for improved guest experiences. Additionally, expanding the project to incorporate multi-site management capabilities could pave the way for a more interconnected and intelligent hotel network infrastructure, further elevating operational efficiencies and guest satisfaction.

CHAPTER 7

REFERENCE:

Kreutz, Diego, et al. "Software-Defined Networking: A Comprehensive Survey." Proceedings of the IEEE 103.1 (2015): 14-76.

Nunes, Bruno A. A., et al. "A Survey of Software-Defined Networking: Past, Present, and Future of Programmable Networks." IEEE Communications Surveys & Tutorials 16.3 (2014): 1617-1634.

Intelligent Traffic Engineering in Software-Defined Vehicular Networking Based on Multi-Path Routing , AHED ABUGABAH , AHMAD ALI ALZUBI of publication March 25, 2020,

Protocols

RFC 2131 - Dynamic Host Configuration Protocol (DHCP)
This RFC provides the standards for DHCP, essential for configuring dynamic IP address allocation within your hotel network.

RFC 791 - Internet Protocol (IP)
The Internet Engineering Task Force (IETF) document detailing the specifications for the Internet Protocol, which is fundamental for understanding IP addressing and routing in your project.