Software-Defined Networking (SDN) Conceptual Project Report

1. Introduction

This project presents a **conceptual Software-Defined Networking (SDN)** implementation designed and simulated using **Cisco Packet Tracer**. The goal is to demonstrate SDN principles—**separation of control and data planes**, **centralized control**, and **programmability**—without deploying real SDN controllers or OpenFlow-enabled hardware.

The project focuses on logical design, traffic flow control, and centralized policy management rather than real-world controller integration.

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2. Project Objectives

- Understand the core concepts of Software-Defined Networking
- Design an SDN-based network topology conceptually
- Simulate centralized control behavior using Packet Tracer
- Compare SDN architecture with traditional networking
- Validate connectivity and traffic flow through simulation

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3. SDN Overview

Software-Defined Networking (SDN) is a network architecture that separates the **control plane** from the **data plane**:

- **Control Plane**: Makes decisions about how packets should flow
- **Data Plane**: Forwards packets based on control-plane decisions

Key SDN Components

- **SDN Controller**: Centralized network intelligence
- **SDN Switches**: Forwarding devices controlled by the controller
- **Northbound APIs**: Interface between controller and applications
- **Southbound APIs (e.g., OpenFlow)**: Interface between controller and switches

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4. Network Topology Design

The network topology was designed in Cisco Packet Tracer using the following components:

Devices Used

- PCs (End Hosts)
- Layer 2 / Layer 3 Switches
- Router (to simulate inter-network communication)
- Server (to simulate controller / application logic)

Logical Topology Description

- End devices are connected to access switches
- Switches are centrally managed (conceptually) by an SDN controller
- The controller enforces forwarding rules and policies
- All traffic decisions are logically centralized

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5. SDN Conceptual Implementation in Packet Tracer

Since Cisco Packet Tracer does not fully support real SDN controllers, the SDN behavior is **simulated conceptually**:

- Centralized decision-making is represented by a server/controller node
- Static and dynamic routing simulate flow rule installation
- VLANs and access control simulate policy-based forwarding
- Packet flow paths demonstrate centralized traffic logic

Addressing Scheme

Device	IP Address	Subnet Mask
PC1	192.168.1.10	255.255.255.0
PC2	192.168.1.20	255.255.255.0
Server	192.168.1.100	255.255.255.0

(Addresses may vary based on topology)

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6. Traffic Flow Explanation

1. End devices send packets to the switch
2. Switch consults centralized logic (controller concept)
3. Forwarding decision is applied
4. Packet reaches destination successfully

This demonstrates how SDN centralizes control instead of relying on distributed routing protocols.

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7. Testing and Verification

The following tests were conducted:

- **Ping Test**: Verified end-to-end connectivity
- **Packet Simulation Mode**: Observed packet flow paths
- **Policy Enforcement**: Confirmed traffic follows defined paths

Results

- All devices successfully communicated
- Traffic followed the intended logical paths
- Centralized control concept was effectively demonstrated

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8. Advantages of SDN Demonstrated

- Centralized network management
- Simplified configuration changes
- Improved scalability
- Better network visibility
- Reduced configuration errors

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9. Limitations

- No real OpenFlow or controller integration
- Limited SDN feature support in Packet Tracer
- Conceptual simulation only

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10. Conclusion

This project successfully demonstrates the **conceptual operation of Software-Defined Networking** using Cisco Packet Tracer. Although real SDN controllers were not deployed, the architecture and behavior reflect core SDN principles. The project provides a strong foundation for understanding SDN before moving to advanced tools such as Mininet, OpenDaylight, or ONOS.

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11. References

- Cisco SDN Overview: https://www.cisco.com/site/us/en/solutions/networking/software-defined-networking/index.html
- Open Networking Foundation (ONF): https://opennetworking.org
- SDN Architecture Explained (IBM): https://www.ibm.com/topics/software-defined-networking

• Cisco Packet Tracer Documentation: https://www.netacad.com/courses/packet-tracer