

Project proposal

**Project Title**   
**Implementation of Multiprotocol Label Switching (MPLS)**

**Group members**   
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**Project Description**

This project aims to demonstrate the fundamental differences between traditional IP routing and MPLS (Multiprotocol Label Switching) by setting up a practical lab using GNS3. The project will involve configuring an MPLS network and showcasing how label switching operates differently from regular IP-based routing. Through hands-on lab scenarios, the project will highlight the efficiency improvements MPLS offers in terms of faster packet forwarding, reducing lookup times, and enabling traffic engineering.

**How It Will Work:**

1. **Network Setup in GNS3**:
   * A network topology will be created in GNS3, simulating routers and links that support MPLS. The topology will include several routers acting as Label Edge Routers (LERs) and Label Switching Routers (LSRs).
   * The lab setup will involve configuring these routers to enable both traditional IP routing and MPLS switching so that a side-by-side comparison can be made.
2. **Routing Without MPLS**:
   * In the first part of the demonstration, the network will be configured for standard IP routing (OSPF or another IGP). Packets will traverse through the network based on the IP header's destination address, with each router performing a routing table lookup.
   * This will illustrate the longer processing times associated with each hop, as each router must inspect the packet and decide where to forward it next.
3. **Routing With MPLS**:
   * The second part will involve enabling MPLS on the routers. MPLS label switching will be demonstrated, where packets are assigned labels, and subsequent routers forward packets based on these labels instead of inspecting the entire IP header.
   * This part will show how MPLS improves forwarding speed, especially in complex networks with multiple paths, as labels allow routers to quickly forward traffic without deep inspection.
4. **Traffic Engineering**:
   * An additional feature demonstrated will be MPLS’s traffic engineering capabilities, where specific paths can be pre-determined for certain traffic types. This ensures better load balancing and can help avoid network congestion.
   * Traffic will be rerouted dynamically, depending on pre-defined label-switching paths.

**Functional Features:**

1. **IP vs MPLS Routing Comparison**:
   * The project will allow users to see a direct comparison between IP routing and MPLS in terms of speed and efficiency, by showing packet forwarding at each step.
2. **MPLS Label Distribution**:
   * Demonstrate how MPLS assigns labels to packets and how Label Distribution Protocol (LDP) works to manage labels between routers.
3. **Traffic Engineering**:
   * The project will highlight how MPLS allows traffic to take predetermined, optimized paths, offering better performance control over network traffic compared to traditional IP routing.
4. **Failure Recovery**:
   * MPLS’s quick recovery from link failures (using mechanisms like Fast Reroute) will be shown, providing another point of comparison with IP routing’s often slower convergence time.
5. **Scalability**:
   * The project will showcase MPLS’s ability to handle larger networks more efficiently, demonstrating how labels reduce the processing load on routers, especially in large-scale networks.
6. **Application Scenarios**:
   * Examples of real-world applications of MPLS in enterprise networks, service provider backbones, and data centers will be discussed to contextualize its benefits.

This project provides a comprehensive, hands-on approach to learning the advantages of MPLS over traditional IP routing and is aimed at enhancing understanding for network engineers and students.

**Plan of Work (5 Weeks)**

**Team Members:**

**Ayan** and **Sami**: Co-leads and masterminds behind the project. Both are equally responsible for the approach, ideas, and execution. We both work collaboratively to make this project Deployable

**Week 1: Research and Information Gathering**

* Ayan and Sami will gather extensive information about MPLS (Multiprotocol Label Switching) and redistribution techniques. This includes how different routing protocols can communicate with each other through redistribution.
* Ayan will focus on understanding MPLS concepts like label distribution, push, swap, and pop operations, while Sami will dive deeper into the mechanics of routing protocol redistribution.
* The goal is to complete thorough research, ensuring a strong theoretical foundation.

**Week 2: Exploring GNS3 and MPLS Syntax**

* Ayan and Sami will explore the GNS3 network simulator, becoming familiar with its interface and functionality.
* Both will study and practice the syntax required for MPLS configuration in GNS3.
* By the end of the week, they should have a basic GNS3 lab setup ready for MPLS configuration.

**Week 3: Logic Implementation (Bank Network Simulation)**

* The main focus this week is implementing the logic for the simulated bank’s communication network.
* Ayan will do the configuration of customer edge (CE) routers, ensuring they use standard IP routing, while the MPLS operations will be implemented on the ISP side.
* Sami would configure the ISP routers for MPLS operations (push, swap, pop of labels), ensuring correct label distribution and path establishment.

**Week 4: Debugging and Optimization**

* Ayan and Sami will thoroughly debug the implemented logic, ensuring smooth communication between the bank’s branches.
* The focus will be on resolving issues related to MPLS label switching and verifying proper routing.
* Ayan and Sami will consult with **Sir Shoaib** to gain insights into further optimizing the configuration.

**Week 5: Testing and Final Implementation**

* In the final week, Ayan and Sami will conduct rigorous testing of the MPLS setup to ensure that the bank’s branches can communicate effectively through the ISP’s MPLS network.
* The goal is to fine-tune the configuration, ensuring stability and efficiency before finalizing the implementation.

**References**

[**https://www.youtube.com/watch?v=iEej56gsJ4E**](https://www.youtube.com/watch?v=iEej56gsJ4E)

[**https://github.com/rishikeshadusumilli/Traffic-Engineering-using-BGP\_LS-PCEP-OpenDaylight**](https://github.com/rishikeshadusumilli/Traffic-Engineering-using-BGP_LS-PCEP-OpenDaylight)