Title: Study on MPLS & Wireless LAN.

Problem Statement:

1. Traditional Vs MPLS throughout measurement.
2. LDP analysis.
3. Analysis of MPLS Traffic Engineering.
4. Throughput measurement and comparison between servers and clients using a Access point.
5. Comparison and measurement of throughput for various transmission power levels and channels of the access point.

Theory & Background:

WAN's: stands for Wide Area Network, which is a telecommunications network that extends over a large geographical area, typically connecting multiple smaller networks, such as local area networks (LANs) or other WANs. WANs can have different topologies, such as point-to-point, hub-and-spoke, mesh, or hybrid topologies. Routing is a fundamental concept in WANs, where data packets are forwarded between different network nodes based on routing algorithms. These algorithms determine the optimal path for data transmission, considering factors like latency, bandwidth availability, and network congestion. WANs rely on various protocols to facilitate communication between different devices and networks. TCP/IP (Transmission Control Protocol/Internet Protocol) is the primary protocol suite used for data transmission over the Internet.

MPLS: Multiprotocol Label Switching (MPLS) is a protocol-agnostic routing technique designed to speed up and shape traffic flows across wide area networks (WANs). It works by assigning short labels to network packets. Multiprotocol Label Switching (MPLS) is a layer 2.5 networking protocol that operates below the network layer (layer 3) and above the data link layer (layer 2). MPLS replaces traditional IP routing with label switching. When a packet enters the MPLS network, a label is attached to it, indicating the path it should follow. Labels are used to forward packets through the network based on predetermined routes known as Label Switched Paths (LSPs). MPLS uses protocols like LDP to distribute labels across the network. LDP enables routers to exchange label mapping information, ensuring that all routers within the MPLS domain have consistent forwarding tables.

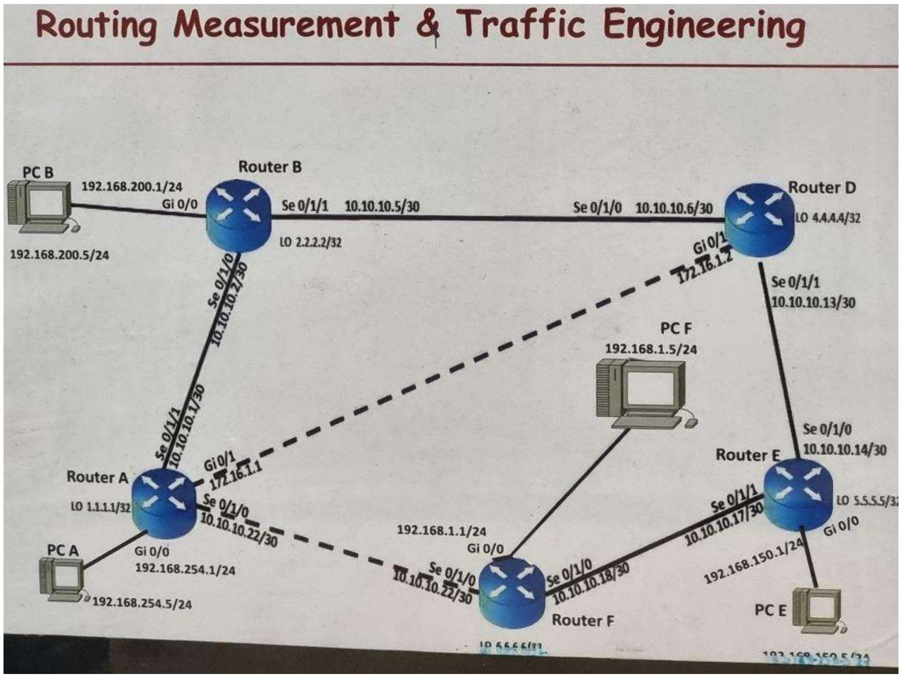


Fig1: Actual network traffic for Lab experiment.

- For traditional method use the following commands:
  1. Telnet 1.1.1.1 (to operate router A configuration)
  2. Shutdown serial 0/1/0
  3. Sh run
  4. Shutdown giga 0/1 & tunnel 0.
  5. Create traffic from PC-B to PC-E:

Ping 192.168.150.5 -t –l 35500 (it creates a continuous traffic of 35500 bytes)

  6. Again, creating traffic from PC-E to PC-B:

Ping 192.168.200.5 -t –l 35500 (it creates a continuous traffic of 35500 bytes)

Now, initiate FTP commands from PC-A to reach PC-F.

- For traditional method use the following commands:
  1. Enable router A: telnet 1.1.1.1
  2. Copy text file (commands) from file manager
  3. Enable MPLS in all the routers (config MPLS).
  4. Check with sh run.
  5. Now, transfer the file from PC-A to PC-F using FTP.
- By traditional method we observed:

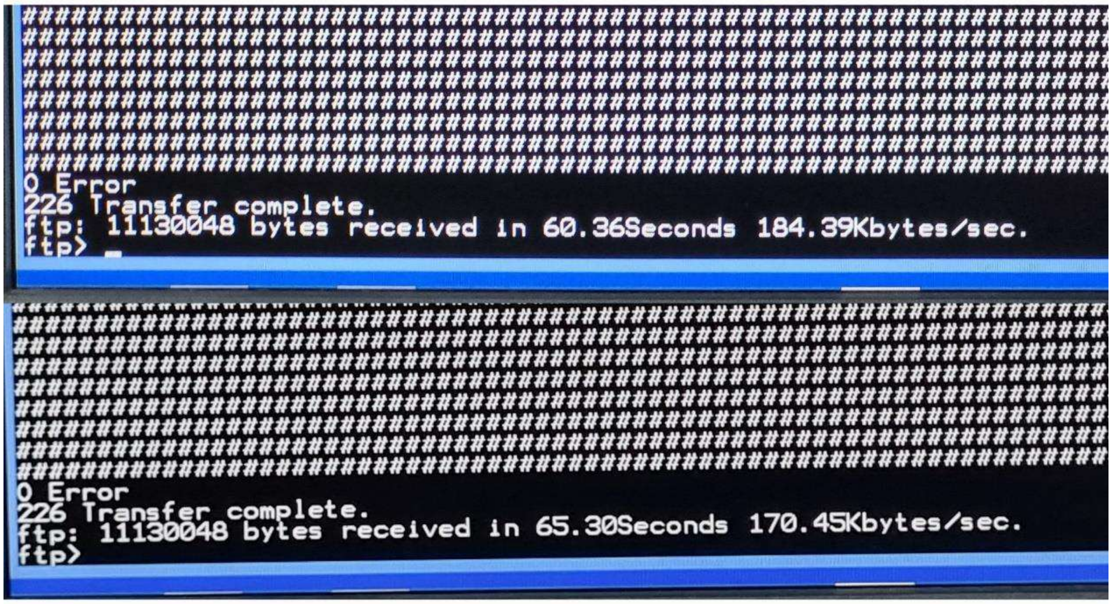


Fig2: Two samples of traditional method FTP throughput.

Samples	Time Taken	Throughput Received
1.	60.36sec	184.39Kbps
2.	65.30sec	170.45Kbps

- By MPLS method we observed:

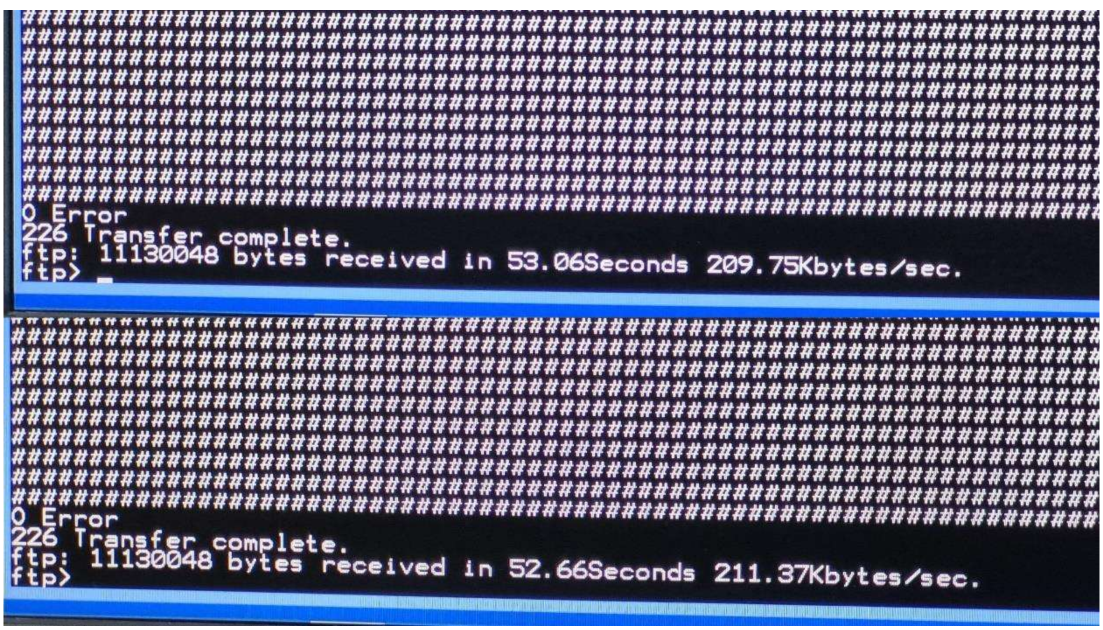


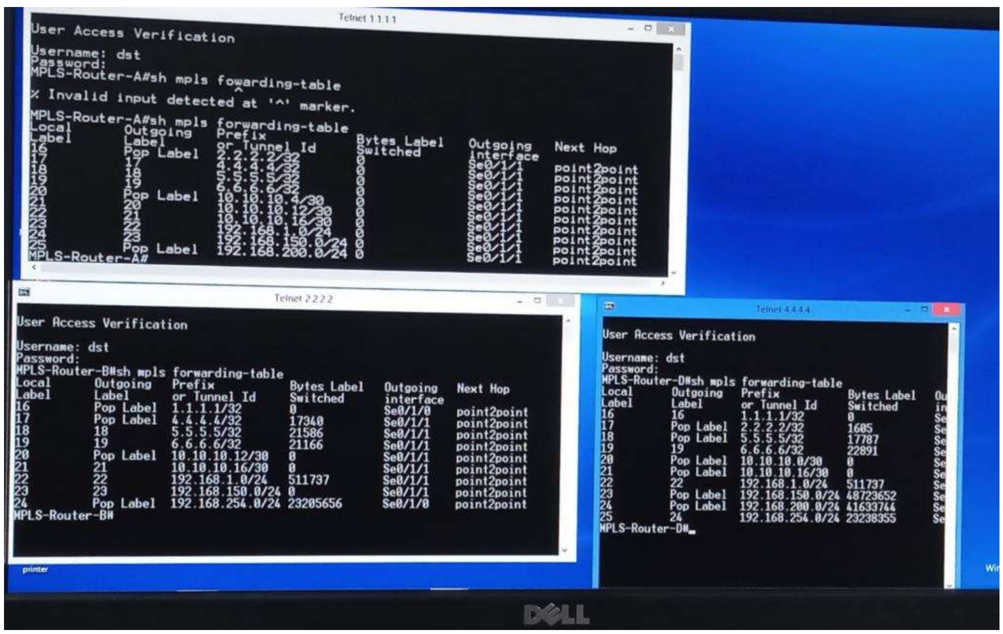
Fig2: Two samples of MPLS method FTP throughput.

Samples	Time Taken	Throughput
1.	53.06sec	289.75Kbps
2.	52.66sec	211.75Kbps

<u>LDP Analysis:</u> Label Distribution Protocol (LDP) is a key component of Multiprotocol Label Switching (MPLS) networks. It's responsible for distributing labels across the MPLS domain, enabling routers to establish label-switched paths (LSPs) and forward packets based on these labels. LDP establishes label bindings between adjacent routers in an MPLS network. These label bindings are distributed using TCP connections between neighboring routers.

- **Command procedure:**
  1. Telnet 1.1.1.1
  2. Sh mpls forwarding-table
  3. Link address between routers = [min (serial1, serial2) -1].
     Ex: Serial1=10.10.10.5
     Serial2=10.10.10.6
     Link address between routers = 10.10.10.5-1= 10.10.10.4
  4. Tracert 192.168.1.5 (PC-A to PC-F).

- **Observation:**



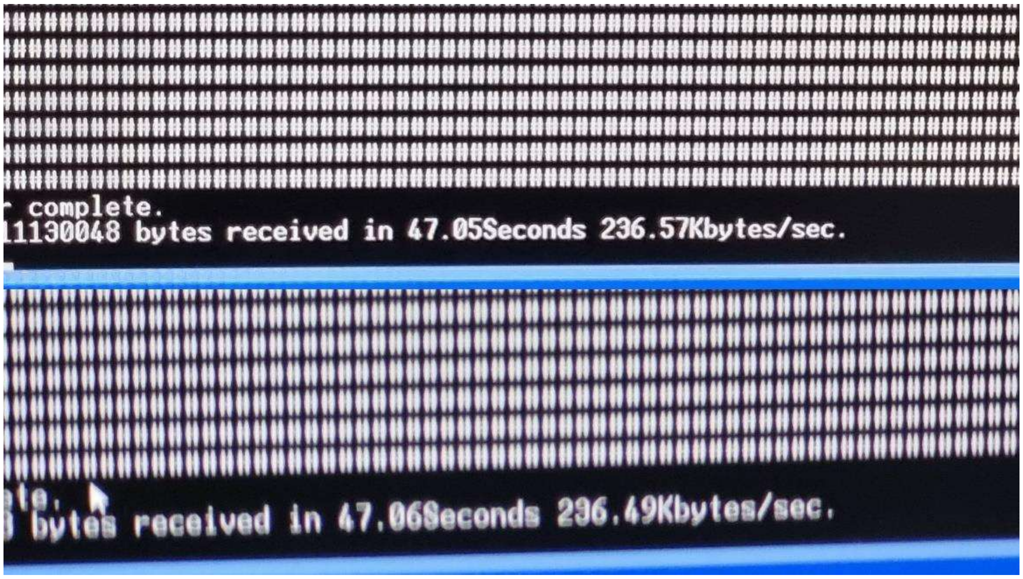
Analysis of MPLS Traffic Engineering:

- **THEORY AND BACKGROUND:**
  Multiprotocol Label Switching (MPLS) traffic engineering is a set of techniques and mechanisms used to control and optimize traffic flows across MPLS networks. It allows network operators to manage network resources, improve network utilization, and ensure quality of service (QoS) by steering traffic along specific paths.
  MPLS-TE allows network operators to create explicit paths, known as Traffic Engineering Tunnels or Traffic Engineering Label Switched Paths (TE LSPs)through The network.
  These tunnels can be set up to follow specific paths based on criteria such as bandwidth requirements, latency constraints, or traffic engineering.

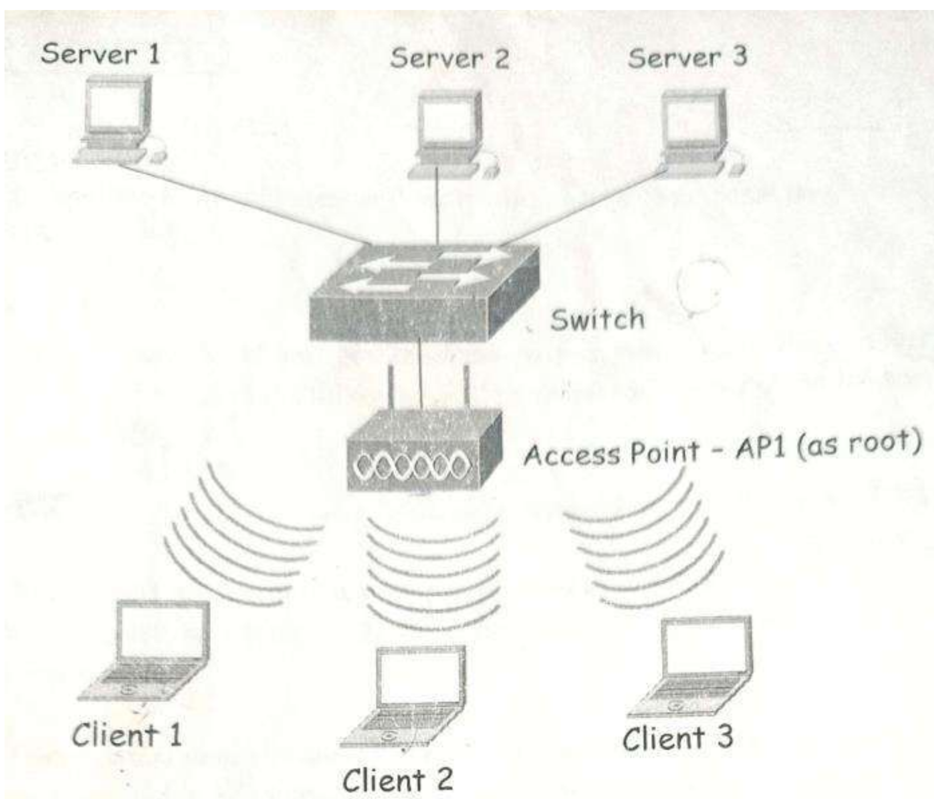
- **Procedure:**

1. First, we unshut the serial 0/1/0, giga 0/1, and tunnel 0 using no shut command.
2. Then, we put the code of traffic engineering file to enable the traffic engineering tunnels.
3. We do it for all the routers.
4. Check it with sh run in router A
5. Check the throughput using FTP
6. Now, shut any of the serial in the longest path and check the throughput. (Serial 0/1/1 is shutdown)
7. Checking the throughput, we get it same as the above.
8. Now, we shut the giga 0/1 diagonal path and note the throughput and trace the path.

Path	Throughput	Time
All path Open	236.57Kbps	47.05sec
Longest path closed	236.49Kbps	47.06sec
Diagonal path shut	232.03Kbps	47.96sec



Throughput measurement and comparison between servers and clients using an Access point:



Access points are typically connected to a wired Ethernet network, either directly or through a network switch. This allows them to bridge wireless and wired networks, enabling communication between wireless devices and devices connected to the wired network. Access points can be managed and configured through web-based interfaces or dedicated management software.

Procedure: Commands for to measure throughput using FTP:

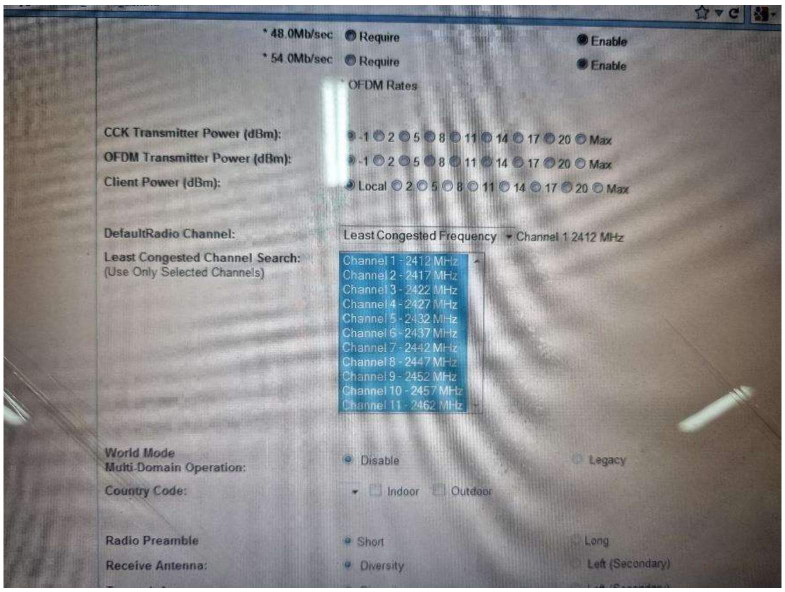
1. Ftp 10.7.1.179
2. Bin
3. Hash
4. Get nids.pdf

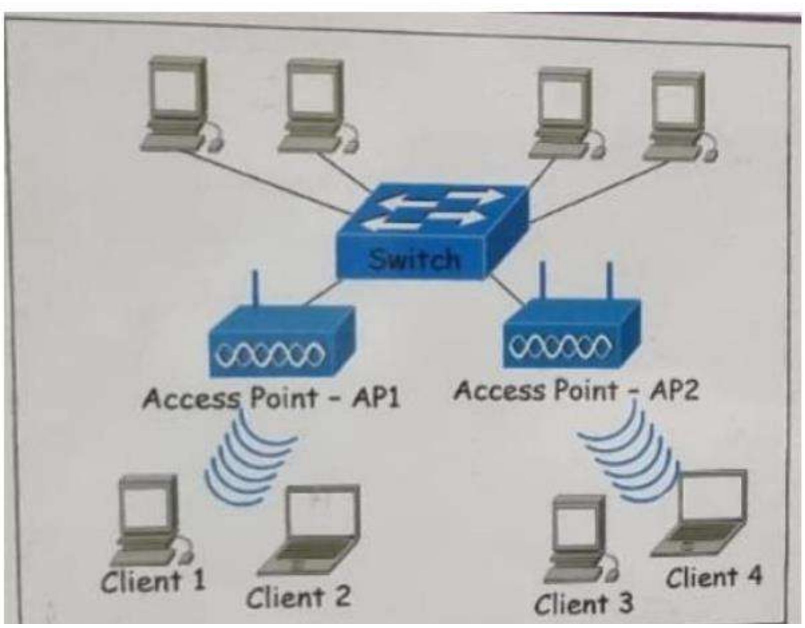
These throughputs are measured at 50MW power for access point and using the same channel.

Client	Throughput	Time Taken
1	726.50Kbps	15.32sec
2	420.43Kbps	26.47sec

Comparison and measurement of throughput for various transmission power levels and channels of the access point.

Now, we use 2 different access points for 2 clients. First, we will use the same channel for both the clients and then different channels for the clients. So first change the channel operating frequency:





OBSERVATION:

Taking power of channel 1= 100MW.
Power of channel 2= 50MW
Access point 1—10.7.1.18
Access point 2—10.7.1.14

Assigning channel 1 to both access points, we get throughputs as:

Client1	803.50Kbps
Client2	1055.48Kbps

Assigning channel 1 to AP1 and channel 2 to AP2, we get throughputs as:

Client1	856.47Kbps
Client2	1123.57kbps