MPLS FOR ABSOLUTE BEGINNERS

BY

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23 July, 2011

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Introduction

Multiprotocol Label Switching (MPLS) technology is concerned with the improvement of network traffic flow and its management. MPLS speeds up traffic flow by improving the efficiency of network routers.

More specifically, a specific path is set up for each packet providing each router with the address of the next node the packet must be forwarded to. The path is provided by a label included in the packet. A key benefit of MPLS is that the decision making of where the packet should be forwarded to is solely dependent on the content of the label and not on the packet itself. This means there is no need for a routing table lookup anytime a packet comes into the router.

MPLS emulates some properties of a circuit-switched network over a packet-switched network since it allows most packets to be forwarded at the layer 2 (data link layer) level rather than at layer 3 (network layer). This is the reason why it is commonly referred to as the Layer 2.5 protocol with respect to the OSI model.

MPLS works with many different protocols including Internet Protocol (IP), Asynchronous Transport Mode (ATM), SONET, frame relay network protocols, etc. MPLS enhances the traffic management of a network in terms of reliability and performance. It is argued that MPLS will be the protocol soon replacing ATM due to its significantly lower overheads.

How MPLS Works

I have created a diagram below showing some of the major (if not confusing) terminologies in MPLS.
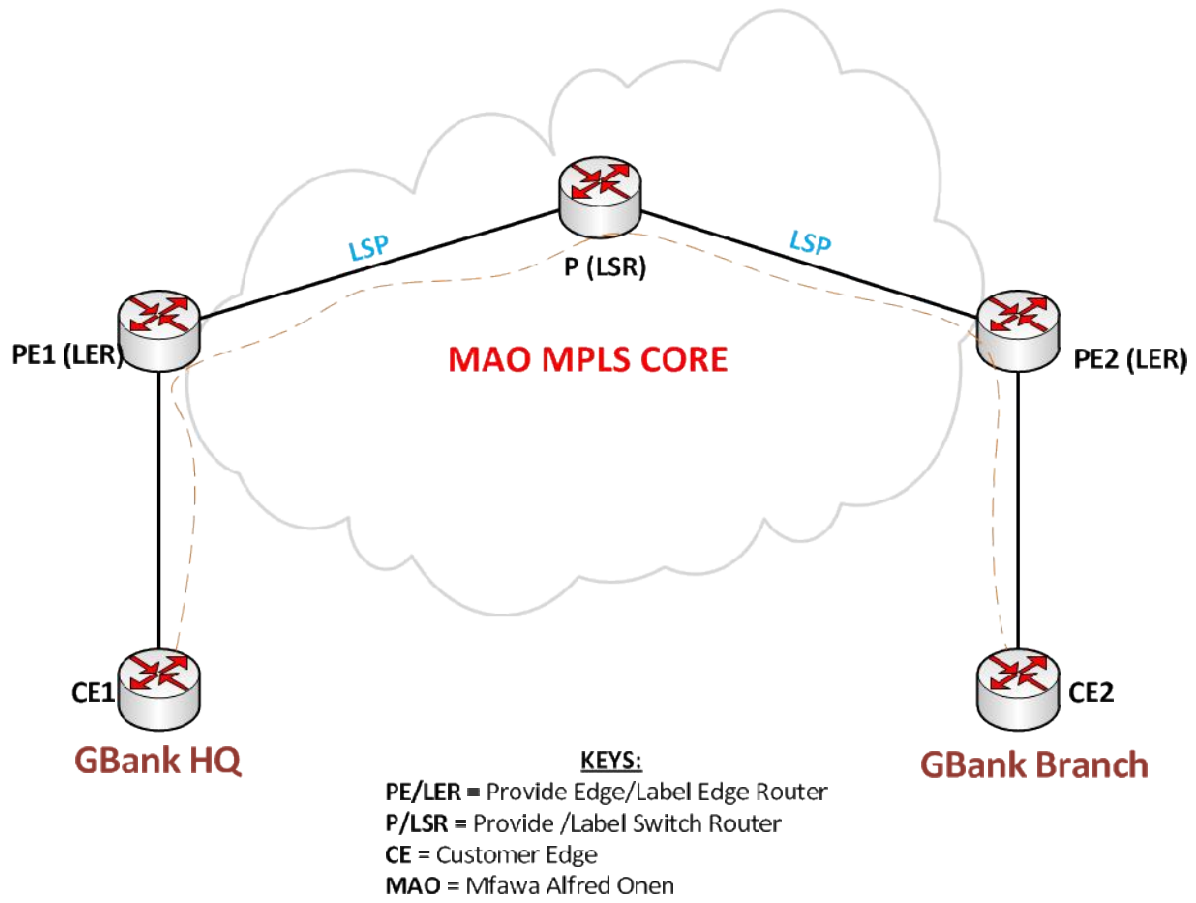
KEYS:
PE/LER = Provide Edge/Label Edge Router
P/LSR = Provide /Label Switch Router
CE = Customer Edge
MAO = Mfawa Alfred Onen

Figure 1: *A typical MPLS architecture/design*

Looking at the diagram, a customer (GBank HQ) has asked its ISP (MAO) to provide MPLS support so that it can connect to one of its branches (GBank Branch) using Layer 3 VPN. The ISP, MAO now has to have a router (called Provider Edge router) connecting to any of the customer edge (Either GBank HQ or GBank Branch). MAO has in its core a bunch of MPLS routers (routers that only forward labels called label switch routers) to forward the customer (GBank) packets across its network. Now when the customer sends a packet, it enters the ISP edge router (called label edge router or PE router) into a virtual routing and forwarding (VRF) table which is also a routing table created by the ISP for that particular customer. Now MAO edge router creates a label forwarding information base (LFIB) which has the label information for the entire label switch routers connected to it. An example will be when the PE1 puts a label 10 on packet coming from CE1 and forward it to P which then removes the label 10 and put 20 and forward it to PE2 which finally removes the label and delivers the packet directly to CE2.

Now the path that the ISP creates for the customer through its network is called label switched path which is similar to permanent virtual circuit in ATM and Frame Relay networks. Now MPLS uses Quality of Service information from layer 2 and still adds labels which does not allow for packet lookup in the routing table. This is why people call it Layer 2.5 as it tries to tuck the label information between layer 2 and layer 3 of the OSI model. The labels carry many details including quality of service (QoS) information as well as their arrangement in the stack (the BS or bottom of stack field).

This brings us to the label distribution technique. The MPLS enabled routers at the ISP core network run a label distribution protocol which handles the distribution of labels across the network. When a packet from CE1 reaches the ingress (PE1) of the ISP, a label is added and forwarded to the label switch router (LSR) which upon label lookup from LFIB replaces the label with another label and forward it to the next router (Egress) which checks to see if it is the last label and eventually removes the label (at PE2). This label less packet is now delivered to CE2 as a normal IP packet and that concludes the MPLS trail and that is how MPLS work. I will follow this up with a simple VPN over MPLS (also called MPLS VPN) scenario to demonstrate the more technical part. A pre-requisite for this Lab session however is your understanding of BGP, EIGRP, Loopback, OSPF etc.
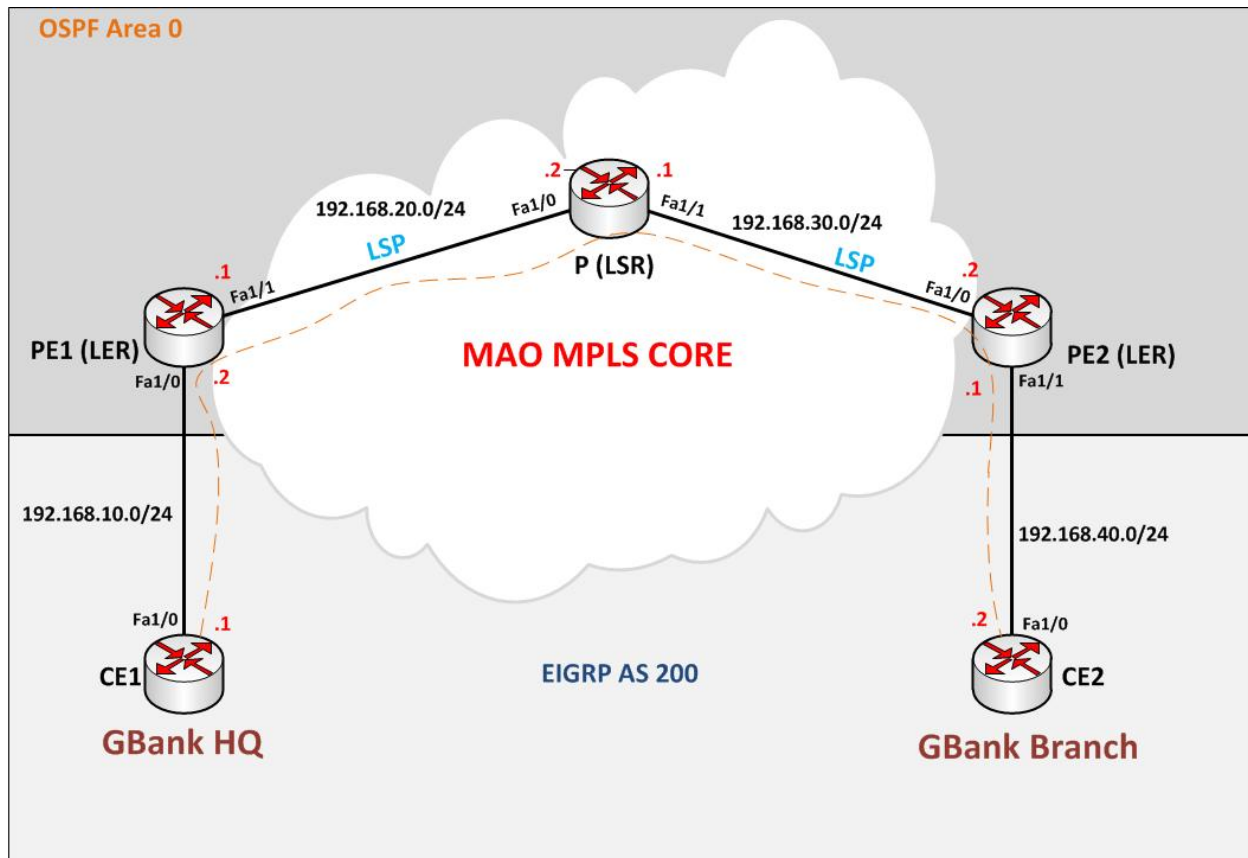
Lab Session

Figure 2: *Our Lab scenario*

Required Software

- GNS3 0.7

- Cisco 7200 Series Router

- Windows (XP, Vista or 7) or Linux variants (Fedora or Ubuntu)

Conclusion

I have decided to actually make a screencast for this lab session. So instead of just releasing a GNS3 file, I will make a video tutorial showing how to configure our scenario. So until then, enjoy the small write-up.