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MPLS Architecture for evaluating end-to-end delivery

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Abstract- This paper presents a MPLS architecture for evaluating end to end delivery. In this we have made a topology through which we show end to end delivery using MPLS. The method we use for end to end delivery is Cisco Express Forwarding (CEF), Label Distribution Protocol (LDP), Tag Distribution Protocol (TDP), Exterior Gateway Routing in this we use Border Gateway Protocol (BGP) ,Interior Gateway Routing in this we use Routing Information Protocol (RIP) protocol and the tool which we have been used for making the topology is Graphical Network Simulator (GNS). MPLS is improved in the future by reducing labels in the network.

Index Terms- MPLS, BGP, TDP, CEF, LDP, GNS

I. Introduction

In MPLS if we do end to end delivery, firstly all data traffic in the MPLS network is MPLS labeled. The topology which we have made in this paper uses the concept of Provider Edge (PE), Customer Edge (CE), and Core Router or provider (p). Customer Edge routers are held by the customer it self. There are two interfaces of the Customer Edge routers. One interface of the customer Edge is attached with the customer and the second interface is attached with the provider Edge. Provider Edge is also called as Label Edge Routers . which is hold by the service provider. At the encapsulation or the incoming side of the MPLS network the Provider Edge attach the labels to the packet. At the decapsulation or the outside of the MPLS network the provider edge routers remove the label. Provider router (p) are also called label switch router . Based on the MPLS labels it switch packet hop by hop.

MPLS label

MPLS uses a concept of labels. For transferring across a network the MPLS attach label to packet. Label is of fixed length. The size of the label is 20 bits. Basically the size of the MPLS packet header is 32 bits which is equal to 4bytes. There are four parts in the MPLS header which are as follows : one is Label which contains 20 bits , second is EXP that is experimental which contains 3 bits, Third one is S that is stacking bit which contains 1 bit and the fourth which is last one that is TTL stands for time to live.

II. WORKING OF THE MPLS

As previously discussed MPLS attach the label to the data packets for transferring data across a network. The importance of MPLS is only on a local node to node connection. In this the function of the node is that it forwards the packet by swapping the current label for the fitting label to route the packet to just after that node. In this way the forwarding concept through out the network is label swapping. The label swapping concept enables the high speed switching of the packet through the backbone of the MPLS network. MPLS Predefined the route through which a data takes across a network and convert that information in to label which is understand by the network routers[4].

A. HOW we establish the route in the MPLS network

In order to pass over the data across a network we use label switch path (LSP). Always the packet enters in to the MPLS network at an incoming side or encapsulation Label Switch Router (LSR) and exits the MPLS network at an outside or decapsulation LSR. In LSR there are predefined Switching tables are there according to that core devices switches labeled packet. LSR can be a switch or router[4].

B. Forward Equivalence Class (FEC)

A Forward Equivalence Class is a class in which the same type of group of packets are described. The same routing treatment is given to the packets of FEC. In hop- by- hop routing the next hop is independently selected by the router for a given Forwarding Equivalence Class[4].

III. METHODS

The method we use for end to end delivery is defined as follows:-

A. *Switching Method Cisco Express Forwarding (CEF)*

CEF is a switching method used by the Cisco Ios for packet forwarding. CEF is the default packet forwarding method in MPLS network. When the router forward the packet the router must know the destination address of the packet which is present in the table. Each and every protocol through which the router can forward the packet must have a separate forwarding table[5].

CEF mandatory in MPLS

Only with the help of Label Forwarding Information Base (LFIB) the labeled packets enter the router are switched. There is a CEF table on the router. Only with the help of CEF Table the IP packets enter the router are switched and the packet which is at the decapsulation can be a labeled packet or an IP packet. Basically there are two main components of CEF. One component is Forwarding Information Base (FIB) and the Second component is adjacency table.The FIB is also known as CEF table[5].

Manipulation of CEF

First of all when a packet enters in to the router it removes the Layer 2 information then in the CEF table the router consider

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the destination IP address. After that the decision takes for forwarding the packets in to the destination then the output of this forwarding decision points to one adjacency entry in the adjacency table. The Layer 2 rewrite string is restored from the adjacency table. With the help of this the router is able to place a new Layer 2 header on to the frame. Do this process right before switching the packet out onto the outside interface approaching the next hop. It is used in the distributed manner[5].

How do CEF Labeling IP Packets

It is necessary to Label the IP packets at the edge of the MPLS network. At the incoming side of the LSR there is a stack of label is imposed on the IP packet. It is not necessary that we impose only one label on the IP packet at incoming side of the provider edge router there can be a two or more labels on the IP packet at the incoming side of the provider edge router. In order to check which label is imposed on the IP packet ,we can check it from the CEF Table. We can enable CEF with global ip cef command[5].

A. LABEL DISTRIBUTION PROTOCOL (LDP)

As we discussed above, We use LSR which performs label swapping in order to forward the packet that means label should be distributed. There are two way to achieve it. one way is that on an already present routing protocol piggyback the labels and the second way is that we can develop a new protocol to do this. In the MPLS network the LDP for the Forward Equivalence Class carries the labels. In order to distribute prefixes between different autonomous system we use only one protocol that is Border Gateway Protocol (BGP). In order to distribute the labels for interior routes we use the LDP. Therefore all point to point connected Label Switch Router must establish an label distribution protocol session between them. Label mapping messages are exchanged between the LDP session by the LDP neighbours. The label which is bound to Forward Equivalence Class(FEC) is known as label mapping.We can enable the LDP by the mpls ip command[5].

B. TAG DISTRIBUTION PROTOCOL (TDP)

TDP is a connection oriented technique and takes a full guarantee of sequential delivery. TDP protocol is used by the switching routers in order to communicate tag binding information to their peers. TDP supports many protocols. The main function of the TDP is that it provides the means for creating and distributing the binding information by the help of Tag Switching Routers (TSR). In order to distribute and release the binding information for network layer protocols we use TSRs.

C. BORDER GATEWAY PROTOCOL (BGP)

In the MPLS provider communicates with the help of the BGP. As in the previous days the provider takes the upper layers of layer 2 as the responsibility for routing and we only worry about the Layer 2. But now days participates run BGP on their router in order to possible the working of MPLS. In order to connect with external network we use BGP[6].

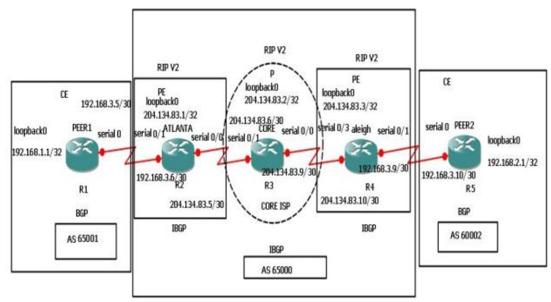
D. ROUTING INFORMATION PROTOCOL (RIP)

Routing Information protocol is Interior Gateway Protocol. In which the routing is performed with in a single autonomous system. Enhancement of the RIP is the RIP2. Messages are updated at regular interval when there is a change in the network topology. In RIP we use a hop count in order to measure the distance between the source and destination. Total no. of hop count we use here are 15 and RIP timer is generally a 30 seconds.

IV. SIMULATION

The simulator used for MPLS end to end delivery is GNS Simulator. GNS is a graphical Network Simulator it supports the simulation of complex networks **.**

Fig1.Topology shows routers are in off position



In this topology, there are basically five routers . The name of the five routers as follows:

A. PEER 1
B. PEER 2
C. ATLANTA
D. CORE ROUTER
E. ALIEGH

In this topology routers are in the off position ,Red lights indicate that the routers are off

A. *PEER1*:- In this topology peer1 is working as the customer edge. *CUSTOMER EDGE***:-** A customer edge (CE) device. This is a router that connects to the customer network and to a service provider.
B. *PEER2*:- In this topology peer2 is also acting as a customer edge.
C. *ATLANTA*:- In this topology Atlanta is the provider edge.
D. *PROVIDER EDGE***:-** A provider edge (PE) device. This is a service provider that connects to a customer and into the provider (P) network.
E. *CORE ROUTER*:- In this topology core router is the core ISP. which is also known as the internet cloud. The name of this router is known as P router.

P:- A provider (P) device. This is a service provider that exists entirely in the provider (P) network and only connects to other service provider devices (not to customers).

CUSTOMER ADDRESSING

A. The devices which we used in it are PEER 1and PEER 2.
B. The loopback0 for PEER1 is 192.168.1.1/32 and the loopback0 for PEER 2 is 192.168.2.1/32
C. The serial 0 for PEER 1 is 192.168.3.5/30 and the serial 0 for PEER 2 is 192.168.3.10/30.

SERVICE PROVIDER ADDRESING

A. The devices in the service provider addressing are ATLANTA, CORE, RALEIGH.
B. The loopback0 for the ATLANTA is 204.134.83.1/32, CORE is 204.134.83.2/32, RALEIGH is 204.134.83.3/32.
C. The Serial0/0 for the ATLANTA is 204.134.83.5/30, CORE is 204.134.83.9/30, RALEIGH is N/A.
D. The Serial0/1 for the ATLANTA is192.168.3.6/30, CORE is 204.134.83.6/30, RALEIGH is 192.168.3.9/30.
E. The Serial0/3 for the ATLANTA is N/A, CORE is N/A, RALEIGH is 204.134.83.10/30.

Fig.2 Routers are in the on position

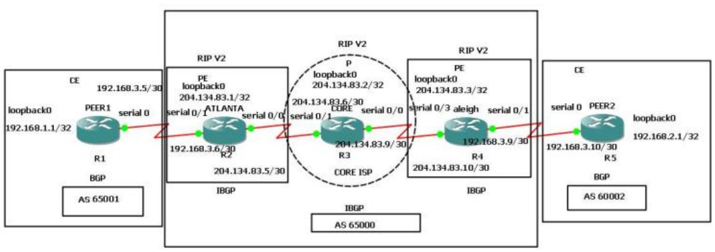


Fig.3 Running mode of the PEER 1

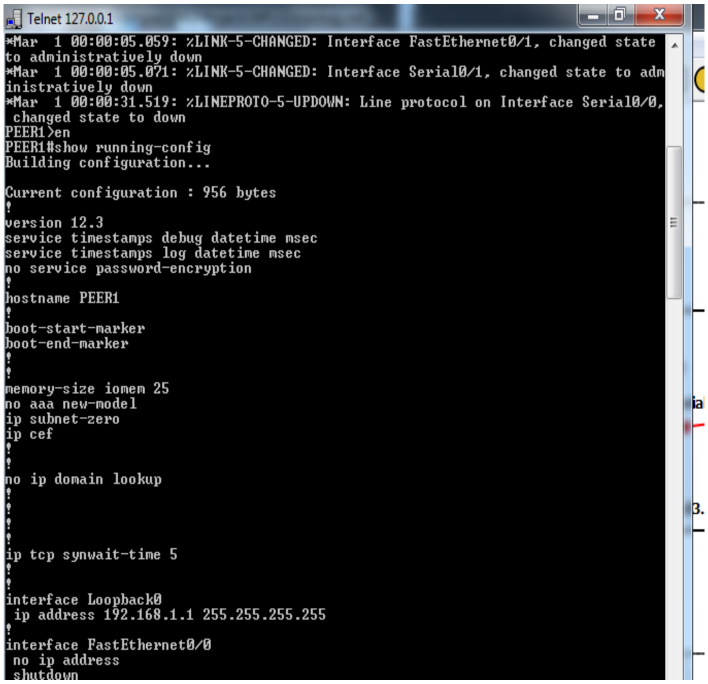


Fig4. Running Interface of PEER 1

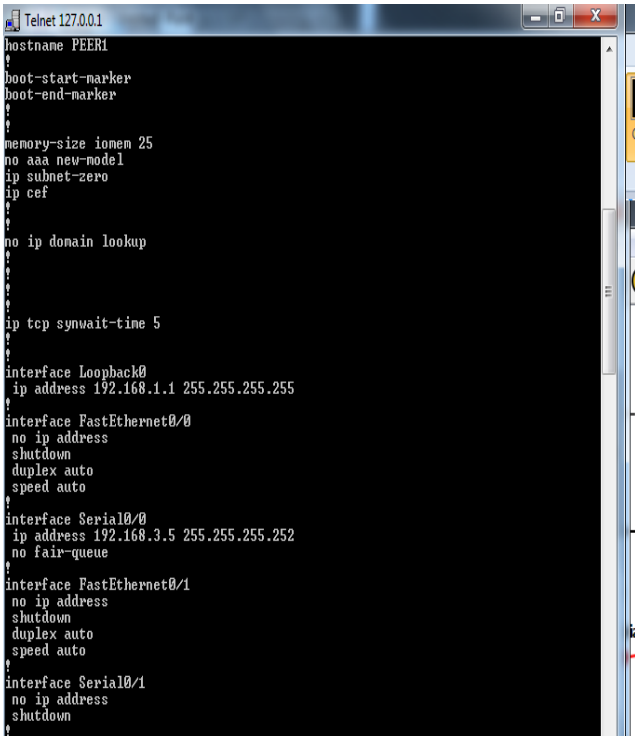


Fig5. Running mode of ANTLATA

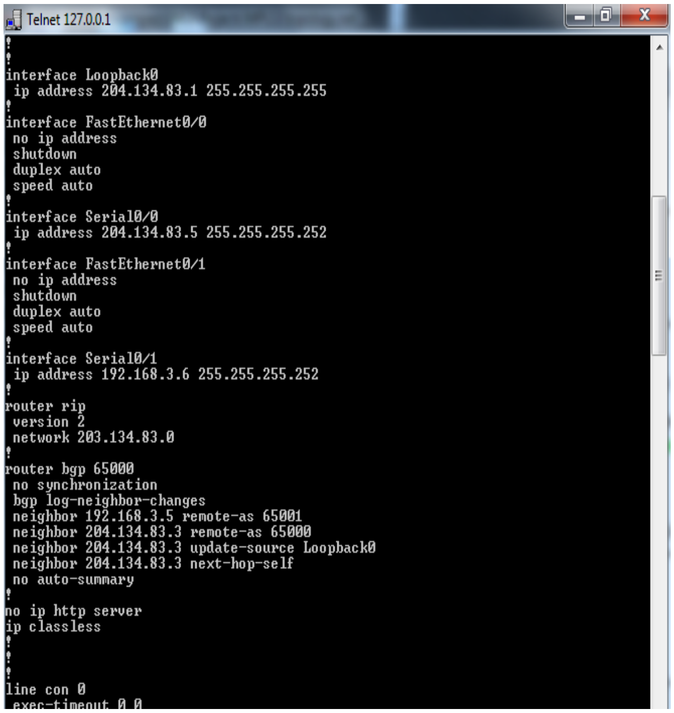


Fig6. Running mode of CORE ROUTER(IP CEF)

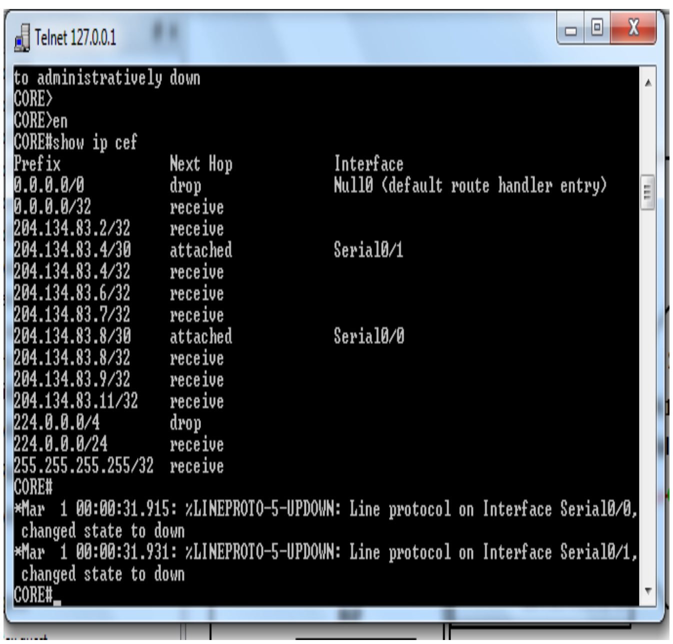


Fig7. Running mode of CORE ROUTER

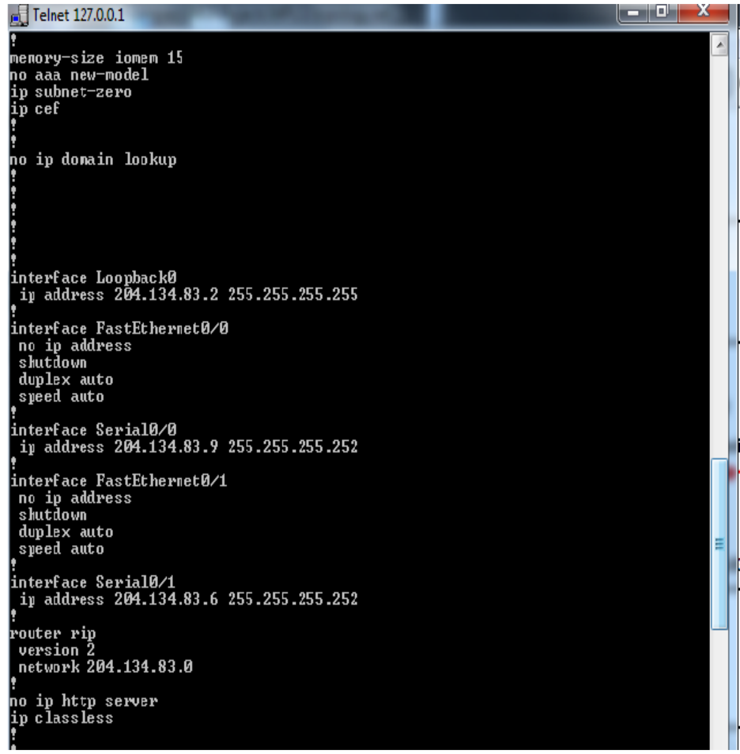


Fig8. Running mode ALEIGH

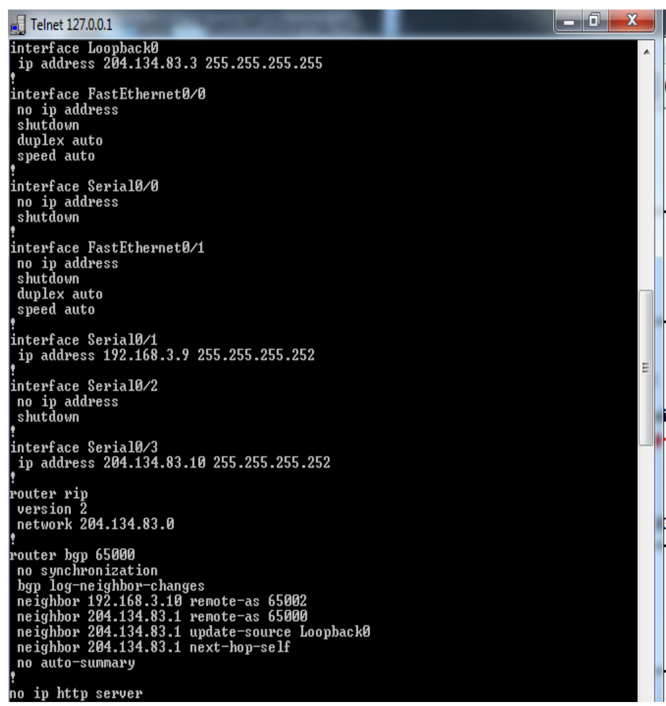


Fig.9 MPLS run on ANTLATA COUNTRY

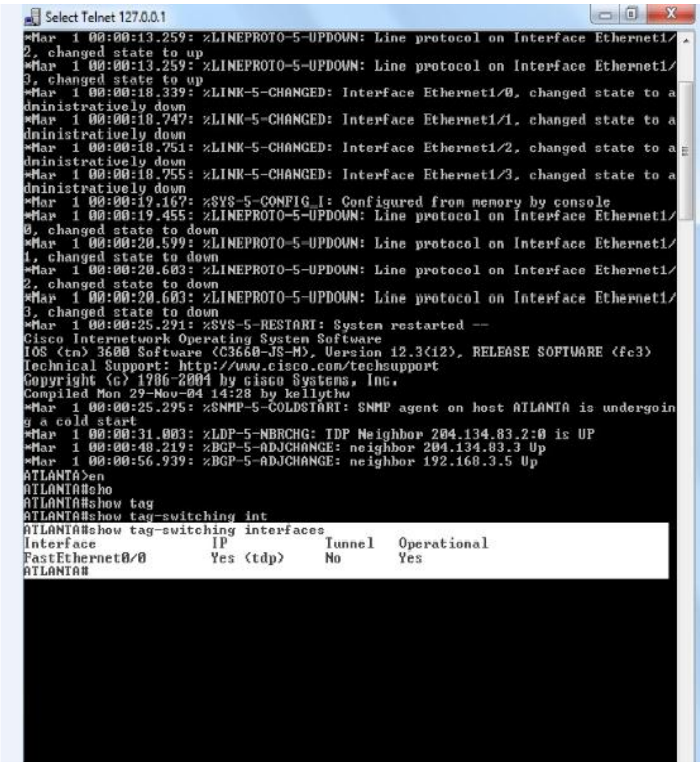


Fig10. MPLS run on CORE ISP

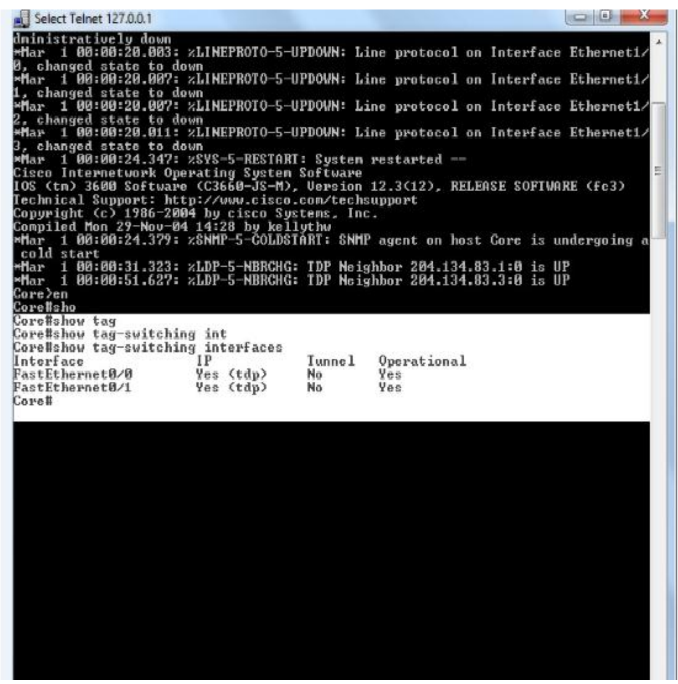


Fig11. LABEL BINDINGS ON ANTLANTA

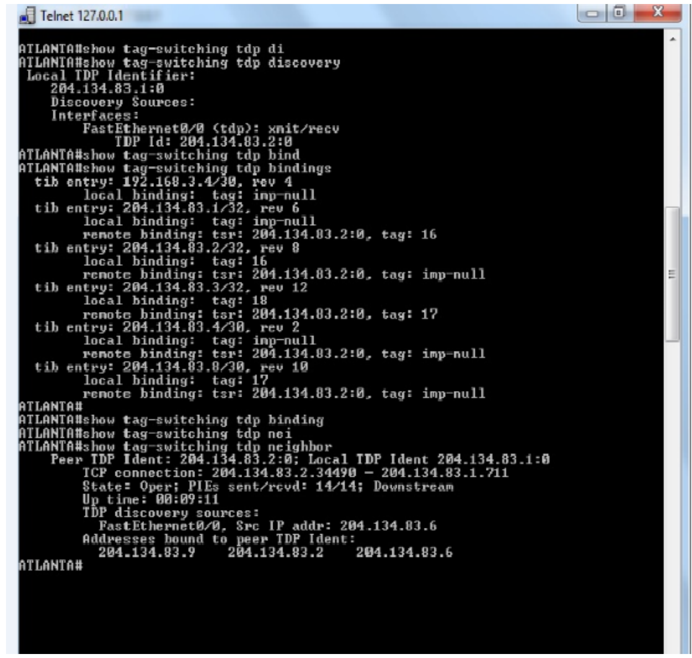


Fig12. LABEL BINDINGS ON CORE ISP

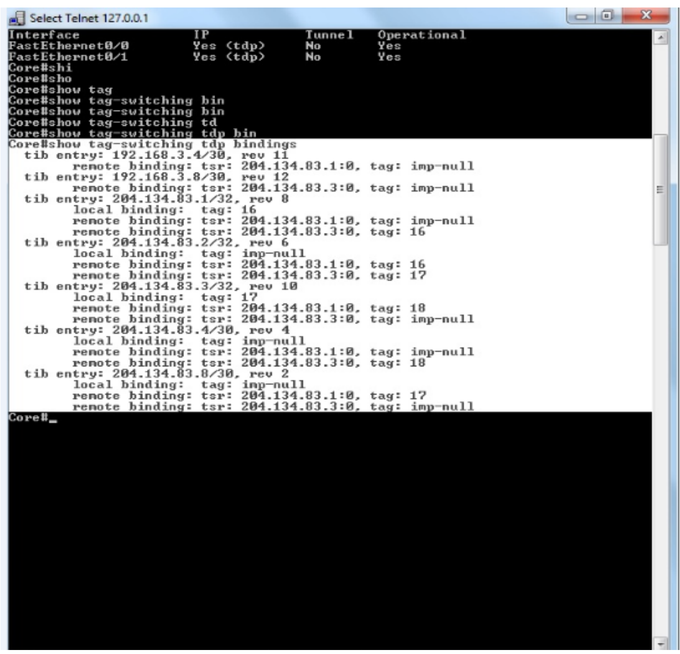


Fig13. END TO END DELIVERY, BGP, LDP

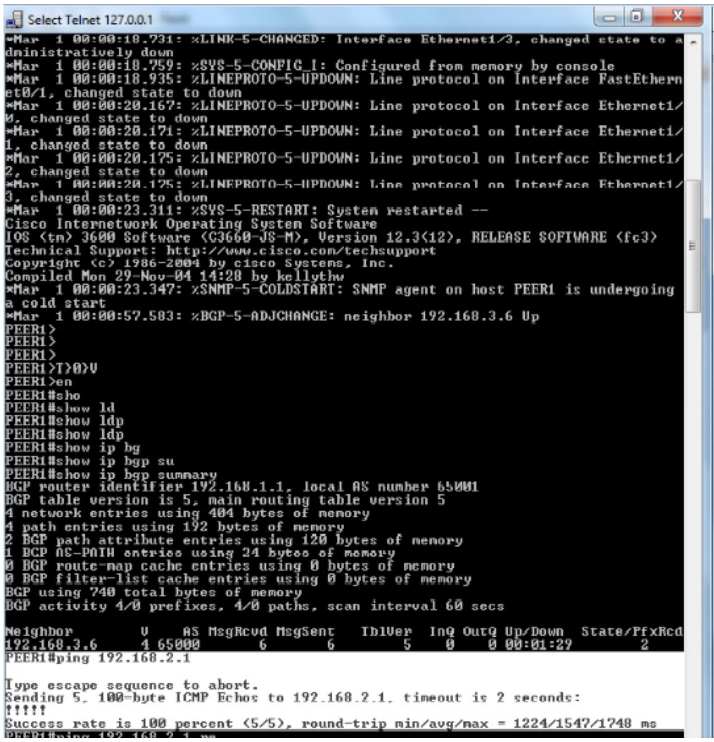


Fig14. ANTLATA FORWARDING TABLE

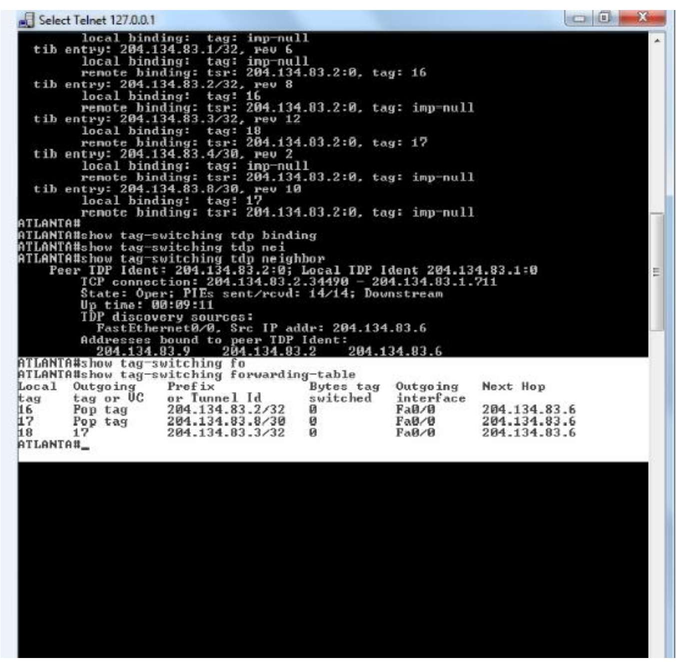


Fig15. ANTLATA FORWARDING TABLE TAGS

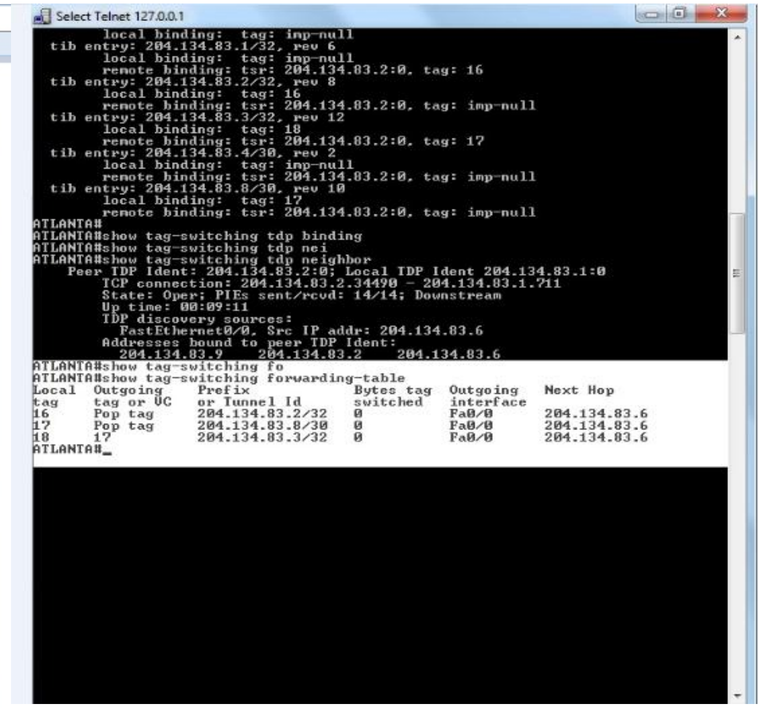


Fig16. TRACEOUT

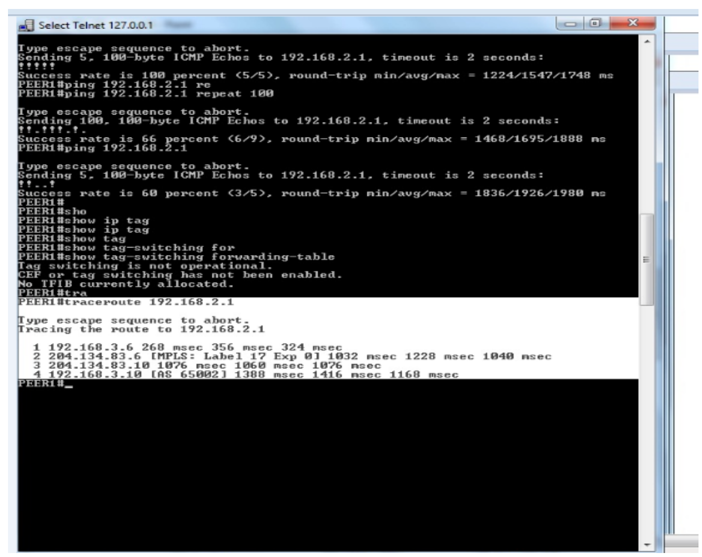


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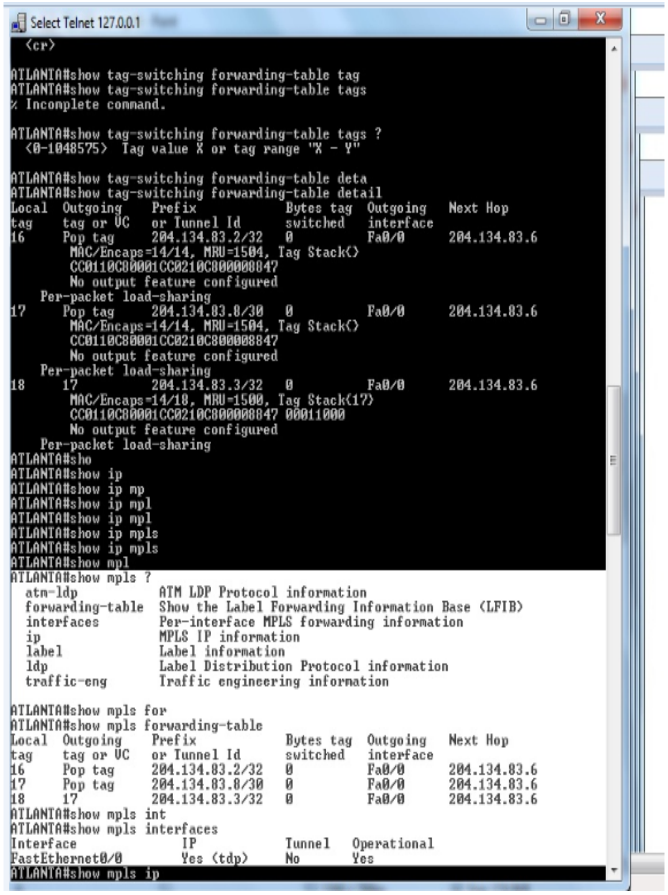
Fig18. End to End Delivery of MPLS



V. CONCLUSION AND FUTURE

The conclusion of this paper is that in which we do the label switching. This label switching technology is used to improve the performance of network layer routing. In this scenario basically a main role of three things that is customer edge, provider edge, core isp. The provider edge performs the label imposition to the packets and send the labeled packet to its way. In which each LSR in the LSP doesn't examine the layer 3 portion of the packet only label examine the layer 3 portion of the packet. In which we do the end to end delivery by externally using BGP protocol and internally using RIP protocol and the future of this paper is that we can improve the performance by reducing the number of labels.

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