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RESEARCH ARTICLE

Improve the QoS by Applying Differentiated Service over MPLS Network

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Abstract— The motivation of Quality of Service is to improve the performance of an Internet Protocol network. The aim of this work is to improve the Quality of Service in the core network and that done by using Differentiated Service is defined as a way to differentiated between service in the internet, and Multiprotocol Label Switching which is a mechanism to accelerate the forwarding of the packet. By integrate the Multiprotocol Label Switching and Differentiated Service we will get the benefits of Multiprotocol Label Switching and Differentiated Service. The objective of this work is to trace the packet when it crosses the network. The result when trace the packet shows the improvement of Quality of Service which is a packet keep its Quality of Service and in the same time goes over Multiprotocol Label Switching network when the service goes throw the network model that designed and configured using Graphical Network Simulator 3 and use wireshark application to show that results.

Keywords— MPLS, DiffServ, QoS, Gns3, ICMP

1.1 INTRODUCTION

At the beginning computer networks were designed mainly for data transfer such as FTP and email, where delay was considered to be un important. In most cases the delivery service was effective, and the TCP protocol dealt with data losses. As the multimedia applications became popular (voice transfer, video conferences), separate telephone and video communication networks were set up (see Fig. 1). Nowadays, office and company networks are transformed into one converged network (see Fig. 2), in which the same network infrastructure is used to ensure all the requested services [1].

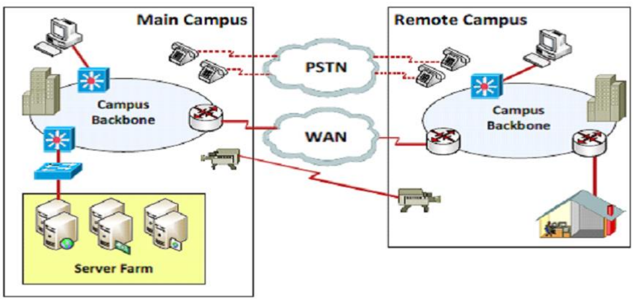

Fig. 1 A classical non-converged network

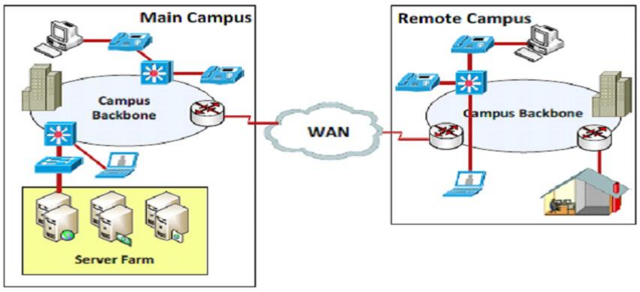

Fig. 2 A converged info communication network

1.2 QUALITY OF SERVICE (QOS):

Is an important issue as more number of multimedia services and more interconnections are increasing day by day. Hence various mechanisms have been developed to improve and maintain QoS in every network generation since from first generation to the NGN. Is also mainly defined as the ability of a network or network elements to provide a certain level of assurance to the user, concerning performance and reliable data delivery. Thus, the network must satisfy a set of specific requirements concerning the particular service or data flow it is transporting. These requirements can be described qualitatively, for example “short delay” or “good quality video.” However, they are more often measured quantitatively, using numerical values. We used many QoS parameters to compare the performance of the two networks, but the main parameters that we used were delay and delay variation [2].

The quality of service (QOS) concept to guarantee a specific QOS-level for real-time multimedia applications on the Internet. A QOS can be defined as a set of parameters that describe the quality (for example, bandwidth, buffering, priority, and CPU usage) of a specific stream of data. One idea behind the development of MPLS is to support the guarantee of QOS in existing IP and asynchronous transfer mode (ATM) networks. It was based on the observation that there exists a sequence of correlated packets for multimedia streams. Such streams are wanted to be processed in the same routing path by a uniform way and we did not want to repetitively examine all the headers of those packets. The observation showed that the headers in those related packets are the same or similar because those related packets in a stream desire consistent and similar processing actions. Hence, MPLS uses new technique to make short-term connection in a path for a sequence of correlated IP packets [3].

1.3 MPLS:

MPLS is a high-performance mechanism that directs data from one network node to the next based on short path labels rather than long network addresses, avoiding complex lookups in a routing table. The labels identify virtual links (paths) between distant nodes rather than endpoints. It uses the packet switching technique. MPLS can encapsulate packets of various network protocols. In an MPLS network, to every data packet labels are assigned and based on the content present in it every node takes the decision of packet forwarding. This allows one to create end-to-end circuits across any type of transport medium, using any protocol. MPLS networks allow the supply of advanced services such as virtual private networks (VPN) or voice (Voice over MPLS) offering a safety and an increased reliability, extremely fast switching times, ways (LSP) by class of service, the engineering of the traffic, a better control of quality of service. One more functionality it allows a better use of the resources from beginning to end in order to ensure the quality of service required by the applications in the data processing networks and telecommunications. [4].

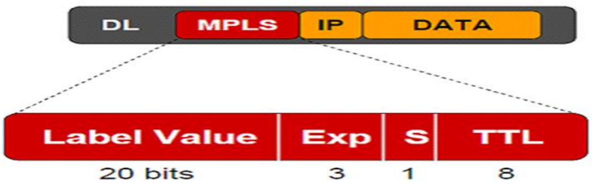

Fig. 3 MPLS Shim Header

As shown in Fig. 3, the MPLS Shim Header consists of an identifier called “Label”. It acts as an identifier of Forwarding Equivalence Class (FEC), and also used for determining the Label Switched Path (LSP). Followed by Label is Experimental field (EXP) which is reserved for the experimental use or are often used for QoS purpose. Stack field (S) is used for indicating whether the label is in the bottom of Stack. If the Label is at the last entry of stack then the value is set to one else is set to zero. The last one is the (TTL) value. TTL value decreases by one on every hop as it passes through the LSRs. The packet is dropped when the TTL value reaches zero. Among all these fields of MPLS shim header, label plays a very important role [4] [5] [6].

1.3.1 MPLS OPERATION:

Step-1: The network automatically builds routing tables as MPLS capable router participate in interior gateway protocols (OSPF, IS-IS) throughout the network. Label distribution protocol (LDP) establishes label to destination network mappings. Label distribution protocol (LDP) uses the routing topology in the tables to establish label values between the adjacent devices. This operation creates Label Switching Paths (LSP) pre-configured maps between destination end points.

Step-2: A packet enters the ingress edge label switching router (LSR) where it is processed to determine which layer-3 service it requires, such as quality of service (QoS) and bandwidth management. The edge LSR selects and applies a label to the packet header and forwards it.

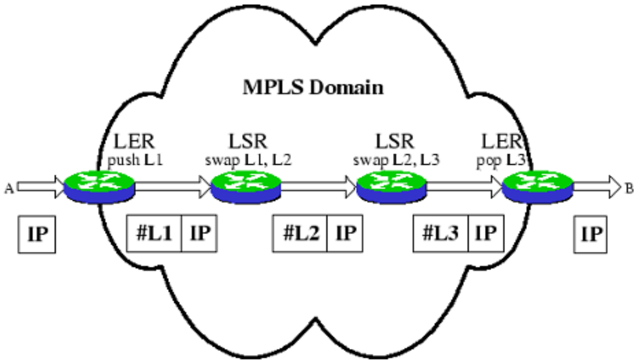

Fig. 4 MPLS packet forwarding

Step-3: The LSR reads the label on each packet replaces it with new one as listed in the table and forwards the packet.
Step-4: The Egress Edge Router strips the label, reads the packet header and forwards it to its final destination [6].

1.4 DIFFERENTIATED SERVICES (DIFFSERV):

DiffServ model trying to solve scalability issues by marking packets with a label read by the routers detailing the treatment and priority they should be given by the routers. In this model, there are no reservations so the routers do not see the flows, which imply that there is no signaling protocol or status information that caused so many problems to the IntServ mode. Quality guarantees are not so strict, which may occasionally be tolerable. Packets are classified into classes, also called Class of Service (CoS). Classes are limited and independent of the number of flows; for this reason, the complexity does not depend on the number of users and does not involve problems of ascending information making the architecture scalable. QoS information is in the datagrams in a DS field; this information is recognized by the routers by configuration and they give the treatment to each class.

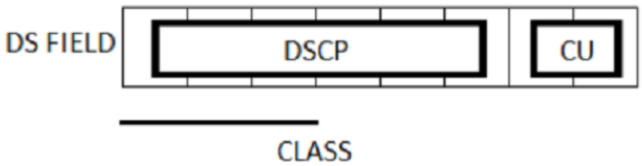

Fig. 5 Fields of DS

Fig. 5 shows six bits dedicated to Differentiated Service code point (DSCP), which indicate the treatment and two CU bits that are not used (currently used in congestion control). With the six bits, it has 64 categories of traffic but they have been divided into three groups. Packets entering a DiffServ Domain (DS-Domain) can be metered, marked, shaped, or policed to implement traffic policies.

Table 1 list the commonly used DSCP values described in RFC2475

DSCP Value	Decimal Value	Meaning	Drop Probability
101 110	46	High Priority Expedited Forwarding (EF)	N/A
000 000	0	Best Effort	N/A
001 010	10	AF11	Low
001 100	12	AF12	Medium
001 110	14	AF13	High
010 010	18	AF21	Low
010 100	20	AF22	Medium
010 110	22	AF23	High
011 010	26	AF31	Low
011 100	28	AF32	Medium
011 110	30	AF33	High
100 010	34	AF41	Low
100 100	36	AF42	Medium
100 110	38	AF43	High

1.5 INTEGRATION OF MPLS AND DIFFSERV:

MPLS and the Differentiated Services model: the mechanisms of MPLS traffic classification and its ability to establish LSPs, which allows it to provide different services to different types of traffic, depending on its specific needs. It is evident therefore that MPLS is not an alternative to the Differentiated Services model, but on the contrary, MPLS can be used as a support of the Differentiated 'Services LSPs that can carry multiple OAs, so the EXP field in MPLS header tells the LSP the PHB to be applied to each packet (contains the information on the service of the packet on its discard probability).

2.1 NETWORK MODEL:

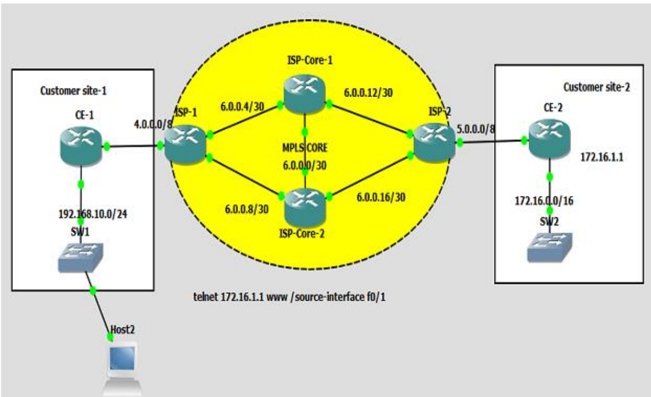

Fig. 6 network model

2.2 CONFIGURATION PART:

2.2.1 CE-1: In it we create class of service for all services (Telnet, ICMP, Http, Voice-signaling and FTP) And then configure policy for these services by give each service DSCP like as shown in table 1 .the configuration.
2.2.2 ISP-1: In it we create the operation of mapping from DSCP to EXP to treatment the packet that enter the MPLS network depend of the policy of DSCP.

2.2.3 ISP-Core-1 and ISP-Core-2: In it we have shown the type of protocol that used in the operation of labeling which we use LDP protocol..
2.2.4 ISP-2: The configuration same as ISP-1.as we know that at the edge of the network of MPLS there are one of operation that done if the packet enter the network will add the label and when the packet leave the network the label will be removed from the packet and then the packet complete its route depending on the IP address.

3.1 SIMULATION:

3.1.1 PART ONE:

In this part we generate many type of traffic that will come from the interface of the Host-2.And we will trace the traffic when it goes through the network until reach the site of customer:
In the simulation we first generate continuous ICMP (ping command) traffic that comes from the Host-2 to the destination IP 172.16.1.1.And we will trace the traffic policy (Diffserv when the packet (ICMP packet) cross network)

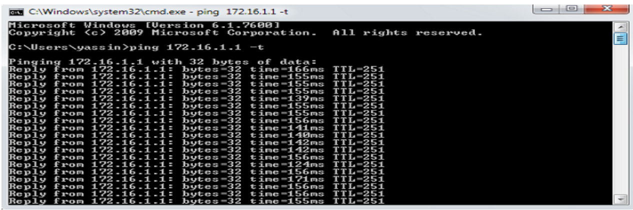

Fig. 7 continuous ping command

Packet of ICMP before reach CE-1 router where the QoS is implemented the differentiated service has a default value (zero) as shown in Fig. 8.

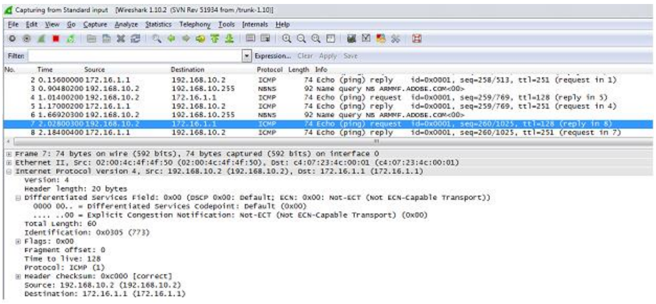

Fig. 8 ICMP packet details before reaching CE-1 Router

When the packet reach CE-1 router the QoS in implemented on packets. As we know in the configuration the ICMP service has DSCP value of in binary (1010).and the pact that comes from this router to interject MPLS network has differentiated service value (1010) as shown in Fig. 9

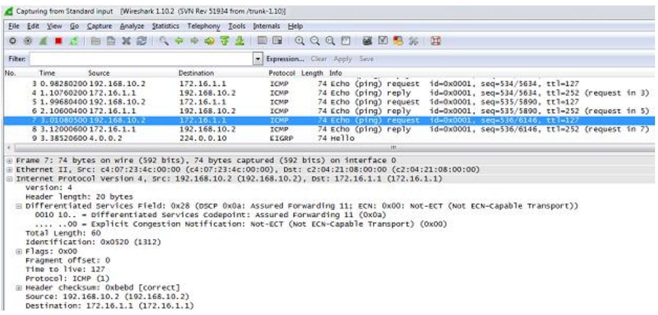

Fig. 9 ICMP packet details before reaching Core network at ISP-1 router

Then the packet treated with MPLS mechanism using labeling between MPLS routers (LERs and LSRs). For our ICMP packet there is operation of mapping will done at the edge of the router (ISP-1) to keep the Diffserv where DSCP value mapping to corresponding experimental value.as shown in Fig. 10 all ICMP traffic goes through MPLS mechanism with it same QoS using same LSP.

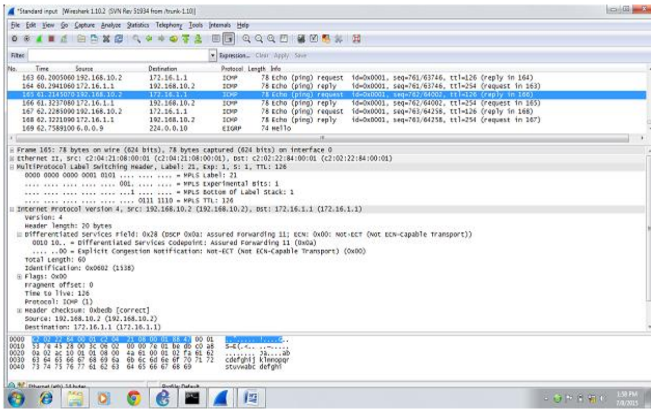

Fig. 10 ICMP packet details through MPLS network

When packet leaves the MPLS network the packet extracted form label and complete to destination using IP address. The ICMP packet will has same DSCP that gives by CE-1 Differentiated service value (1010) as shown in Fig. 11.

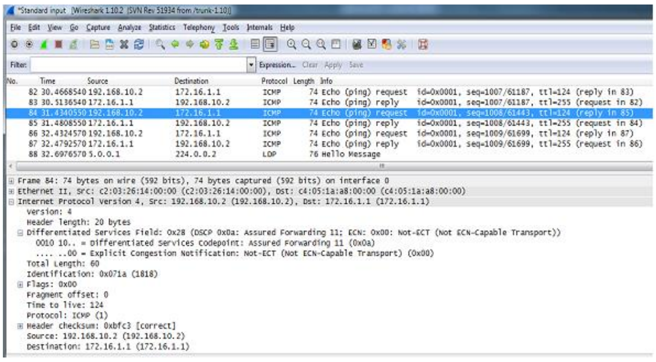

Fig. 11 ICMP packet details when it goes out from MPLS network toward CE-2 router

3.1.2 Part two:

We can also use wireshark to analysis the traffic of ICMP before and after and inside the MPLS network.

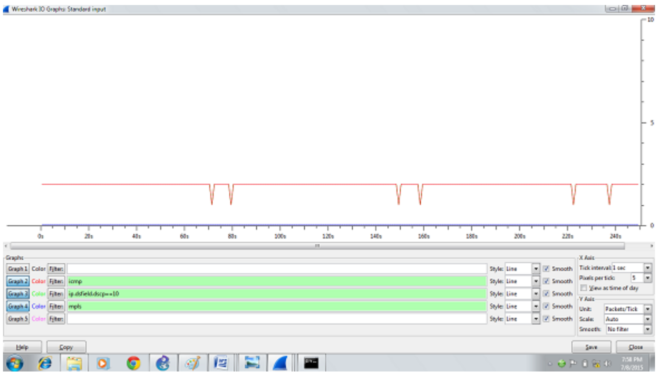

Fig. 12 ICMP traffic before MPLS network

In Fig. 12 we are notice that the traffic of ICMP (red line) is equal the traffic that with DSCP value of (1010) (green line) where there are no traffic carried by MPLS (blue line).

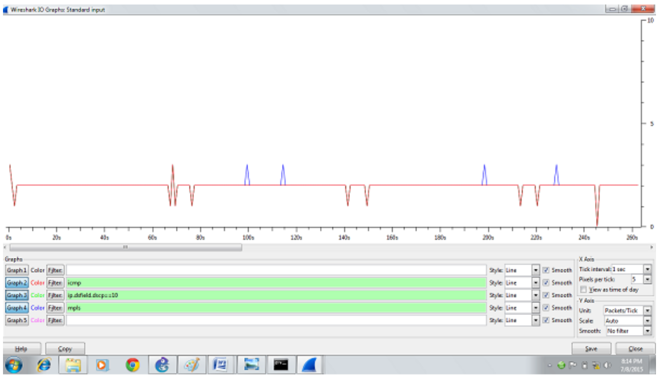

Fig. 13 ICMP traffic in MPLS network

In Fig. 13 we are notice that the traffic of ICMP (red line) is equal the traffic that with DSCP value of (1010) (green line) is equal traffic carried by MPLS (blue line).That means all the traffic carried by MPLS mechanism with QoS.

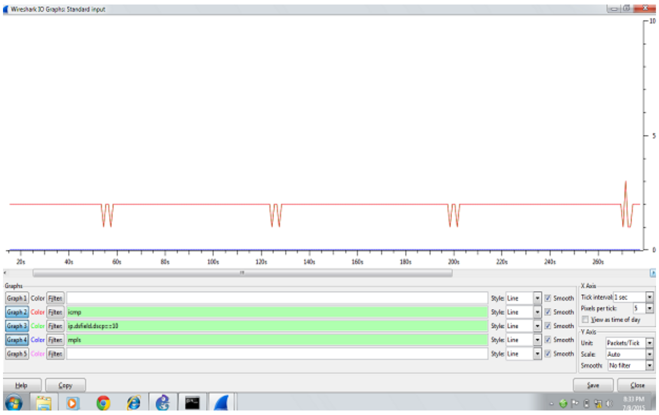

Fig. 14 ICMP traffic after MPLS network

In Fig. 14 we are notice that the traffic of ICMP (red line) is equal the traffic that with DSCP value of (1010) (green line) where there are no traffic carried by MPLS (blue line). part two Figures prove that at the edge of MPLS network (core network) all the traffic goes through MPLS mechanism and as the result of that the QoS will be improved.

5.1 CONCLUSION:

The simulations results shows that service that has QoS depend of Differentiate of Service(DiffServ) will be carried through the MPLS network with full specification of QoS and that make integrated mechanism that take a benefits of MPLS in fast forwarding of packets plus the specification of DiffServ to make a decision of which packet will be served first and that will be very useful in current network because there are some traffics (VoIP, Video conference and other multimedia applications) are sensitive about delay.

5.2 RECOMMENDATIONS:

In future work there will be need to generate real traffics or high traffic to show the effects of DiffServ and also we need application tool that generate more result than Wireshark to analysis more things which is lack of graphics results.

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