QoS in the MPLS-DiffServ Network

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Abstract—The service types deployed (streaming) as well as the difficulties inherited from IP protocol make networks are vulnerable in terms of QoS management. It is thus necessary to fulfill customers’ requirements with regard to the transmission of the data conveyed through network IP, which can occur only by setting up suitable protocols (MPLS and DiffServ). Moreover, MPLS architecture introduces advanced functionalities in terms of QoS management such as the resource sharing and the optimization of flow. We highlighted functionality MPLS and to study the various algorithms and concepts of QoS for management of the performance Policy. In this article, we into practice put the techniques of video transfer in streaming and ftp. One studies the progressive installation of policies of QoS; we will show via a demonstration the importance of the choice of MPLS-DiffServ solution.

Keywords—IP (Internet Protocol); QoS (Quality of Service); DiffServ (Differentiated Services); MPLS (Multi-Protocol Label Switching).

I. INTRODUCTION

At its beginnings, the Internet had as the only objective of to transmitting the packages to their destinations. Conceived thus for the asynchronous transport of the data, IP (Internet Protocol) was not planned for the applications in real time like telephony or the video, as it was very limited. The requirement of increasingly reliable equipment, from one end to another of the network, thus became inescapable. The integration of DiffServ and MPLS is a very effective approach to solve such a problem. DiffServ provides standardized mechanisms of QoS [1] while MPLS provides techniques of routing, which enable us to optimize the use of resources and the engineering of the traffic [2]. Two interesting aspects of this tendency will be approached in the two following sections: guarantee of QoS in the world of IP and traffic engineering (TE) in networks MPLS.

New Generations Networks NGN, [3] being IP networks, and aiming mainly at combining the data, the voice and the video, suffer from the principal defects from this protocol, therefore several mechanisms of QoS were implemented in order to adapt IP protocol to the transport of the voice and the data to knowing IntServ (Integrated Service), protocol

This includes RSVP (Resource Protocol reservation), DiffServ and MPLS. QoS is the method, which will make it possible to guarantee to traffic of data, whatever its nature, to take the best conditions of routing answering preset requirements. QoS fixes in particular rules of priority between various flows. In its turn, MPLS allows to simplify the administration of a heart of network by adding new functionalities particularly interesting for the management of QoS. In the same spirit that architecture DiffServ, MPLS makes it possible to reduce the cost of the treatments associated with the relay with the packages by deferring them to the periphery with the network and by reducing the frequency. It brings also a mechanism of hierarchical routing effective, i.e. tunnels making it possible to manage the virtual private networks. The label thus decides in each router of the next router, the DiffServ behavior and the possible use of the reserved resources [4].

II. QUALITY OF SERVICE

The QoS is a method making it possible to guarantee traffic of data, whatever its nature, the best conditions of routing answering preset requirements. It defines a whole of the mechanisms entering in action to distribute the resources of the network according to the type of Time, flow, Gigue and Rate of loss of packets. Various categories of applications are treated in various classes of service one can distinguish the following mechanisms: The traffic shaping, the traffic policing, the buffer management, the operation of traffic scheduling. The treatment differentiated from packages is a relatively old concept in the Internet. It is present right from the start IPv4 protocol with the ToS field, but a too vague definition limited its deployment. These concepts were re-defined year to offer a treatment adapted to the very heterogeneous needs for the applications in IPv6 [4] [5].

A. Intserv/RSVP model

Protocol RSVP [6] allows the dynamic allocation of the bandwidth as well as the reservation of the resources via the receiver. During the establishment of a session, protocol RSVP maintains the state of flow in each node, and the established way must remain the same one during all the session. What means that with the increase amongst users, the number of states to maintain thus becomes very important, which degrades the performances and the capacity of the network owing to the fact that one must refresh the states in a periodic way, especially in wide-area networks (WAN) or the network
is saturate that cooling between routers becomes important. Of or the fact that this protocol is adapted more for small networks (LAN). The final systems being in connected mode, it is not possible to use RSVP for the management of the queues on the final equipment. The model IntServ [7] defines architecture able to deal with QoS independently of IP protocol.

B. DiffServ model

The model DiffServ [8] ensures a distinction of the packages by classes of flow that involve simpler treatments in the intermediate routers. Indeed the DiffServ model proposes to separate the traffic by classes, contrary to IntServ, which proceeds with a separation by flow. Thus, the DiffServ routers treat all the packages of a class in the same way, irrespective of transmitter or of receiver. This model also makes it possible to defer the losses of packages on certain classes of traffic, to protect some from others. The protocol DiffServ [9] showed its mettle, it is better adapted to the wide area networks like ISPs, because there is no information of state to maintain on the level of the routers, and thus it is more scalable. Therefore, it does not use a heavy signaling protocol to will implement as RSVP; therefore, it is largely used by the NGN, only, or associated with other protocols as MPLS [10] [11].

C. Protocol MPLS

MPLS [12] is a technical network which aims at the combination of the mechanisms of IP routing of level 3 (mode off-line, without quality of service and setting up of the routing), and the mechanisms of the commutation of level 2 (connected mode, with quality of service and setting up of commutation). MPLS treats commutation in connected mode (based on the labels), the tables of commutation being calculated starting from information coming from the protocols of IP routing as well as protocols of control. This technique can be wide with multiple protocols under IP (Ipv4, IPv6, IPX, Appletalk, etc) and it brings the connected mode that uses the services of level 2 (PPP, ATM, Ethernet, ATM, Frame Relay, SDH…).

THERE exists a great analogy between the components of DiffServ architecture and those of MPLS: A node of the network, “Label Switching Router” (LSR), will have at the same time a table of routing and commutation. One distinguishes three types of LSR (see Figure 1):

- Ingress Edge LSR (router of entry): HE classifies IP packages received in FEC (Forwarding Equivalence Class) with which are associated labels or labels. HE encapsulates these packages in units of labeled MPLS data, and it commutates them at exit.
- Interior LSR (internal router): its role consists to receive units of labeled MPLS data, and to commutate these PDU according to their label.
- Egress Edge LSR (router of exit): It receives units of labeled MPLS data, removes heading MPLS of the received PDU, and road IP packages.

D. MPLS-DiffServ integration

MPLS makes it possible to simplify the administration of a heart of network by adding new functionalities particularly interesting for the management of quality of service [13]. In the same spirit that architecture DiffServ, MPLS makes it possible to reduce the cost of the treatments associated in relaying packets by deferring them to the periphery with the network and by reducing the frequency. It brings also a mechanism of effective hierarchical routing, i.e. tunnels making it possible to manage the virtual private networks. The principle of MPLS is to allot a label to each package when it enters the network. This label is allotted according to the class of relay to which the package belongs. The definition of these classes depends on the operator of the network but it can also take into account the DiffServ class of service. The label thus decides in each router of the next router, the DiffServ behavior and the possible use of the reserved resources. The function of DiffServ is to help to put priorities when the congestion starts. It penalizes certain flows to decrease the time and the loss of others; it is thus a control mechanism of congestion. MPLS allows rerouting the traffic in the event of congestion; it is thus a mechanism of avoidance of congestion [14]. In the event of congestion, DiffServ alone makes it possible to choose which packages will be eliminated in first; MPLS only tiny room the chances of congestion but if it occurs, the packages are thrown randomly. When MPLS and DiffServ are both used, the congestion is less probable and one chooses which packages will be thrown in first if it arrives. The combined use of MPLS and DiffServ is very promising. For example, DiffServ could be installed in the operator, whereas MPLS would be deployed a priori in the heart of network of the operators [15].

III. Results AND Discussions

The test architecture consists of a cloud of transport contains two routers (Ingress Edge LSR) connected by another router (LSR Interior) (Figure 1). The dynamic routing protocol OSPF is used to obtain global connectivity around internal routers.
A. Service provisioning with Best Effort

Multimedia services such as VoD are particularly sensitive to routers states and their parameters such as routing, queuing and congestion, all this are a direct impact on video quality. Some packet loss and delay are acceptable for applications such as Web browsing and e-mail applications and generally passes unnoticed by users.

The percentage of images affected by packet loss will depend largely on number of pixels and type of information in the packet. In general, a small amount of packet loss can affect a large portion of video or audio stream. However, the lost packets for a video service can degrade overall experience of viewing related nature of high-compression video content. Packet loss during the broadcast channel IP can lead to grain on TV screen, frozen frames, and sometimes, in some cases, the user will see temporary drafts of a second or more on screen. If the latency is too high, end users begin to see failures as corrupted and blocked images, frozen frames on the screen. The consequences of degradation of QoS may vary depending on sufficient bandwidth to deliver video channels.

The client requests a VoD service that requires an assured QoS, the service in competition with other services such as FTP. In best effort mode, the changes are related to the queue fills up router, once it is full, the flow decreases, it will again increase when there is space in the queue. The fluctuations in flow decreases the quality of the video image of at client-side: the appearance of static pixels, saccades effect. The sharing of bandwidth between FTP and real-time services is no differentiation as in Case 1, this leads to Case 2 represents the congestion.

Each router determines the order of packet transmission by controlling the packets; the packets will be placed in the queue and how queues are maintained with respect to the other. In the first case BE and FIFO discipline is sufficient (Figure 2), but unlike the second case of congestion, the queue will be full and packets are deleted in entry which means the loss of packets for the both flows FTP and VoD.

B. Implementation of QoS policy with MPLS-DiffServ

Now, we will use QoS model DiffServ for defining classes of service by coding the DS field (DSCP) and IP MPLS. This method is more elaborate than the specification of priority that has been conducted. In contrast, our implementation of the marking is thereby changed, for the award of the code point in conditioning treatment (PHB) to be performed by each router. We define two PHB in our case:

- **EF** (Express Forwarding) or "premium" for the video stream. Indeed, it is necessary for this type of flow have a link to guaranteed bandwidth, low loss rate, jitter and latency.
- **AF** (Assured Forwarding) for the FTP stream, less important, which does not mean you should neglect it. Assign it the priority mechanism through AF22, that is to say, a class of service level 2 of 4 (which are called "Silver") and a probability of rejection “medium” in case of excess of traffic.
- **BE** (Best Effort): for other types of non-interactive traffic. Upon activation of MPLS, routers assign a unique label to each route identified. The information is transmitted with LDP (Label Distribution Protocol) to other routers. Each router creates two databases:
  - **LIB** (Label Information Base) that is built first, and contains for each IP subnet the list of labels assigned by the neighbors.
  - **LFIB** (Label Forwarding Information Base) that is built from the LIB and that it is used for routing. It indicates the label corresponding to the output label input.

![Figure 2. Throughput for VoD, FTP services for MPLS/DiffServ](image)

Performance is shown in Figure 3 (EF, AF, BE) in Ingress Router. The influence of AF and BE classes cause preemption when it is EF-class service. The AF and BE traffic reroutes service LSP selection. When it becomes an AF class service (FTP), it influences the BE service traffic. When it comes to a service class BE, did not affect performance because it is served late.
IV. CONCLUSION

In this paper, we studied the limitations of classical model require the use of protocols by filling the gaps caused by this latter. This is especially the couple MPLS / DiffServ is most used. These two models report in IP world powerful tools to manage QoS, in order to adapt it to carry voice and video. Furthermore, and as an interesting remark, we noticed that integrating MPLS with DiffServ allows different classes of service, which can negotiate with the Throughput. The results of the simulations show that a MPLS-DiffServ domain cannot perform admission control. The system allows traffic flows that it has to drop in case of congestion. In order to avoid the dropping of packets, a Throughput is essential to allow only traffic that the core network can support, reducing the number of dropped packets and congestion situations within the core network.

References


