Journal of Applied Sciences 4 (1): 24-27, 2004
ISSN 1607-8926

Behavior of TCP and UDP Flows with Differentiated Services

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Abstract: This study aims two objectives. The first is the comparative study between the behavior of flows front of the presence (crossing) of a differentiated services domain and a classic heterogeneous network. The obtained results prove that the Diffserv model assures an equitability (same quality of service) for the treatment of flows of the same type. The second objective aim the study of the behavior of the TCP and UDP flows sharing the same domain of the differentiated services with the same priority class of AF, in order to define so equitability exists. Results show that the UDP flow is aggressive (insensible) screw to screw of the TCP flow.

Key words: DiffServ, PHB, AF, TCP, UDP, QoS

INTRODUCTION

The differentiated service is an architecture IP QoS, based on the marking of packets, to the means of a priority information : Differentiated Service Code of Priority (DSCP). During the period of the congestion, packets of weak priority will be eliminated before packets of high priority.

The DiffServ model (Differentiated services)[1] proposes to abandon the treatment of the traffic under shape of streams (micro-streams) to characterize it under shape of classes of QoS (macro-streams). The Diffserv routers have the Per-Hop Behavior of commutation (PHB) according to the DSCP value.

This study simulates three various cases of one same bottleneck sharing by the UDP and TCP flows, with and without the differentiated services. We analyze the discharge of flows sharing the same Diffserv domain, we compare the Behavior of the TCP and UDP flows, finally we discuss results of obtained simulations.

Simulation environment: We used the simulator of network NS-2[2] of the university of Berkeley/LBL (Lawrence Berkeley Laboratory) to simulate the Behavior of the UDP and TCP flows in a heterogeneous network with and without differentiated services.

From a profile (nodes and links), we programmed a script in OTcl language under NS while defining all properties of the network: flows, protocols, queues, beginning time....and the duration of simulation.

NS proceeds by discretization of time. The result of the simulation is in a file containing noted events on the network. We used this file to construct graphs.

Description of the simulation: We simulate the Behavior of flows in the case of a heterogeneous network with and without DiffServ. The network is composed of ten nodes. The node 0 and the node 1 are the sender sources. Nodes 7, 8 and 9 are receptors. In the topology with diffserv, the Differentiated Services domain (DS) is constituted of boundary nodes: the node 2 is the DS ingress node, the nodes 4, 5 and 6 are DS egress node and the DS node core is the node 3 (Fig. 1). The classification used to the boundary nodes is of type Assured Forwarding: AF PHB[3].

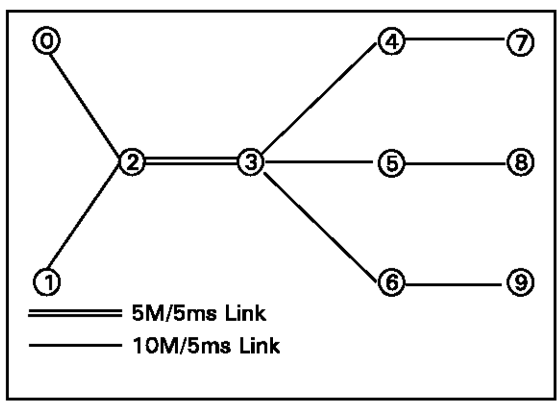

Fig. 1: Heterogeneous topology with DiffServ

For the heterogeneous topology without DiffServ, the boundary nodes and the core node are replaced by simple nodes.

Simulation

Behavior of the UDP flow:

- The source node 0 send two CBR flows on UDP to nodes 7 and 8.

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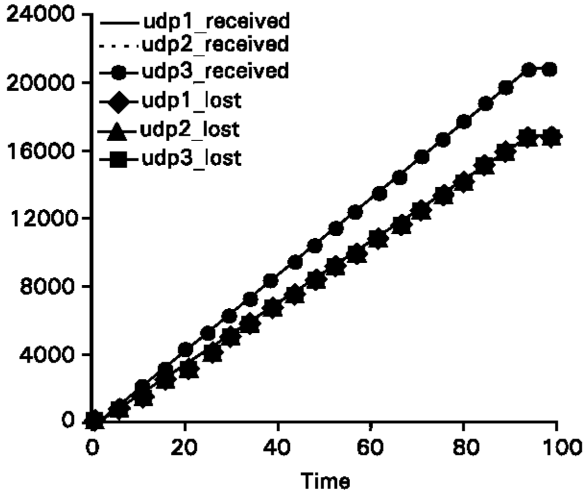

Fig. 2a: UDP flow with DiffServ

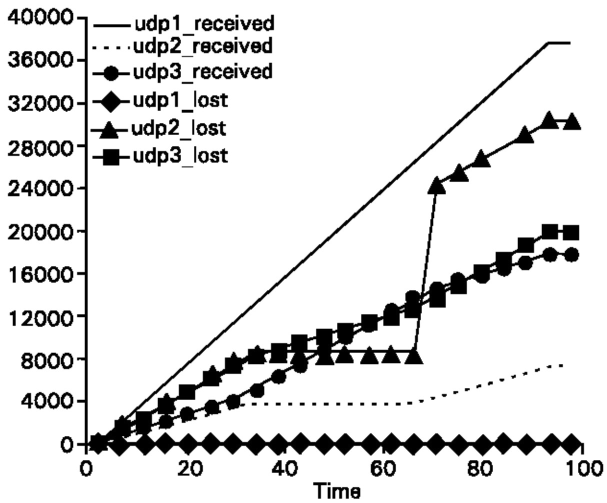

Fig. 2b: UDP Flow without DiffServ

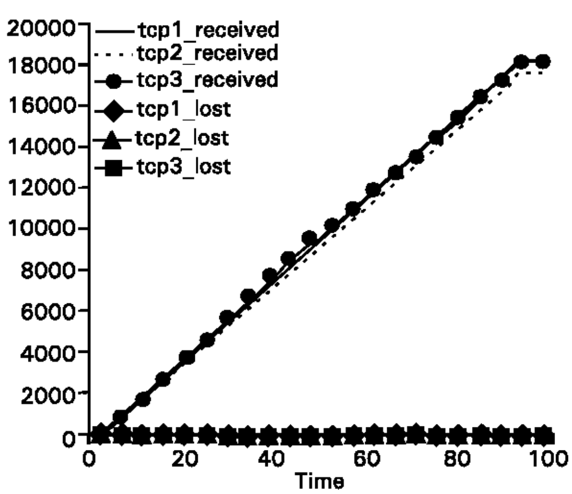

Fig. 3a: TCP Flow with DiffServ

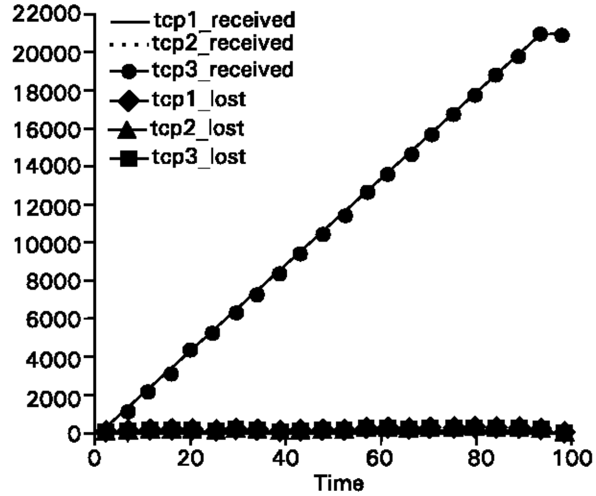

Fig. 3b: TCP Flow without DiffServ

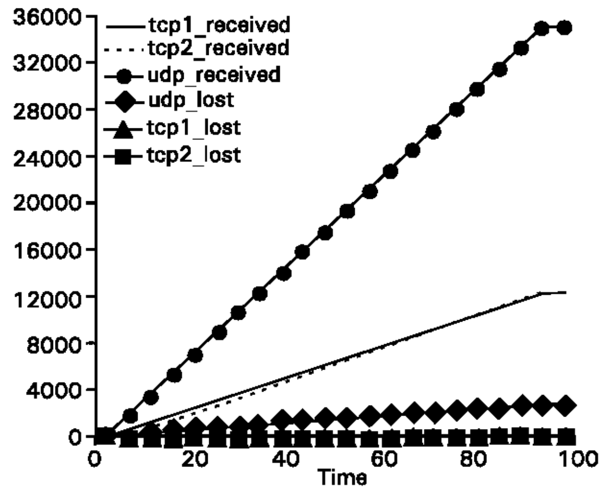

Fig. 4a: TCP and UDP Flows with DiffServ

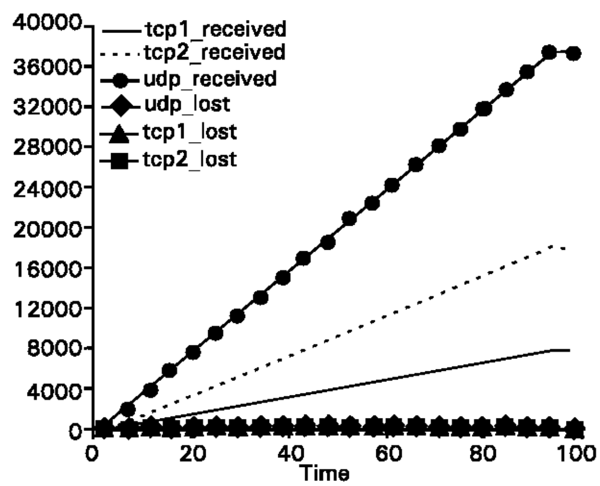

Fig. 4b: TCP and UDP Flows without DiffServ

- The source node 1 send a CBR flow on UDP to the node 9.

From the Fig. 2a, we note that the three receptors receive on average 21.000 packets with a loss of 17.000 packets for each receptor.

For the "without DiffServ" case, we note (Fig. 2b) that the node 7 receives 38.000 packets, the node 8 receives 18.000 packets and the node 9 receives 8.000 packets. We conclude that the node 7 is best served with a hopeless loss, the node 9 is most unfavorable with a considerable loss of 30.000 packets.

These results show that DiffServ establish an equitability between the UDP flows: same treatment, same priority. However, without DiffServ, a UDP flow can carry away him on the other.

In conclusion, in the two cases, the totality of received flow is 64.000 packets and the loss is of 50.000 packets, This loss is considerable. To remedy to this, is interesting to increase the capacity of waiting files (queue) in the routers.

Behavior of the TCP flow

- The source node 0 send two FTP flows on TCP to nodes 7 and 8.
- The source node 1 send a FTP flow on TCP to the node 9.

We note (Fig. 3a) that the three receptors receive on average 18.000 packets with a hopeless loss. From Fig. 3b, we note that the three receptors receive on average 21.000 packets with a hopeless loss. We note that in the "without DiffServ" case, the TCP flows are well served. We conclude that with or without DiffServ, the equitability is assured between the incoming TCP flows.

Behavior of the TCP and UDP flows

- The source node 0 send two FTP flows on TCP to nodes 7 and 8.
- The source node 1 send a CBR flow on UDP to the node 9.

In the two cases, the UDP flow and the two TCP flows share the neck with a negligible loss of the UDP that reaches 35.000 packets.

However, we note that "with DiffServ" (Fig. 4a) the TCP flows are treated in the same way and reach a reception flow of 12.000 packets. However, the node 7 in the "without DiffServ" topology (Fig. 4b) is well served that the node 8.

DISCUSSION

The various simulations, permitted us to analyze quantities of the received and lost flows. Results show that the DiffServ model assures the equitability between flows of the same type on a heterogeneous network. This equitability doesn't encourage any receptor on another. To know that all incoming flows in a domain will be classified according to a definite priority and according to these various results, we conclude that flows of the same type are received with the same quality of service (QoS).

Of the last simulation (Fig. 4a), we note that out-flows of UDP are insensible when they share the same class of AF with TCP out-flows.

To assure a distribution just of bandwidth and to protect the TCP out-flows, it is necessary to assign UDP with a value of priority different from that of TCP.

The study of Ellouni[4] bases on the definition of Drop precedence for the PHB AF. The precedence of a packet reflects its priority. In the same class, packets of X precedence are routed with a superior probability to the one given to Y precedence packets, if $X < Y$. To the breast of a router this information can be used to improve considerably the function of loss packets in the case of congestion. The PHB AF defines four classes. Each class include three precedences. So, it is composed by a group of 12 interdependent PHB.

So for one same class of AF, one differentiated the treatment of out-flow by the assignment of one of the three precedence.

The study of Seddigh[5] made use of precedence of the PHB AF. Six various combinations of priority have been explored. Results showed that some priority are beneficial to the TCP flows whereas other is it for the UDP flows.

For our study, knowing that the dominant flow in the Internet network is the TCP, the need to assure that the appreciable out-flows of TCP are protected against the insensible out-flows in the same class is justified..

Hitherto, discussions to solve the problem of UDP/TCP equitability for the PHB AF are concentrated on the penalty of the UDP out-flows. However certain UDP out-flows require the same treatment that owing TCP flow to requirements of the multimedia.

Of this fact, a multimedia flow requires a strongly reliable service which can be provided thanks to the Expedited Forwarding: PHB EF[6]. This last made the object of our progress study.

Acronyms

AF	Assured Forwarding
CBR	Constant Bit Rate
DiffServ	Differentiated Services
EF	Expedited Forwarding
FTP	File Transfer Protocol
PHB	Per-Hop Behavior
QoS	Quality of Service
TCP	Transmission Conrol Protocol
UDP	User Datagram Protocol

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