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RESEARCH ARTICLE

IMPLEMENTATION OF DIFFERENTIAL SERVICES BASED ON PRIORITY, TOKEN BUCKET, ROUND ROBIN ALGORITHMS

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Abstract - The purpose of this paper is to analyze and compare the different tools being used in DiffServ (Differential services) which have been proposed for QoS (quality of services). Differentiated Services approach provides a way to control traffic that is more flexible and more scalable than the Quality of Service approach. In this paper, we analyze and compare the performance of metrics used in DiffServ namely Token bucket, Round Robin and Priority based to classify that which of the DiffServ performs better in terms of throughput, jitter, end to end delay, delivery ratio and no packet loss. This analysis will be useful in determining the best algorithm among DiffServ to ensure better data transfer, speed, and reliability.

Keywords - Bandwidth, Quality of Service, DiffServ, Packet Loss, Throughput.

I. INTRODUCTION

QoS (Quality of Service) refers to a broad collection of networking technologies and techniques. The goal of QoS is to provide guarantees [1] on the ability of a network to deliver predictable results. Elements of network performance within the scope of QoS often include availability, bandwidth (throughput), and number of packet loss, etc. QoS involves prioritization of network traffic [2].

The QoS implementation may be divided into two broad categories [7]:

i. Application layer QoS – These are implemented at the application level i.e. at the end system. The jitter is mainly controlled at end system in such cases.
ii. Network layer QoS – In this approach the QoS performance are controlled at the network layer i.e. at the router and switch. Usually the bandwidth compliance and delay is controlled in the intermediate system in such cases.

QoS Performance Metrices

The transmission quality of the network is determined by various parameters [5] [8]:

i. Average Delay: Delay would be time taken by the packets to travel from the source to the destination. The main source of delay can be further classified into propagation delay, network delay, source-processing delay and destination processing delay.
ii. Jitter: It is the variation in the delay introduced by the components along the communication path. It is the variation in the time between packets arriving. Jitter is commonly used as indicator of consistency and stability of a network.
iii. Packet loss: It affects the perceived quality of the application. This is a quantity that can be measured by the network analysis tools and this quantity is the percentage of packets that are sent from one end of the network connection that do not reach the other end. Packet loss increases due to congestion.
iv. Throughput or Bandwidth: It is a measure of the data rate (bits per second) generated by the application. Performance will also be greatly affected due to the process latency, inefficiency in radio source management and channel access mechanisms can become a bottleneck in high speed networks.

II. DIFFERENTIAL SERVICES

Differentiated Services (DiffServ or DS) [4] is a criteria for specifying and controlling network traffic by class so that certain types of traffic get precedence - for example, voice traffic, which requires a relatively uninterrupted flow of data, might get precedence over other kinds of traffic. Differentiated Services is the most advanced method for managing traffic in terms of what is called Class of Service. All traffic allocated to that class is treated with the same policy, such as being queued in a high priority queue. DiffServ is provided by the router and defines a set of service classes with corresponding forwarding rules. A packet coming to the router with a Type of Service (ToS) field may get better services than other, provided by some classes depending upon that ToS content. There are different forwarding classes as follows.

a) **Expedited Forwarding (EF) [24]** - It is intended to provide a building block for low delay, low jitter and low loss services by ensuring that the traffic is served at a certain configured rate over a suitably defined interval, independent of the offered load of non-EF traffic to that interface.
b) **Assured Forwarding (AF) [18]** - The AF Per Hop Behavior (PHB) group provides delivery of IP packets in four independently forwarded AF classes. Within each AF class, an IP packet can be assigned one of three different levels of drop precedence, low, medium and high.

A. DIFFERENTIAL SERVICE ARCHITECTURE

DiffServ model [9] 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 [1] [3].
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.

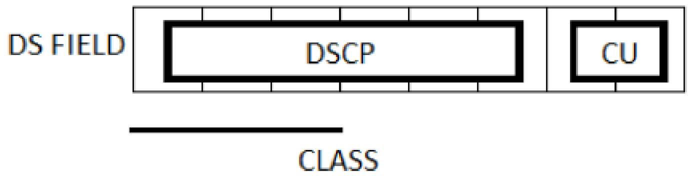

Figure 1: Fields of DS [22]

Figure 1 [22] 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. Metering is done using a token bucket algorithm, shaping is done using Frame Relay Traffic Shaping (FRTS), and policing is done using class-based Policing.

B. *DIFFERNTIAL SERVICE TECHNICAL TOOLS*

In this paper some algorithms are used:

i. Round Robin (RR)
ii. Priority Based (PRI)
iii. Token Bucket (TB)

i. ROUND ROBIN (RR)

Round–robin [21] is one of the algorithms employed by process and network scheduler in computing . As the term is generally used, time slices are assigned to each process in equal portions and in circular order, handling all processes without priority. Round-robin scheduling is simple, easy to implement. Round-robin scheduling can also be applied to other scheduling problems, such as data packet scheduling in computer networks. It is a system concept.

ii. PRIORITY BASED (PRI)

Each process [20] is assigned a priority, and the process having priority is allowed to execute. Equal-Priority processes are scheduled in FCFS order. The shortest-Job-First (SJF) algorithm is a special case of general priority scheduling algorithm. An SJF algorithm is simply a priority algorithm where the priority is the inverse of the (predicted) next CPU burst. That is, the longer the CPU burst, the lower the priority and vice versa. Priority can be defined either internally or externally. Internally defined priorities use some measurable quantities or qualities to compute priority of a process. Figure 2 shows the process of priority based algorithm [20].

Process	CPU Burst	Priority
P1	8	
P2	20	1
P3	1	3
P4	5	2

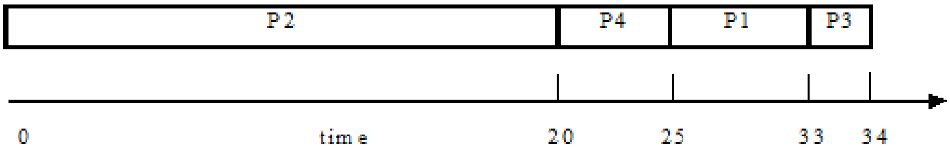

Figure 2: Priority – based algorithm [20]

iii. TOKEN BUCKET (TB)

The token bucket algorithm [20] is based on an analogy of a fixed capacity bucket into which tokens, normally representing a unit of bytes or a single packet of predetermined size, are added at a fixed rate. When a packet is to be checked for conformance to the defined limits, the bucket is inspected to see if it contains sufficient tokens at that time. If so, the appropriate number of tokens, e.g. equivalent to the length of the packet in bytes, are removed ("cashed in"), and the packet is passed, e.g., for transmission. The packet does not conform if there are insufficient tokens in the bucket, and the contents of the bucket are not changed. Non-conformant packets can be dropped. A conforming flow can thus contain traffic with an average rate up to the rate at which tokens are added to the bucket.

III. SIMULATION

The topology shown in Figure 3 is made to carry out the task. In this topology we have 3 source node, 3 intermediate nodes and 3 receptors nodes.

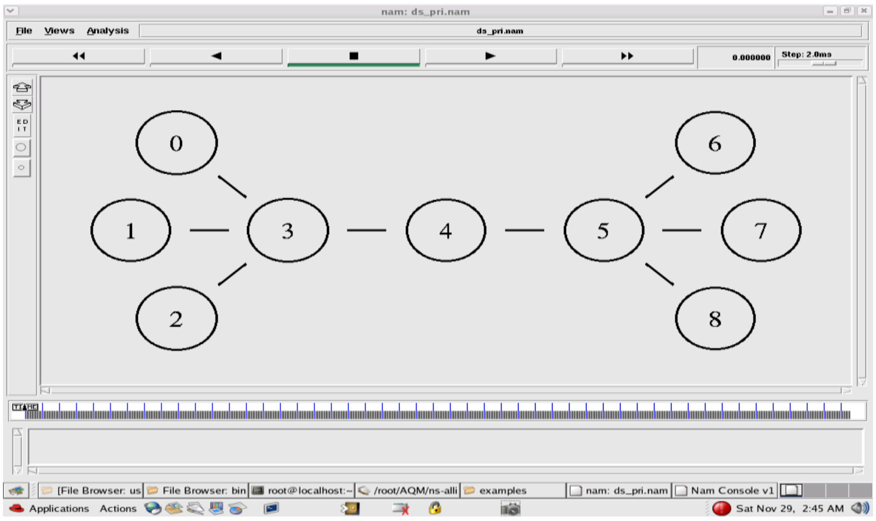

Figure 3: Executed Topology

The topology will be implemented in the NS-2 software to verify the performance of three algorithms (token bucket, round robin, priority algorithm) used in differentiated services. Values of packet loss, total number of packets send and total number of packets received usage will be determined as parameters for comparison between these three algorithms as mentioned in the service.

IV. RESULT

A. TOTAL PACKETS SEND

In the given scenario, we implemented the topology and found the total number of packets send from source nodes to destination nodes, example in figure 3 node 0, node 1 and node 2 are the source nodes and node 6, node 7 and node 8 are the destination nodes respectively. By using the above scenario, we compared the capacity in terms of number of packets communicated.

Three virtual queues are maintained at the intermediate nodes 3 to queue the packets send by three source nodes respectively. In this simulated topology different queues are associated with different source nodes like queue 10 is associated with node 0; queue 20 is associated with node 1 and queue 30 with node 2. These nodes are programmed to send packets.

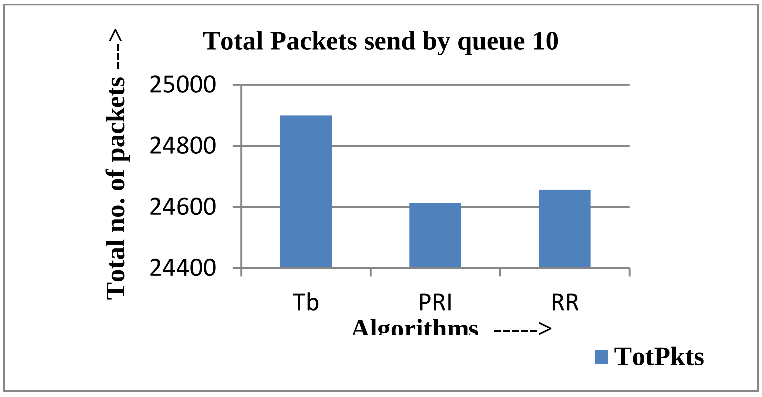

Figure 4: Total Packets send by queue 10

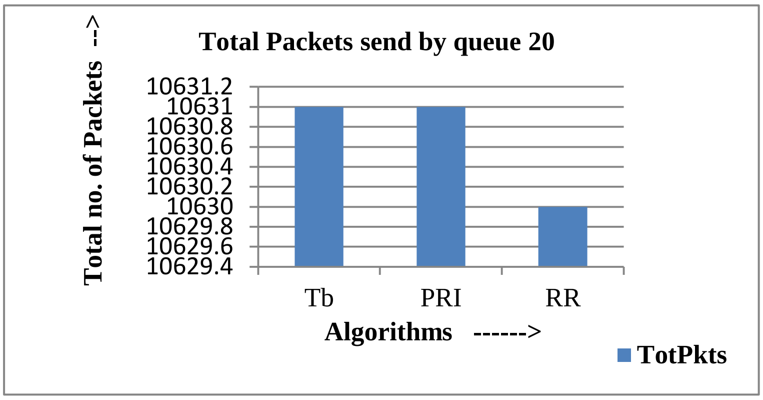

Figure 5: Total packets send by queue 20

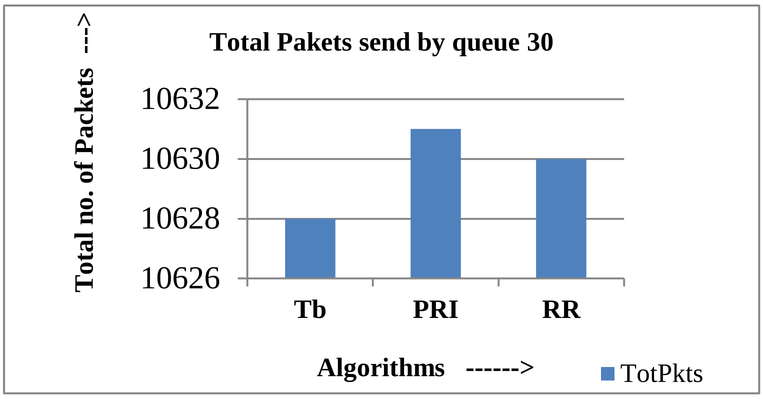

Figure 6: Total packets send by queue 30

Figure 4 shows that TB has maximum capacity to send packets as compared to other algorithms. In figure 5 TB and PRI both have equal capacity to send packets. Similarly figure 6 show that PRI can send maximum number of packets.

B. TOTAL PACKETS RECEIVED

In this subsection, we will count the total number of packets received at the receptor nodes such as node 6, node 7 and node 8. As discussed above in subsection A earlier that queue 10, queue 20 and queue 30 are associated with node 0, node 1 and node 2 respectively. Likewise queue 11, queue 21 and queue 31 are associated with node 6, node 7 and node 8 respectively.

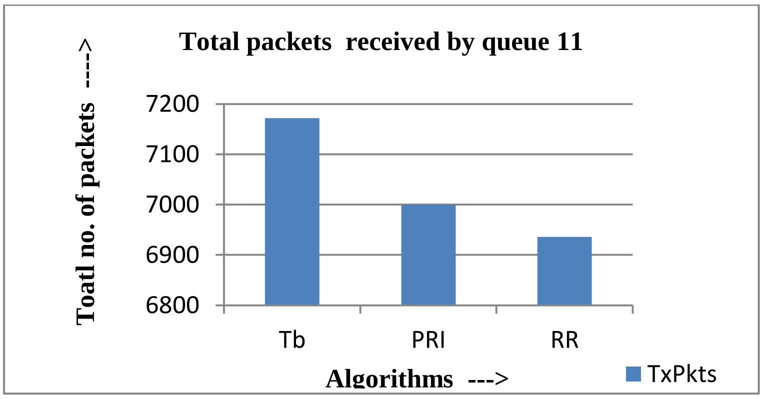

Figure 7: Total packets received by queue 11

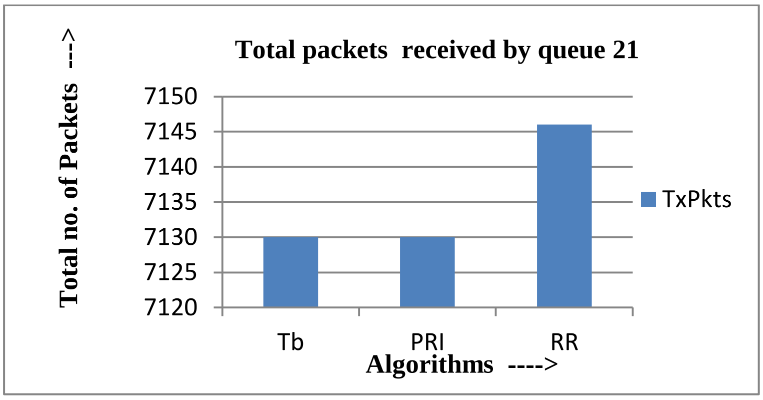

Figure 8: Total packets received by queue 21

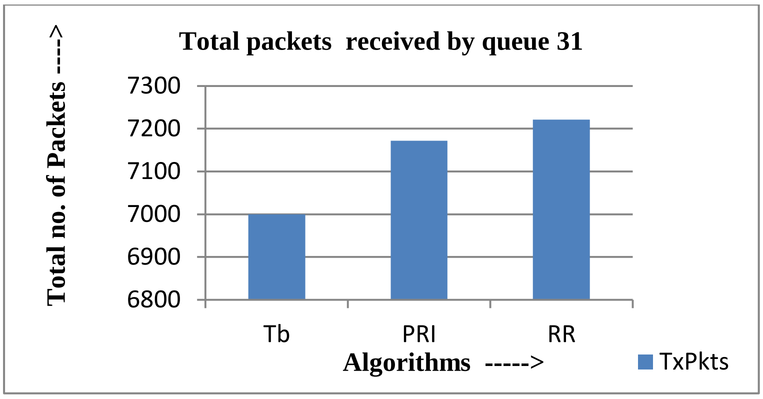

Figure 9: Total packets received by queue 31

Figure 7 illustrates that TB have maximum capacity to receive the packets as compared to other. In figure 8 RR algorithms performed better than other. Whereas, figure 9 shows the results in favor of RR algorithm.

V. CONCLUSION

In this paper we implement the various techniques used in a traffic engineering model to provide QoS, to improve the performance of real-time traffic in a constrained bandwidth network. The procedures like shaping, marking, metering, conditioning and classifiers were also studied which help the packet to bring into the level of conformance with an agreed over service level. We implemented a network topology of nine nodes and compared the results of the algorithms such as TB, PRI, RR on the basis of parameters like number of packets send, number of packets received and number of packets lost. Various graphs were drawn for of these parameters and compared the results for the obtained result.

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