Chapter 6
A Priority-Based Deficit Weighted Round Robin Queuing for Dynamic Bandwidth Allocation Algorithm in Gigabit Passive Optical Network

Md. Hayder Ali and Mohammad Hanif Ali

1 Introduction

Accessing Internet is going to be a fundamental right like other basic human rights. It is not a matter that how often a user uses or surf Internet, waiting for a web page to load is certainly an irritation. To overwhelm this condition, Internet surfing speed has enlarged meaningfully in the earlier era to retain step with the petition of end-users, innovative amenities, and bandwidth-hungry claims. These anxieties embrace as hypermedia content-based e-commerce, video on claim, high classification TV, IPTV, online gaming, social media, etc. The communication protocols for hypermedia circulation have conventional a great transaction of attention in the earlier few ages. Since multimedia traffic must provision numerous types of traffic simultaneously, it is crucial to process data according to its characteristics. Thus, protocol originators have to grasp the features of traffic and select a processing method suitable for the performance requirements. For instance, actual acoustic traffic in a voice service requires rapid transmission, but the loss of a small amount of audio information is tolerable. On the opposite site, the transfer of a text file should guarantee 100% reliable transfer; real-time delivery is not of primary importance in this case. Real-time video service, such as video on demand (VOD), requires not only rapid transfer but also high reliability. When a piece of video information is lost, its quality of service (QoS) is degraded. Therefore, multimedia communication protocols should be premeditated to afford the performance requirements of a wide range of multimedia services [1–7].

Md. H. Ali (✉) · M. H. Ali
Jahangirnagar University, Dhaka, Bangladesh
e-mail: hayder.iict@gmail.com

M. H. Ali
e-mail: hanif_ju03@juniv.edu

M. Shorif Uddin et al. (eds.), *Intelligent Energy Management Technologies*,
Algorithms for Intelligent Systems,
https://doi.org/10.1007/978-981-15-8820-4_6

The other parts of this paper are organized as follows. Proposed DBA poling mechanism for PMDWRR is introduced in Sect. 2. In Sect. 3, Pseudo code for PMDWRR is briefly described. Simulation scenario is in Sect. 4 and performance analysis between WRR, DWRR, and PMDWRR and stated in Sect. 5. Finally, Sect. 6 draws a conclusion to this paper.

2 Proposed DBA Poling Mechanism Design for Modified Deficit Weighted Round Robin

1. **Start**
2. ONUs/ONTs calculate the amount of received data
3. ONUs/ONTs predict the size of data in waiting time
4. ONUs/ONTs calculate the traffic for T-CONTs (T-CONT1 to T-CONT4)
5. ONUs/ONTs enhance the prediction of accuracy by calculating arriving in waiting time ($P^{T}_{i,n}$) for n-th Cycle.
6. OLT calculates the arithmetic mean for the data received in waiting time.
7. Repeat step 2 to 6 for n-th cycle.
8. **Then**
9. Calculate the difference for the size of data received in waiting time at ONT_i/ONU_i in the n-the cycle.
10. Calculate the size of traffic prediction arriving in waiting time at ONT_i/ONU_i in the n-th cycle by adding a weighting factor.
11. Increase the average order to ensure the prediction accuracy.
12. OLT grant frame size or allocate the frame size for priority traffic.
13. ONTs/ONUs send data according to OLT's priority grant frame.
14. **End**

To execute the above algorithm for GPON networks, it is necessary to maintain a queuing system. DWRR algorithm is suitable for this. As it provides protection among different flows, it overcomes the limitations of strict PQ (Fig. 1).

3 Pseudo Code for Priority-Based Deficit Weighted Round Robin

The pseudo code in this section does not describe the procedure of any exact DWRR execution. Although each execution will vary from this model, studying the samples and outlining the pseudo code will make it calmer to recognize the explicit enterprise results that are compulsory to make for executions.

The array flexible Deficit_Counter is reset to zero. In this sample, the queues are numbered 1 to n, where n is the extreme number of lines on the output port:

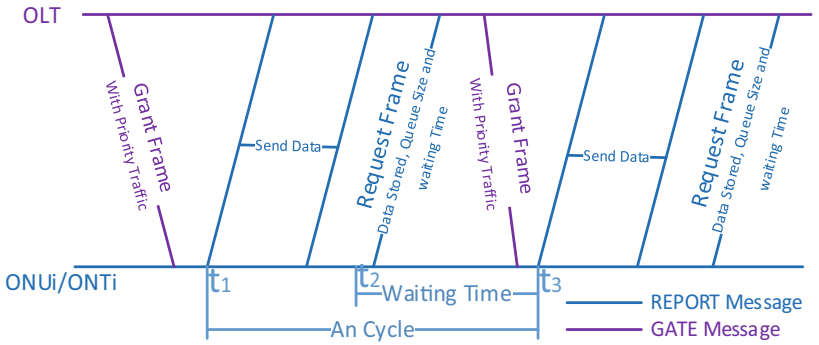

Fig. 1 DBA polling mechanism diagram for PMDWRR

```
FOR i = 1 to n                          /* Visit each queue index */
  Deficit_Counter[i] = 0    /* Initialize Deficit_Counter[i] to 0 */
ENDFOR

      i = the index of the queue that will grip the new package
       IF (ExistsInActiveList(i) = FALSE) THEN /*IF i not in
          ActiveList */ InsertActiveList(i)          /* Add i to the end
          of ActiveList */ Deficit_Counter[i] = 0     /*Reset
          queue Deficit_Counter[i] to 0*/
       ENDFOR
       Enqueue packet to Queue[i] /* Place packet at finish of queue i */
  END Enqueue
// Removes the element with the highest priority form the list
void pop (Node** head)
{
      Node* temp = *head;
      (*head) = (*head)->next;
      free(temp);
}

// Function to push according to priority
void push (Node** head, int d, int p)
{
      Node* start = (*head);
```

Whenever an index is at the head of the ActiveList, the function Dequeue () transmits up to Deficit_Counter[i] + Quantum[i] worth of bytes from queue.

```
Dequeue ()
        While (TRUE) DO
            IF (ActiveList is NotEmpty) THEN
                i = the index at the head of the ActiveList
                Deficit_Counter[i] = Deficit_Counter[i] +
                                                        Quantum[i]
                WHILE (Deficit_Counter[i] > 0 AND NOT
                    Empty (Queue[i])) DO
                    PacketSize = Size (Head (Queue[i]))
                    IF (PacketSize <= Deficit_Counter[i]) THEN
                            Transmit packet at head of Queue[i]
                            Deficit_Counter[i] = Deficit_Counter[i] –
                            PacketSize
/* To find out the largest traffic volume */
                                /*Declare largest as integer*/
                            Set largest to 0
                             FOR EACH value in A DO
                                    IF A[n] is greater than largest THEN
                                        largest ← A[n]
                                    ENDIF
                             END FOR
                                Dequeue the largest first
                            ELSE
                                                    Break /*exit this while loop*/
                            ENDIF
                ENDWHILE
                IF (Empty (Queue[i])) THEN Deficit_Counter[i] = 0
                        RemoveFromActiveList(i)
                ELSE
                        InsertActiveList(i)
                ENDIF
            ENDIF
        ENDWHILE
END Dequeue
```

4 Simulation Design

The simulation is done by using OptSIM (RSoft System Suit, version-2016.06) Simulation software. The simulation scenario is like bellow Fig. 2. It is composed of one OLT (Optical Line Terminal), one 1:32 Splitter and then thirty-two ONUs/ONTs. Each ONU/ONT has four signal sources producing T-CONT1 to T-CONT4 services respectively. Before each ONT, there is Bandwidth Analyzer to measure the consumed bandwidth of individual ONU/ONT. The OLT's up and down link rates are 1.25 and 2.48 Gbps. Each ONU/ONT is 20 km far from the OLT.

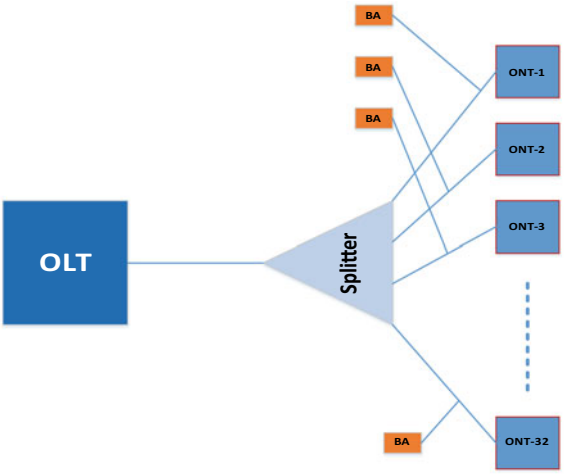

Fig. 2 Simulation scenario in OptSIM simulator

5 Result Analysis

The data has captured from OptSIM simulator and analyzed by MATLAB. Delay measurement and usage bandwidth are calculated by MATLAB coding.

Figure 3 stated that number of end-users is more in PMDWRR. Considering 2GBPS bandwidth allocation, DWRR is allowing 17 users, MDWRR is allowing 20 users, while PMDWRR is allowing 23 users. Bandwidth is shared with maximum users which satisfy the properties of GPON system.

Figure 4 shown that delay per user is minimum in PMDWRR. Considering 25 users in the system, DWRR shows 3 ms delay, MDWRR shows 2.4 ms delay while

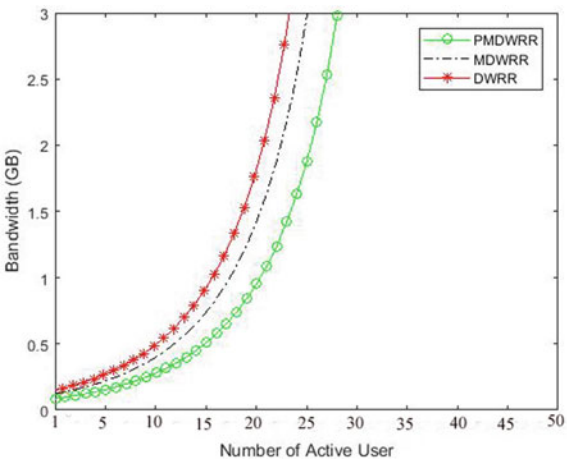

Fig. 3 Bandwidth allocation versus number of users

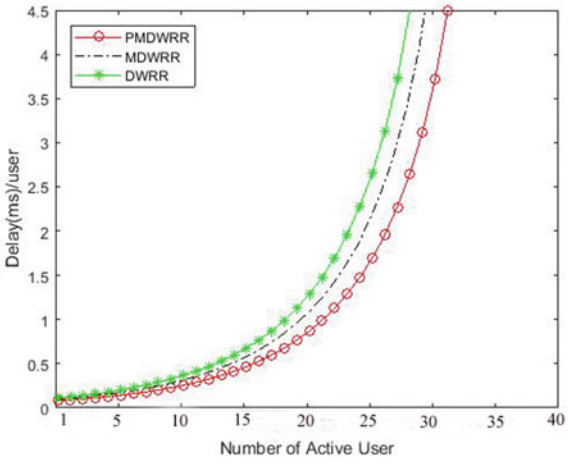

Fig. 4 Delay versus number of users

PMDWRR shows only 1.7 ms/user. The per user delay is less in PMDWRR and it increases the system performance.

6 Conclusion

In this paper, have partially modified to set priority into the existing MDWRR. In PMDWRR, ONU/ONT predict the data size and send allocation request to OLT, OLT increases the prediction accuracy. It could calculate the size of the queue and store the data size. By calculating the queue size, it can predict the priority traffic. It transmits the priority of the traffic and this way it could minimize the transmission delay and it satisfies the full service of QoS requirements of GPON system.

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