Congestion Control Scheme for Multimedia Traffic over ATM ABR Service

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ABSTRACT

According to the development of B-ISDN on ATM network, the uses of Multimedia service is growing. Although ABR service uses the network resource most effectively because it is able to change the transfer rate, it is not used for multimedia service until recently. In this paper, we set priority queue and non-priority queue in the ATM switch and each queue has threshold so is can be adopted in different transfer rate method. We propose the real-time traffic transfer method over ABR service based on an effective traffic control method.

I .Introduction

B-ISDN has been issued to support multimedia service such as data, voice, and image for the future information society. It can allocate few Kbps to few hundred Mbps of bandwidth to support various services and the traffic it should admit has burst traffic. ATM has been adapted to switching and transmission method of the B-ISDN to satisfy for each class and various services. Multimedia information has various traffic properties so it needs special control method to provide high quality and services for multimedia user's demand. Therefore, several traffics control methods being proposed on ATM network environment and it is still studying recently. ITU-T has defined the traffic and congestion control with simple mechanism that can keep the efficiency of network in 1996 and ATM Forum announced Traffic Management Specification Version 4.0[1,2,3] The data traffic between Fast LAN is very burst, and it has high transfer rate and unexpected variation property so it is difficult to control congestion effectively by preventative traffic control such as connection admission and usage parameter.

Also, data traffic is sensitive to cell delay and loss of a cell can occur retransmission too many cells. Therefore, the studies about ABR (Available Bit Rate) Service that transfers fast data by available bandwidth, which remain from the usage of CBR and VBR Services is studying recently. A key goal of ABR traffic control is a fair allocation for network bandwidth for each VC. In case of data traffic, the traffic demand is varying constantly, hence the congestion control algorithm has been issue and the ATM Forum adopted a 'rate-based' congestion control algorithm using feedback mechanism. The ABR Service guarantees only minimum cell transfer rate and it can transfer traffic to maximum cell transfer rate using available bandwidth when the link is free, so it must needs the congestion control by feedback mechanism to reduce the cell loss.[4,5] In this paper, we propose a method that control traffic congestion effectively by RM cell and a control method with priority these can make possible to support Multimedia Service.

II. Multimedia application over ABR service

1 ABR Control mechanism

ABR control structure is defined at ATM Forum Traffic Management Specification4.0 [6,7]. The transfer rate at Source can be classified as 4 parameters below. ACR (Allow Cell Rate) indicates the transfer rate of recent source. ICR (Initial Cell Rate) defines the first transfer rate, which is allocated to ACR after connection. MCR restricts the minimum transfer rate of ACR. In a congestion block, a switch sets EFCI (Explicit Forward Congestion Indication) bit that is in a data cell header to 1. Destination always watches EFCI bit and save the information. Destination send the information by RM cell to source CI (Congestion Indication), NI (No Increase), ER (Explicit Rate) fields are used at this time. CI bit

should be set when too heavy congestion occurred and NI bit should be set when traffic congestion is light. Destination can calculate the transfer rate directly and allocate it to source. Destination saves the value in ER field. Also, a switch can change these three fields according as network condition. Source changes transfer rate after notice the three values, which are in RM cell.[8]

2 The requirement to support Multimedia application on ABR service

We should consider Non-zero MCR supporting, guarantees against cell loss and delay, and Multicasting [8]. If congestion occurs a certain block, ABR service cannot control delay because is has been designed to transfer general data. ABR service can control transfer rate by RM cell but it is not able to prevent delay occurrence. To solve this problem, source transfers data that can recognize priority order. If it is possible to delete cells according as priority order in a congestion block, source can reduce delay and controls the congestion rapidly. 2level algorithm that uses CLP (Cell Loss Priority) is being proposed recently.

Ⅲ Multimedia traffic transfer by ABR service.

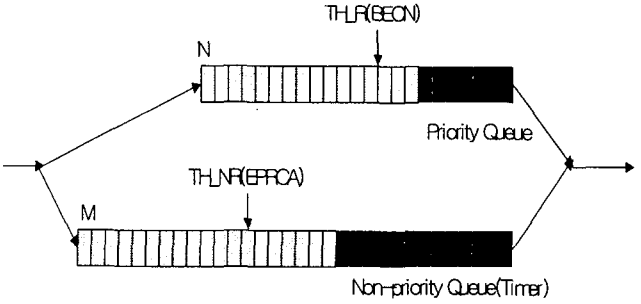
1.The existing algorithm

According to APRCA traffic control method, If congestion occur during data transfer a switch in point calculates transfer rate and set ER field in RM cell. This RM cell must have feedback process and controls the source bandwidth consults with ER value and ACR. Because EPRCA method is FEED BACK LOOP method, it is difficult to prevent delay occurrence. At contrast, BECN method informs congestion directly at the congestion block. Therefore, BECN method is faster than EPRCA method to response congestion.

2. The proposed Algorithm

In the past, the ABR Service was not able to guarantee about the delay because it has been modeled for data transfer. To support the ABR Service that can transfer Multimedia, we set two independence queues in the switch. One is the priority queue that transfers the cell, which is sensitive to delay such as moving picture and it has high priority. Moreover, the other is the non-priority queue that transfers the cell, which is insensitive to delay and it has low priority.

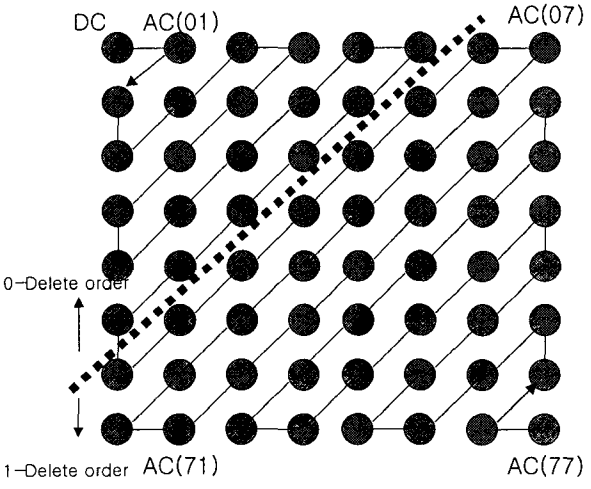
According as <Figure1> when a cell arrived ATM node, ATM node confirms the traffic contract by VPI/VCI and distinguishes which cell is sensitive to delay or not and after that puts into the queues. The cells that are stack in high priority queue must be processed firstly because it makes the jitter by cell delay variation and general cells that are sensitive to loss but insensitive to delay can be processed when it is free in the high priority queue.



<Figure 1> Switch control buffer

If the real-time cells such as Multimedia come into priority queue, the non-priority cells cannot be processed and stack on the queue continuously and cell loss can be occurred finally. To prevent this problem we propose a method below. If there is no traffic congestion in priority queue, the cells, which are in non-priority queue those are delayed over a certain time, can be processed at same rate as the cells that are in priority queue. In addition, we set different thresh hold at priority queue and non-priority queue then control the traffic congestion. Non-priority queue controls the congestion by EPRCA algorithm because it is non-sensitive to delay but sensitive to loss and priority queue controls the congestion by BECN algorithm, which is faster than EPRCA algorithm in responsible time because it is sensitive to delay but non-sensitive to loss. If source transfer the frame that is compressed by Motion-JPEG, each frame can be set 8*8 block as <Figure 2> and be

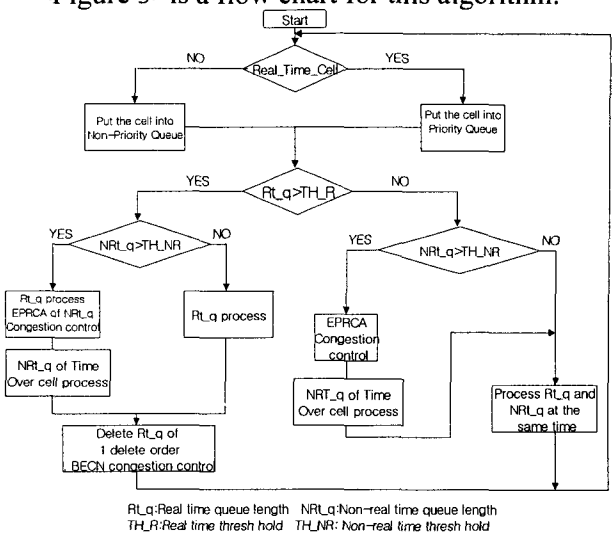
quantized to compress. The data that has been processed is displayed one DC coefficient and 63 AC coefficients. These coefficients are set ZIG_ZAG order by important frequency to image display[10]. Next step is to compress block1 (DC and AC factors) that has important information in image display. After that, the block1 becomes AAL packet, which has 0-delete order and the block2 that has 1-delete order saved as a packet. We separated 2Level of delete order in this paper but it is possible to separate 3 or 4Level delete order. When the 1-delete order packet is being divided to ATM cell, the CLP of all cells should be set to 1 and the CLP of all 0-delete order cells should be set to 0. If there is no traffic congestion, source can transfer both 0, and 1-delete order. However, if the source receives BECN cell, source omits 1-delete order such as moving picture and sends 0-delete order data. In addition, when priority queue reaches over the thresh hold, ATM switch deletes ATM cells from 0 to 1-delete order. If the case in CLP of cell is 1, ATM switch deletes all the cells firstly therefore only 0-delete order date can be transferred.



<Figure 2> Zig-zag order

It is possible to distinguish 0 and 1-delete order seeing weather CLP is 0 or 1 on ATM layer.

<Figure 3>is a flow chart for this algorithm.



<Figure 3> Flow chart for this algorithm

Ⅳ. Simulation

We set priority queue and non-priority queue and control traffic congestion by BECN and EPRCA algorithm, and compare and contrast about congestion rate of priority queue that uses cell delete order algorithm with non-priority queue.

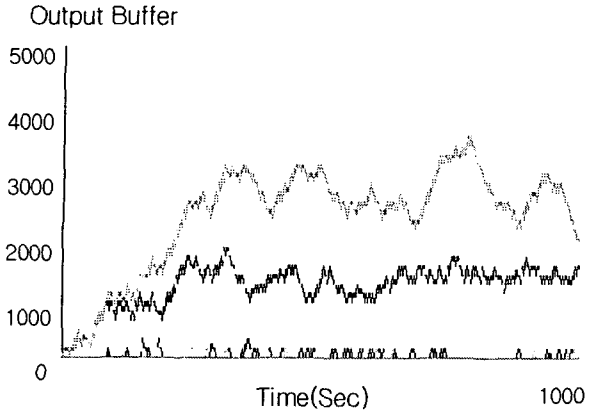
1. Simulation model

The simulation is modeled to transfer cells through the ATM switch, which include priority queue and non-priority between source and destination. The interval of cell arriving from source to ATM switch follows Bernoulli's distribution. Burst traffic should be occurred to estimate multimedia transmission by ABR service. We give full switching speed to suppose that the buffer is an output buffer without inner blocking and set it as output buffer type in the ATM switch. Cell has 53bytes fixed size. We simulate BECN and EPRCA+ cell delete order method and one that is not like this separately. The thresh hold of priority queue and non-priority queue are changing by the buffer's length. To generate congestion, the input rate of each queue should be changeable.

2 Simulation result and analysis

<Figure 4> is the result of the simulation that supposing the distance between source and destination is 50km. The graph that has small usage of buffer and small vibration is the graph of real-time queue, and the other one is non-real-time queue. As

you see in <Figure 4>, real- time queues can response to congestion in faster and more sensitive way. At the same time, non-real-time queue uses the buffer



<Figure 4> Buffer usage rate of each queue

safely. In conclusion, To process priority firstly, we could notice the guarantee of real-time transmission. In addition, we could see that the efficient use of network resource to response congestion occurrence rapidly.

V. Conclusion

In this paper, we propose the effective network resource control method for non-priority data transfer and multimedia transmission method with the ABR Service that we mostly use at data transfer recently. As the result of the simulation, we could measure the efficiency of the method.

The usage of multimedia transmission will increase. Therefore, we expect that the multimedia transfer control methods with ABR should keep studying to use the network resources effectively.

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