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Enhanced Efficient Proportional Rate Control Algorithm for Congestion Control Mechanism

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ABSTRACT: Traffic control and congestion management are the two critical issues in Asynchronous Transfer Mode networks (ATM). Congestion occurs when network traffic exceeds the capacity of the network. Congestion management's primary function is to guaranteebetter throughput and minimal delay efficiency while maintaining the resource allocation to the users in the network. First, the scheme proposed by the ATM forum based on Enhanced Proportional Rate with Congestion Avoidance (EPRCA) was considered in this paper. Improvements to the existing EPRCA scheme is proposed to address the problem of cell drop. Next, the results obtained for improved EPRCA schemes have been compared to the results of a simple EPRCA scheme.This paper describes congestion management procedures that make use of the improved EPRCA protocol. A full conventional EPRCA protocol is addressed, along with the simulation setting and simulation results. A comprehensive enhanced EPRCA protocol in two separate methods, including simulation environment and outcomes is addressed.

1. INTRODUCTION:

The EPRCA Enhanced algorithm for Proportional Rate Control is a rate-based procedure in which the switch mentions the rate where the source is to be transmitted [2, 3]. In this scheme, each transition between the source end system and the destination one maintains a buffer or queue with multiple congestion thresholds like QT (indicating mild congestion) and DQT (indicating severe/extreme congestion). In network each switch calculates the mean permitted cell rate (MACR) on a regular basis, which is the mean of every ACR source-end systems. In RM cells, the MACR value is considered for explicit rate estimation.

For feedback, a network may have two polarities: positive or negative. In the EPRCA method, only positive feedback is used, and when the network forwards positive feedback, the source can only increase the output. Even the MIT scheme is with only negative feedback to the source and lower switches cannot increases the rate. In the MIT scheme, the source system must receive an RM cell first with the stamped bit cleared to increase the rate, and then submit another RM cell with the stamped rate replaced by the desired rate of a source system. In feedback, the FIT scheme employs all polarities. Using bipolar feedback may provide a quicker convergence of the steady state while also minimizing oscillations in buffer occupancies and bit rate [1].

The primary goal of this research is to simulate the ATM network and evaluate the efficiency of rate-based congestion management schemes such as the EPRCA schemes, as well as to identify drawbacks for each of these strategies and suggest methods for improvement. The EFCI approach is simple to implement, but for burst network traffic, cell drop at the transitional switch and ACR values that oscillate between the peak and minimum rates were observed. The EPRCA scheme estimates the explicit rate for root end systems by measuring the mean ACR. When the mean ACR is a rational approximation of the fair share, this approach converges to a fair distribution. However, if the ACR is not a better measure, the scheme can result in significant injustice. Another problem with the use of this design is the reduction of cell drop in systems and circuits.

The ERICA scheme is more appealing since only a few network parameters must be configured during connection setup. It is also faster than EPRCA since it quickly reaches the full operating level. This is due to the use of the intermediate switch to monitor the load on each link, assess the load factor, available power, and calculate the number of current connections, and then set the explicit rate that each source will obey. For heavy traffic, we can still see a small percentage of cell drop at the intermediate turn.

The main disadvantage ofEPRCA is cell drop at the intermediate turn. The main aim of the thesis is to improve the efficiency of the techniques by reducing the number of cells drops. Enhanced systems for EPRCA have been applied, and their effectiveness has been demonstrated. Rate-based systems, as previously mentioned, are clustered in nature, and usually have scalability issues. We found a multi-agent approach to dealing with critical resources like link bandwidth. We created a strategy for managing bandwidth and congestion in the ATM network that uses a multi-agent approach and has proven to be very effective in managing congestion in a distributed environment.

According to current research, feedback control may not be successful in networks with a broad delay bandwidth product. Despite the fact that some authors have investigated this problem, no one has used practical assumptions in their models for explicit rate schemes. We will investigate this issue under practical assumptions and demonstrate that Enhanced EPRCA works effectively. The EFCI and EPRCA schemes' analytical models were introduced by All ABR sources are believed to behave in the same way. The time between ACR updates was believed to be constant.

The capacity of the switch buffer was thought to be infinite. For the queueing model, “greedy” ABR sources were chosen. Iteratively solving a series of differential equations yielded solutions for Maximum queue length and throughput at the turn. The impact of propagation delays on the EPRCA scheme's efficiency was discussed. It has been stated that under long propagation delays, the permitted cell rate of all sources experiences large oscillations. When the propagation delay becomes too long, the connection is not completely exploited, according to the results. However, the studies did not include a fair performance assessment of the EPRCA system, because it believed there was no background traffic and “greedy” ABR sources.

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Finally, the potential benefits of improved schemes for rate-based network congestion and multi-agent congestion management in ATM networks were presented.

2. EEFCI PROCEDURE

The binary feedback schemes, including the EFCI scheme, are very slow for applications in high-speed networks and are limited by the cell drop problem. In addition to the above, the authors discovered the following drawbacks when simulating the EFCI scheme. The EFCI scheme is a negative feedback scheme in the sense that when the switch senses congestion, the source end system reduces its permitted cell rate only after receiving an RM cell, and the feedback information is transmitted in the form of an RM cell. If the cells of the congestion alert (RM) return to the source, severe congestion occurs, and these cells are more likely to be dropped by the network.

Furthermore, the EFCI scheme necessitates the use of an interval timer for both end systems to function, resulting in increased implementation complexity. Another obvious disadvantage is the oscillating nature of cell rate propagation, which varies from maximum to minimum values.

2.1 Existing Procedure

Because of the potential problems with the negative feedback process, more robust schemes such as EPRCA [4,5,6,7] emerged.A source system sends an RM cell for every 31 data cells to observe the network's congestion status[8,9]. The RM cell contains the source's maximum permitted cell rate (ER) as well as the latest permitted cell rate (ACR). A source's ACR decreases with each data cell transmitted until it receives an RM cell from the destination. The RM cell obtained at the destination system is returned to the source on the reverse direction.

The switch keeps track of a control parameter called MACR (mean ACR), which should preferably be the average of all active connections in the ACRs. The switch updates its MACR based on the forward Rem cell field in Current Cell Rate (CCR). The switch controls the transmission rate of source end systems by setting a value based on the degree of congestion in the ER field of backward RM cells.In the event of severe congestion, the switch replaces ER in the RM cell with min (ER, MACR * MRF). Because of the lower ER, all source end systems automatically reduce their transmission speeds. During normal congestion (ER, MACR * ERF), ER should be replaced with min. The reduced ER automatically forces the selected source end systems where the current ACR is greater than MACR*DPF. As a result, the chosen source end systems must reduce their transmission speeds. MRF, ERF, and DPF are referred to as the primary reduction factor, contextual reduction factor, and down pressure factor, respectively, and their default values are shown in table 1.

2.2 Simulations:The EPRCA scheme [4,6] mentioned in the preceding subsection is implemented with a network configuration NIST GNS3 Network Simulator[10]. Cells are transmitted by source end systems at their required ACR, which is initially set to PCR in our simulation. The bandwidth on both links (links 1 and 12) was set to 155 Mbps. For various switch and source end systems parameters the default values are also assigned as shown in Tables 1 and 2.

Parameter	Value
Queue length (in cells)	1000
Low threshold (in cells)	600
Very Congested Queue Threshold (in cells)	900
Explicit Reduction Factor (ERF)	0.9375
Major Reduction Factor (MRF)	0.95
Down Pressure Factor (DPF)	0.875
Average Factor (AV)	0.0625

Table 1 EPRCA Procedure parameters for switch 1,2

Parameter	value
Initial Cell Rate (ICR)	7.49 Mbps
Minimum Cell Rate (MCR)	1. 49 Mbps
Peak Cell Rate (PCR)	149.76 Mbps

Table 2 Source system EPRCA scheme parameters

2.3 Implementation

The traditional EPRCA was implemented and the results are shown in the graphs below:

1. Allowed Cell Rate (ACR) in Mbps vs time for each source-end unit.
2. Cell drop percentage vs. switch time1.

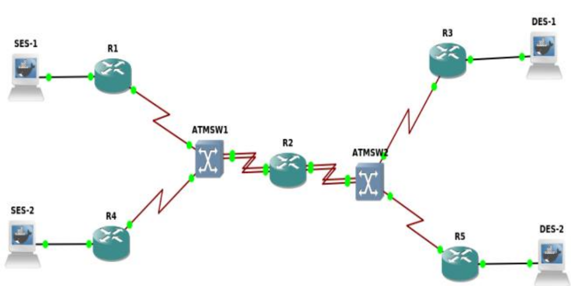

Figure 1: Proposed Network

The source BTEs of ACR vs time graphs are shown in Fig. 2, and the percentage cell decrease over Time at switch1 is visualized in Fig.3.

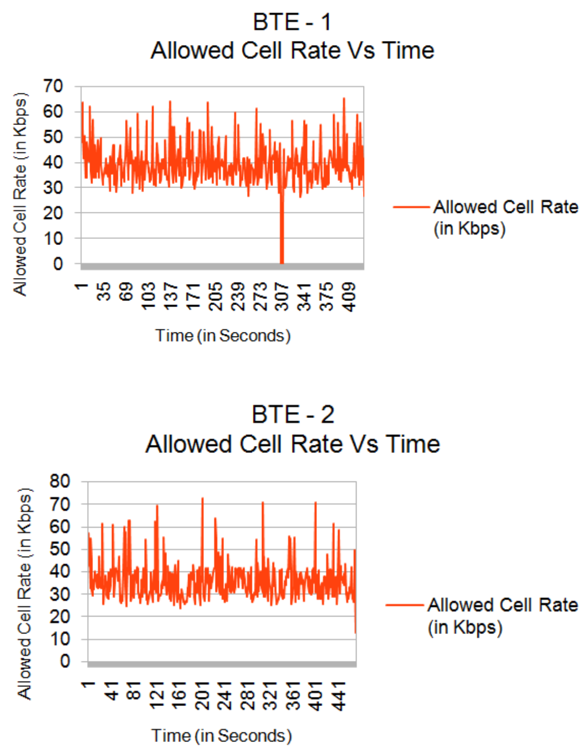

Figure 1: BTEs Vs Time for EPRCA

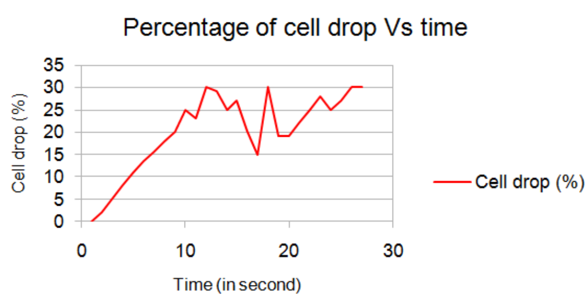

Figure2: Cell Drop Vs Time for EPRCA

The EPRCA scheme's graphs show that in the absence of RM cells in the feedback loop, the permitted cell rate (ACR) of source terminals decreases continuously. It can also be shown that cell drop at switch1 is about 33%, implying a reduction mechanism.

2.4 Proposed Procedure

Improvements to the traditional EPRCA scheme is proposed by taking the following modifications into account in order to reduce the cell drop problem.

2.4.1 Procedure 1 and 2

During this process, the end systems (source) behaviour is altered by changing the PCR value in order to achieve lower cell dropouts and optimal use of relations. A default value of 149.7 Mbps for the simple EPRCA schemeis set to PCR. This PCR value is then assigned to ICR, and every source end systems tarts transmitting the cells at higher PCR rates at first, and at switch1 resulting in large cell drops. The author conducted experimental experiments with varying PCR values and discovered that the optimal network output can be achieved by selecting an optimum PCR value of 100 Mbps.

With optimal PCR value improved EPRCA(behaviour of improved source end system) has been implemented, and graphs for ACR vs time for all source end systems are shown in Fig.

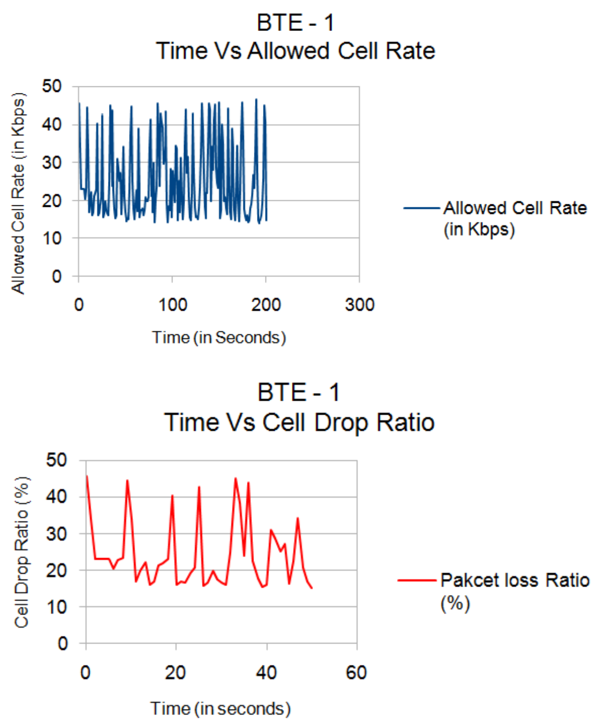

Figure 3 Cell Drop Vs Time ratio for EEPRCA

Initially, the source end systems send cells to ICR, which is set to the optimal PCR value. The switch calculates the best ER value based on the current cell rate of the source end systems and the length of the switch buffer, and this value is communicated to the cell transmission source end systems. The source end systems are forced to pass medium range cells because the source end systems' PCR has been reduced to its full value. The graph for percent cell drop vs time is shown in Fig. 4 The graph shows that the EEPRCA scheme1 results in a 21% cell decrease.

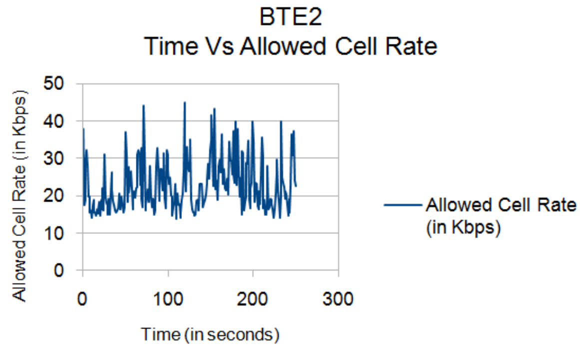

Figure 4 EEPRCA Procedure1 for ACR Vs Time

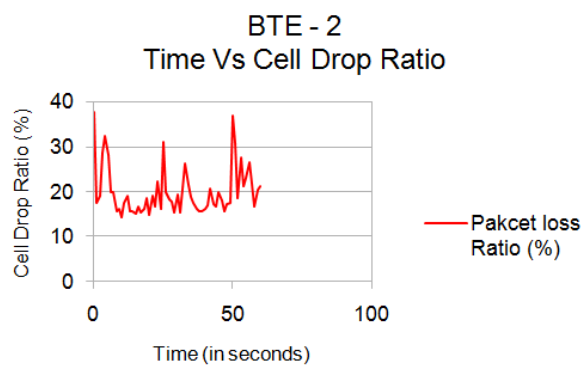

Figure 5 EEPRCA Procedure1 for Cell Drop over Time (in %)

The graphs show the percentage of cell decrease significantly at switch1, which is less than the simple EPRCA scheme and IEPRCA schemes1 and 2. As a result, the scheme IEPRCA3 is clearly superior to the simple scheme EPRCA.In this section, three methods for improving the efficiency of the basic EPRCA scheme have been implemented: First, by setting the PCR to the optimal value for IEPRCA scheme1, second by changing the switch behavior for IEPRCA scheme2, and later by setting the optimal PCR value and the modified behavior of the switch for IEPRCA scheme3. The IEPRCA scheme3 discovered that all other enhanced EPRCA schemes established by the author outperformed the EPRCA scheme. The IEPRCA scheme3 is superior to the simple EPRCA scheme, but it still suffers from cell drop.

CONCLUSION:

ATM networks face significant traffic management and congestion control challenges (ATM). Congestion occurs when network traffic exceeds the network's capacity. The primary role of congestion management is to ensure better throughput and low performance delay while ensuring a decent allocation resources to users in the network. This paper considered the ATM forum's scheme focused on Enhanced Proportional Rate with Congestion Avoidance (EPRCA). To solve the problem of cell, drop, we proposed improvements to the EPRCA scheme and the results of improved EPRCA schemes have been compared to the results of a simple EPRCA scheme.

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