CONGESTION CONTROL FOR INTERNET USING FUZZY LOGIC: A REVIEW

NEHA AGGARWAL¹, DEEPAK GAUR², KUNAL GUPTA³ & NAVDEEP AGGARWAL⁴
M.tech Student, Computer Science and Engineering, Amity University, Noida, New Delhi, India

ABSTRACT

Congestion plays a significant role in degrading the performance of the network. Internet congestion occurs when a packet arrives faster than the output link capacity. Despite the implementation of conventional congestion control algorithms, congestion remains a critical concern in networks. Hence it is necessary to detect and control congestion. Fuzzy Logic is applied to solve the problem of congestion. This paper is the review of fuzzy Logic based congestion control.

KEYWORDS: Queue Management Scheme (QMS), Fuzzy Logic, Congestion Control

INTRODUCTION

The number of internet users are speedily grown and by increasing the number of users, the amount of traffic is also increased. Congestion is caused by the saturation of network resources like buffers, communication links etc. In circuit switched networks (PSTN) [10], each connection uses a predetermined amount of bandwidth and data is transmitted at a steady bit rate. Hence the call acceptance procedure is very simple. But internet architecture is the packet switched network that allows dynamic sharing of bandwidth among different flows in the network.

Hence the major issue in this integration is congestion control. If the source delivers packets to the queue at a rate higher than the service rate of the receiver queue, than the size of the queue will grow up. If the size of the queue is finite then packets will experience excessive delay and data losses will occur. Also the problem of congestion cannot be solved by introducing “infinite” buffer space in the network, the queue would then grow without bound and the end-to-end delay would increase.

Moreover, when the packet lifetime is finite, the packets coming out of the router would have timed out already and been retransmitted by the source. As the packets will have to be dropped only after they have consumed valuable network resources so too much space in the router can be more harmful.

As the network resources are finite and should be managed for sharing among all the users, congestion will occur if the resources are not effectively managed. There are various reasons intended for congestion. They are packet collision, buffer overflow, channel contention, etc. packet collision lead to packet drops. Buffer overflow occurs when the number of incoming packets is greater than the available buffer space.

Queue management mechanism play a key role in meeting future increasing demand for the performance in internet applications. The queue management mechanism matches the transmission rate of sender to ensure excellent performance, when sinking the overall network delay by decreasing the queuing delay.
The role of queue management is to control the length of the queue and potentially which flows occupy it, by selecting which packets to drop and determining when this is appropriate. Queue management mechanisms are orthogonal and complementary to both scheduling (which determines the service order) and buffer management (which determines the number of queues per output interface; aggregate/class based or per-flow queues). However, it should be noted that packet drop has traditionally been interpreted by TCP as a congestion indication, thus, the queue management mechanism is also the place where the feedback to the source originates by either dropping (or marking) packets. The primary goal of queue management is congestion avoidance, but there are other goals: avoid global synchronization, eliminate the bias against bursty traffic, maintain upper bounds on router queue sizes even in the presence of non-cooperating flows, penalize aggressive flows, reduce the number of packet drops, and provide lower-delay interactive service.

RELATED WORK

Yaghmaee (2001) et al. [9] proposed Fuzzy Logic Controller (FLC) to control traffic sources in ATM networks. The proposed controller had two parts: Fuzzy Connection Admission Control (FCAC) and Intelligent Usage Parameter Controller (IUPC). The FCAC operated on all incoming connections and estimated necessary bandwidth to decide whether to accept or reject connection request. IUPAC was responsible for monitoring and regulating input traffic stream, after FCAC accepted the connection. Main goal of fuzzy logic based IUPAC was to tune the leaky rate based on state of traffic sources. Control actions were implemented based on accurate estimation of mean cell rate in real time. IUPAC used internal feedback to decide whether to reject or tag the violating cells, so that benefit of statistical multiplexing gain can be exploited. It was shown that fuzzy approximation obtained using FCAC is better as compared to other methods such as fluid flow, stationary approximation & fuzzy predictor. They evaluated performance of IUPAC for two different type of traffic: voice and data. They observed that IUPAC has well Selectivity, low response time and null false alarm. They illustrated IUPAC outperformed other popular methods such as Leaky Bucket (LB), exponentially weighted moving average & window-based fuzzy policer (FP) [9].

Zrida (2003) et al. [2] described rate feedback data flow control problem in one source single bottleneck communication system and proposed a fuzzy logic based controller that ensures stability performance. Main advantage of proposed solution was its simplicity as compared to other methods. It was shown that proposed controller is robust to
uncertainty caused by communication channel delay. It was also shown that proposed controller stabilizes the system and also ensures to asymptotically regulate queue length to a desired steady state value [2].

Lim (2001) et al. [5] proposed use of fuzzy logic prediction on connection Admission Control (CAC) and congestion control in high speed networks. Traffic predictions had been demonstrated with having the ability to improve system efficiency and QoS. Firstly Fuzzy Logic predictor was applied to congestion control in which ABR queue was estimated one round trip time in advance. It was shown that fuzzy logic scheme decreased the convergence time & over all buffer needs as compared to traditional schemes. Secondly, they modelled traffic characteristic utilizing on-line fuzzy-logic predictor on CAC. By using simulation it was shown that fuzzy logic prediction enhanced the efficiency of both conventional as well as fuzzy based CAC [5].

Fengyuan (2002) et al. [7] proposed a fuzzy logic controller for Active Queue Management (AQM). AQM is implemented on intermediate nodes to support end-to-end congestion control. They described that Proportional Integral (PI) controller performs better than traditional Random Early Detection (RED) algorithm, but mismatches in the TCP model deteriorates the performance of PI controller which is dependent on precision of plant such as for small buffer system tends to perform poorly. It was shown that FLC based AQM is robust against noise and disturbance as compared to PI controller based AQM system due to round trip time, number of active flows and non-responding UDP flows and link capacity. They also described that transient response and tracking ability of FLC based AQM was also superior than PI controller based AQM [7].

WHY FUZZY LOGIC CONTROL

Fuzzy logic controller is able to manage with the complexity and fuzzy nature of the Internet, because of its effectiveness and its lack of costs in terms of computation complexity, which is more suitable for time-sharing queuing discipline [4]. Fuzzy logic concentrates on attaining an intuitive understanding of the way to control the process, incorporating human reasoning in the control algorithm. It is inherently robust since it does not require precise, noise-free inputs and can be programmed to fail safely if a feedback sensor quits or is destroyed. The output control is a smooth control function despite a wide range of input variations. Since the FL controller processes user-defined rules governing the target control system, it can be modified and tweaked easily to improve or drastically alter system performance. New sensors can easily be incorporated into the system simply by generating appropriate governing rules.

CONCLUSIONS

Existing TCP/IP congestion control algorithms cannot efficiently bear new and emerging services needed by the internet community. Intelligent techniques based on Fuzzy Logic for congestion control are discussed in this paper. As the requirement for the queue management scheme for congestion avoidance is congestion detection. It is hoped that in the continuing paper, an improved networking congestion control approach for TCP using ECN feedback mechanism based on Fuzzy Logic will be implemented.

REFERENCES


10. Mohammad Hessien Yaghmaee Moghaddam “A Fuzzy Active Queue Management Mechanism for Internet Congestion Control” Third International Workshop on Advanced Computational Intelligence, 2010-Suzhou, Jiangsu, China.


