INTELLIGENT TRAFFIC MANAGEMENT SERVICE FOR HIGHSPEED
NETWORKS BY USING FUZZY LOGIC CONTROL

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ABSTRACT: In view of the fast-growing Internet traffic, this paper proposes a distributed traffic management framework, in which routers are deployed with intelligent data rate controllers to tackle the traffic mass. Unlike other explicit traffic control protocols that have to estimate network parameters (e.g., link latency, bottleneck bandwidth, packet loss rate, or the number of flows) in order to compute the allowed source sending rate, our fuzzy-logic-based controller can measure the router queue size directly; hence it avoids various potential performance problems arising from parameter estimations while reducing much consumption of computation and memory resources in routers. As a network parameter, the queue size can be accurately monitored and used to proactively decide if action should be taken to regulate the source sending rate, thus increasing the resilience of the network to traffic congestion. The communication QoS (Quality of Service) is assured by the good performances of our scheme such as max-min fairness, low queueing delay and good robustness to network dynamics. Simulation results and comparisons have verified the effectiveness and showed that our new traffic management scheme can achieve better performances than the existing protocols that rely on the estimation of network parameters.

I. INTRODUCTION:

Network traffic management can prevent a network from severe congestion and degradation in throughput delay performance. Traffic congestion control is one of the effective approaches to manage the network traffic [1], [2]. Historically, TCP (Transmission Control Protocol) Reno [3], [4] is a widely deployed congestion control protocol that tackles the Internet traffic. It has the important feature that the network is treated as a black box and the source adjusts its window size based on packet loss signal [5]. However, as an implicit control protocol, TCP encounters various performance problems (e.g., utilization, fairness and stability) when the Internet BDP (Bandwidth-Delay Product) continues to increase. These have been widely investigated with various proposed solutions such as the AQM (Active Queue Management) schemes [6]–[10] whose control protocols are also implicit in nature.

As an alternative, a class of explicit congestion control protocols has been proposed to signal network traffic level more precisely by using multiple bits. Examples are the XCP [6], RCP [11], JetMax [12] and MaxNet [13]. These protocols have their controllers reside in routers and directly feed link information back to sources so that the link bandwidth could be efficiently utilized with good scalability and stability in high BDP networks. Specifically, JetMax and MaxNet signal network congestion by providing the required fair rate or the maximum link price, and then the final sending rate is decided by sources according to some demand functions or utility functions. XCP feeds back the required increment or decrement of the sending rate, while RCP directly signals sources with the admissible sending rate according to which sources pace their throughput. The advantages of these router-assisted protocols are that 1) they can explicitly signal link traffic levels without maintaining per-flow state, and 2) the sources can converge their sending rates to some social optimum and achieve a certain optimization objective [12]. However, most of these explicit congestion control protocols have to estimate the bottleneck bandwidth in order to compute the allowed source sending rate or link price. Recent studies show that misestimation of link bandwidth (e.g., in link sharing networks or wireless networks) may easily occur and can cause significant fairness and stability problems [14], [15]. There are some latest protocols on wireless applications such as QFCP (Quick Flow Control Protocol) [16] and the three protocols called Blind, ErrorS and MAC [17]. They have improved on the estimation error while having high link utilization and fair throughput. However, they still have the fundamental problem of inaccurate estimation resulting in performance degradation. In addition, their bandwidth probing speed may be too slow when the bandwidth jumps a lot. Also, they cannot keep the
queue size stable due to oscillations, which in turn affects the stability of their sending rates. There are some explicit protocols that appear to compute the sending rates based solely on the queue size, but in fact they still need to estimate the number of active flows in a router, and this consumes CPU and memory resources. Examples are the rate-based controllers [18]–[20] for packet switching networks and the ER (Explicit Rate) allocation algorithm [21] for ATM (Asynchronous Transfer Mode) networks. For the API-RCP controller [19], both the original method (a truncated network model) and the improved method [22] face a memory problem when dealing with many flows (that numbers in millions) arriving to a core router every hour [23]. In some other controllers (e.g., [21]), the TBO (Target Buffer Occupancy) is designed to be as high as 3 times of the BDP, which can cause large queueing delay and thus degrading network performance, and this becomes even worse in the high-speed networks. Historically, the ER allocation algorithms in ATM networks also share the same problems (e.g., [21], [24]) because they need to evaluate the link bandwidth and/or the numbers of active VCs (Virtual Circuits). Some others (e.g., [25]) adjust the source sending rates in binary-feedback switches or explicit feedback switches according to a few queue thresholds, which may cause unfairness as well as high cell loss rate [2].

2. EXISTING SYSTEM:

Historically, TCP (Transmission Control Protocol) is a widely deployed congestion control protocol that tackles the Internet traffic. It has the important feature that the network is treated as a black box and the source adjusts its window size based on packet loss signal. However, as an implicit control protocol, TCP encounters various performance problems (e.g., utilization, fairness and stability) when the Internet BDP (Bandwidth-Delay Product) continues to increase.

2.1 DISADVANTAGES OF EXISTING SYSTEM:

They still have the fundamental problem of inaccurate estimation resulting in performance degradation. In addition, their bandwidth probing speed may be too slow when the bandwidth jumps a lot. Also, they cannot keep the queue size stable due to oscillations, which in turn affects the stability of their sending rates.

3. PROPOSED SYSTEM:

The contributions of our work lie in:

1) Using fuzzy logic theory to design an explicit rate-based traffic management scheme (called the IntelRate controller) for the high-speed IP networks;

2) The application of such a fuzzy logic controller using less performance parameters while providing better performances than the existing explicit traffic control protocols;

3) The design of a Fuzzy Smoother mechanism that can generate relatively smooth flow throughput;

4) The capability of our algorithm to provide max-min fairness even under large network dynamics that usually render many existing controllers unstable.

3.1 ADVANTAGES OF PROPOSED SYSTEM:

✓ The queue size can be accurately monitored.
✓ Used to proactively decide if action should be taken to regulate the source sending rate.
✓ QoS (Quality of Service) is assured by the good performances of our scheme such as max-min fairness, low queueing delay and good robustness to network dynamics.

4. SYSTEM ARCHITECTURE:
4.1 SIMULATION SETUP:

![Simulation Setup Diagram]

4.2 DATA FLOW DIAGRAM:

1. The DFD is also called as bubble chart. It is a simple graphical formalism that can be used to represent a system in terms of input data to the system, various processing carried out on this data, and the output data is generated by this system.

2. The data flow diagram (DFD) is one of the most important modeling tools. It is used to model the system components. These components are the system process, the data used by the process, an external entity that interacts with the system and the information flows in the system.

3. DFD shows how the information moves through the system and how it is modified by a series of transformations. It is a graphical technique that depicts information flow and the transformations that are applied as data moves from input to output.

4. DFD is also known as bubble chart. A DFD may be used to represent a system at any level of abstraction. DFD may be partitioned into levels that represent increasing information flow and functional detail.
5. CONCLUSION:

A novel traffic management scheme, called the IntelRate controller, has been proposed to manage the Internet congestion in order to assure the quality of service for different service applications. The controller is designed by paying attention to the disadvantages as well as the advantages of the existing congestion control protocols. As a distributed operation in networks, the IntelRate controller uses the instantaneous queue size alone to effectively throttle the source sending rate with max-min fairness. Unlike the existing explicit traffic control protocols that potentially suffer from performance problems or high router resource consumption due to the estimation of the network parameters, the IntelRate controller can overcome those fundamental deficiencies. To verify the effectiveness and superiority of the IntelRate controller, extensive experiments have been conducted in OPNET modeler. In addition to the feature of the FLC being able to intelligently tackle the nonlinearity of the traffic control systems, the success of the IntelRate controller is also attributed to the careful design of the fuzzy logic elements.

REFERENCES


