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A Survey on Distributed Explicit Rate Schemes in Multi Input Multi Output Network Systems

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***Abstract*—The design of distributed explicit rate flow control schemes for the multi input multi output services has received the considerable focus with the ever increasing wireless and the wired data applications. This paper proposes two novel multi points to multi point flow control schemes. The schemes are based on the distributed self-tuning proportional integrative plus derivative controller. The control parameters can be designed to ensure the stability of the control loop in terms of the source rate. In order to regulate the transmission rate the controllers are located at the wireless/wired multi point to multipoint multicast source. We further analyze the theoretical aspects of the proposed algorithm, show how the control mechanism can be used to design a controller to support many-to-many multi-rate multicast transmission based on ER feedback, and verify its agreement with simulations in the case of bottleneck link appearing in a multicast tree. The simulation results can be obtained in terms of the system stability, high link utilizations, fast response, scalability, high throughput and fairness.**

***Keywords*— Explicit rate, Flow control, socket, multicast congestion control, rate based congestion control.**

1. INTRODUCTION

Communication systems that use multiple transmitters and receivers are often called multiple-input multiple-output (MIMO) systems. Flow control is used to control the traffic sources so that they do not send too much data into the network at any moment. Multicast is the delivery of a message or information to a group of destination computers simultaneously in a single transmission from the source creating copies automatically in other network elements, such as routers, only when the topology of the network requires it. Multicast design pays more attention to the worst channel-case user than the average performance with respect to all users in the multicast group. Multicast improves the efficiency of multipoint data distribution from multiple senders to a set of receivers.

MIMO technology has attracted attention in wireless communications, because it offers significant increases in data throughput and link range without additional bandwidth or increased transmit power. With the significant improvement in the multicast data applications wireless and wired multicast i.e. multipoint-to-multipoint transmission has considerable effect on many applications such as teleconferencing and information dissemination services. Multicast improves the efficiency of multipoint data distribution from multiple senders to a set of receivers [1].

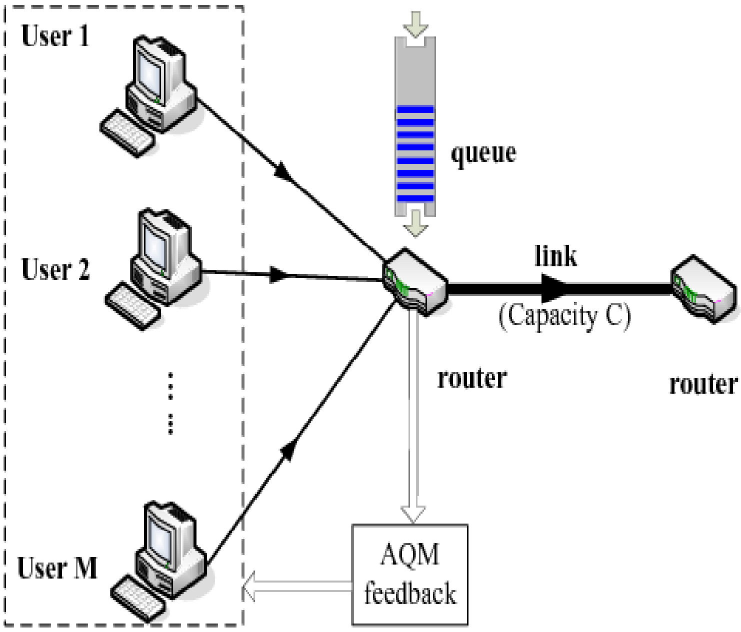

Fig 1. Shows Multicasting with Congestion in Router

Figure.1 shows the limited bandwidth and large number of users, the network will be congested if everybody tries to send as much flow as possible. So it is necessary to have a flow control mechanism.

The widely used multicast transport protocols, which are layered on top of IP multicast, can cause congestion or even congestion collapse if adequate flow control is not provided. Flow control thus plays an important role in the traffic management of multicast communications. Without an adequate flow control scheme being implemented in a multicast tree, the incoming traffic to a bottleneck link might

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be much more than the outgoing link capacity, which could subsequently cause the buffer to overflow, and cause excessive queuing delay or even deadlock in certain nodes.

There are many flow schemes handling unicast transmissions efficiently [2], and they were formulated as a discrete-time feedback control problem with delays. This control-theoretic approach to explicit rate control for available bit rate i.e. ABR service was further analyzed and verified using a real-network test bed experiment [3]. Many other methods are also proposed in this regard [4]. All these methods are efficient in rate allocation and flow control for unicast transmission. Unfortunately, multicast flow control is much more sophisticated than that of unicast, due to the complexity of multicasting mechanism.

Many multicast flow approaches have been proposed [5]. The main advantages of these methods lie in the simplicity of the hop-by-hop mechanism. The major difficulty in designing multicast flow control protocols arises from the long and heterogeneous RTTs involved in the closed-loop control. We can observe some important points in this research. One of the aspects is the existing algorithms lack scalability, since they require each router to keep maintaining the saturation status of every session, and as virtual sessions (VSs) travel through it, this yields a major computational bottleneck. To this end, we are going to present an algorithm that is scalable. Another aspect is that the known flow control methods usually do not have explicit control over link buffer occupancy; as a consequence, the allocated rate can wander considerably before converging, and the link flow can temporarily exceed the capacity. To attack this problem, we will focus on the stability of our rate control scheme. One more important point to be noted is that, no explicit rate (ER) allocation has been given in the known approaches.

In this paper, we develop an algorithm to overcome the vulnerability due to the heterogeneous multicast receivers. In our scheme, flow controllers regulate the source rate at a multicast tree, which accounts for the buffer occupancies of all destination nodes. The proposed control scheme uses a distributed self-tuning proportional integrative plus derivative (SPID) controller. The control parameters can be designed to ensure the stability of the control loop in terms of source rate.

This paper is organized as follows. Section 2 describes the literature survey.Section 3 describes system architecture. Section 4 describe the methodology. Section 5 gives the conclusion.

2. LITERATURE SURVEY

The purpose of this literature survey is to provide the background information on the issues to be considered in this paper and to emphasize the relevance of the present study.

Literature survey is organized considering the following aspects

- ways of Flow control and its usage in various types of networks
- Explicit rate in Flow control
- Comparison between inflows and outflows

2.1 Bottle neck Flow control

Multiple users sharing the links of the network each attempt to adjust their message rates to achieve an ideal network operating point .Each user has a fixed path or virtual circuit. This definition concentrates on a fair allocation of network resources at network bottlenecks. All shares constrained by the same bottleneck are treated fairly by being assigned equal throughputs. With this definition, the network may accommodate users with different types of message traffic.

2.2Virtual-channel flow control

Network throughput can be increased by dividing the buffer storage associated with each network channel into several virtual channels. Each physical channel is associated with several small queues, virtual channels, rather than a single deep queue. The virtual channels associated with one physical channel are allocated independently but compete with each other for physical bandwidth. Virtual channels decouple buffer resources from transmission resources. This decoupling allows active messages to pass blocked messages using network bandwidth that would otherwise be left idle.

2.3 A novel explicit rate flow control mechanism in ATM Networks

The explicit rate flow control mechanisms for ABR service are used to control congestion in ATM. In this paper, a control theoretic approach that uses a deadbeat-response (DR) controller to the design of an explicit rate flow control mechanism is present, and the mechanism has a very simple structure. The rate-based flow control algorithm for ABR service in ATM networks operates as follows: the source periodically sends a “Forward” Resource Management (FRM) cell to the destination every Norm data cells. This FRM cell contains several fields, mainly including the Current Cell Rate (CCR) field that is set by the source to its current Allowed Cell Rate (ACR) when it generates a FRM cell, the Congestion Indication (CI) field that is used to have a source increase or decrease its rate by some predefined amount, and the Explicit Rate (ER) field that carries a 15-bit floating point number representing the explicit rate. Upon receipt of the FRM cell, the destination returns it to the source with the latest network information, and this FRM becomes a “Backward” RM (BRM) cell. The network information is contained in either one or both of its CI and ER fields depending on the mode of operation of the switch.

2.4 Explicit Rate Flow Control in Metro Ethernet Networks

On-off flow control is not able to quickly react to the network bandwidth fluctuation and may result in buffer overflow and packet drop. Moreover, the flow control performance deteriorates with the larger transmission delay, which is typical in the Metro Ethernet that has long transmission distance. To overcome above problems, we proposed an Explicit Ethernet Rate Control (EERC) algorithm based on control theory. EERC scheme utilizes the concept of control theory, which has fast rate control under system with large transmission delay like in Metro Ethernet networks. Such method shows its great advantage than the existing 802.3x. Low control schemes in Ethernet, especially in the situation where available individual output rate fluctuates with time and there is long transmission delay.

2.5 A simple, scalable, and stable explicit rate allocation algorithm for max-min flow control with minimum rate

The proposed ER algorithm is simple in that the number of operations required to compute it at a switch is minimized the user transmission rates and the network queues are asymptotically stabilized at a unique equilibrium point at which max-min fairness with minimum rate guarantee and target queue lengths are achieved, respectively.

2.6 Static Information Flow Analysis with Handling of Implicit Flows and a Study on Effects of Implicit Flows vs Explicit Flows

Implicit flow has significant impact on all these applications. In security violation detection, implicit flow detects more security violations than explicit flow. In type inference, implicit flow infers more un-trusted type variables. In the study of the effect of thread-shared variables, implicit flow detects more affected variables than explicit flow. In the implicit flow sender will overflows the receiver but in the case of explicit flow according to receiver requirement sender will send the packets.

3. THE SYSTEM STRUCTURE DESIGN

The Multi Input Multi Output network system is as shown in figure 2.

In this network system Multicast sources will send the packets along with FCP to the router, router will forward those packets to the multicast receiver. Receivers will check their congestion level and they will send BCPs to the upstream nodes. According to the requirements of receivers source node will reduce its sending rate and multicast the packets.

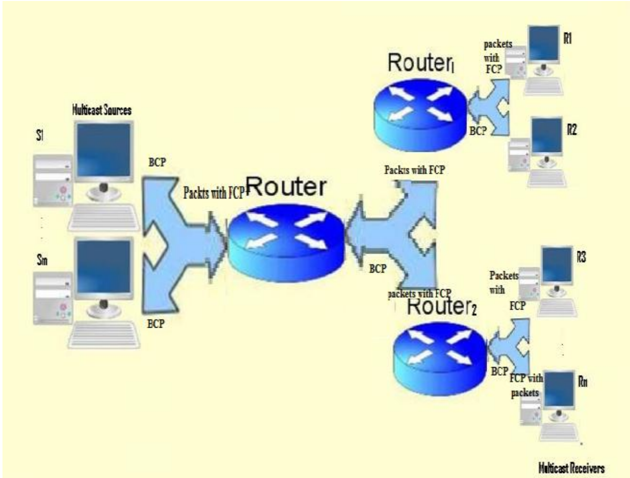

Figure 2. System Architecture Design

4. METHODOLOGY

Flow control is the technique for assuring that a transmitting entity does not overwhelm a receiving entity with data Communication systems that use multiple transmitters and receivers are often called multiple-input multiple-output (MIMO) systems.In the MultiInput MultiOutput(MIMO) Network system the sender will send the packets according to the requirements from the receiver. Sender must be installed.

- Approaches are proposed which consider the flow control based on
  - Buffer Occupancy
  - PID controllers
  - Explicit rate

Software, each side communicates with socket which is bound to a specific port number, the router just waits, listening to socket for a sender to make a connection request and similarly receiver waits, listening to socket for router to make connection request.

On the sender side: The user has to specify the IP address of the machine on which the multiple routers is running and the port number on which the router is listening. To make a connection request, the multiple senders try to rendezvous with the multiple routers on the machine and port. The sender also needs to identify itself to the router so it binds to a local port number that it will use during this connection. If everything goes well, the router accepts the connection. Upon acceptance, the route gets a new socket bound to the same local port and also has its remote endpoint set to the address and port of the sender. It needs a new socket so that it can continue to listen to the original socket for connection requests while tending to the needs of the connected sender. On the sender side, if the connection is accepted, a socket is successfully created and the sender can use the socket to communicate with the router. Now once the connection over sender will send packets along with the FCP to the router. This methodology applies to multiple senders

On the router side: The user has to specify the IP address of the machine on which the multiple receivers is running and the port number on which the router is listening. To make a

connection request, the router tries to rendezvous with the receiver on the machine and port. The router also needs to identify itself to the router so it binds to a local port number that it will use during this connection. If everything goes well, the receiver accepts the connection. Upon acceptance, the receiver gets a new socket bound to the same local port and also has its remote endpoint set to the address and port of the router. It needs a new socket so that it can continue to listen to the original socket for connection requests while tending to the needs of the connected receiver. On the router side, if the connection is accepted, a socket is successfully created and the sender can use the socket to communicate with the receiver. Now once the connection over router will forward packets along with the FCP to the receiver. Upon receiving packets receiver will check its buffer occupancy if its buffer occupancy is about to cross the congestion level it will send BCP to the router. Router will forward those BCP to the upstream nodes. This methodology applies to multiple routers.
On the receiver side: The user has to specify node id of receiver, listen port number and packet processing time. The receiver also needs to identify itself to the router so it binds to a local port number that it will use during this connection. If everything goes well, the receiver accepts the connection. When the set of receivers get FCP with packets from the router it will buffer the packets into the buffer occupancy. If an incoming packets overflows the buffer capacity or buffer occupancy is about empty, the receivers will generate the BCPs and send those BCP to the router. Router will forward them to the senders. Once sender gets information it will slow down or increase its sending rate according to the requirement of the set of receivers. Real time scenario represent efficiency in usage of controllers, network load etc and their results are displayed in the form of graph.

- Algorithms are proposed considering
  - Controllers
  - Explicit Rate

To improve the communication speed and reduce the time for waiting multithreading in receiver side, router side and in sender side makes the system have stable, flow control, packet loss and congestion control.

A. Advantages of proposed system

1. Sender will adjust the sending rate
2. Set of nodes will check for the Buffer occupancy and never overwhelm the Buffer capacity.
3. Set of receiver will check for the congestion level and replies via BCP to the Sender. From this packet loss can be reduced.
4. Multicast improves the efficiency of multipoint data from distribution multiple senders to a set of receivers.

5. CONCLUSIONS

This paper satisfies the different requirements of multiple users. We have used PID controller to regulate the sending rate according to the user requirement. Literature survey carried out in terms of three different aspects 1. Ways of flow control 2. Explicit rate flow control and 3. Comparison between inflows and outflows. From this project we are achieving congestion control, less packet loss and controlled sending rate, fast response and proper usage of buffer occupancy. In future we can enhance this project by using various algorithms to reduce packet loss, congestion control and improve the system scalability.

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