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An Anycast Routing Algorithm by Estimating Traffic Conditions of Multimedia Sources

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Abstract - **Multimedia has to carry data of heterogeous types. Multicast communication techniques can supply the most appropriate infrastructures to such multimedia. Of many multicast protocols, the core based tree (CBT) protocol is the most concentrative studies are conducted on. The CBT places a core router at center of the shared tree and transfers data through the core router. However, the CBT has two problems due to centralizing all network traffics into a core router. First, it can raise bottleneck effect at a core router. Second, it is possible to make an additive processing overhead when core router is distant from receivers. To cope with the problems, this paper proposes an intelligent anycast routing protocol. The anycast routing attempts to distribute the centralized traffic into plural core routers by using a knowledge-based algorithm. The anycast routing estimates the traffic characteristics of multimedia data for each multicast source, and achieves effectively the distributing that places an appropriate core router to process the incoming traffic based on the traffic information in the event that requests of receivers are raised. This method prevents the additional overhead to distribute traffic because an individual core router uses the information estimated to multicast sources connected to oneself and the traffic processing statistics shared with other core routers.**

I. INTRODUCTION

Recently, the evolving of computer communication has enabled network traffic to transmit the pervasive multimedia services of various types. They make a requirement to quality of service (Qos) for video conference, virtual reality, remote medical diagnosis system, video on demand and so on.

The Qos for multimedia services includes methods utilizing transmission line characteristics, compression technologies, and routing algorithms. However real-time multimedia Qos has difficulties to efficiently use the resource, easily change the topology and additionally increase the bandwidth of networks. Among the problems, the efficient use of resource has been taken more interest in by reason of economical aspect [1].

Multicast protocols are a Qos-guarenteed protocol. In multicast, a sender can transmit data to all the participants who have joined in a group by using IP multicast. Evolving out of the out-of-date point-to-point communications, multicasts communicate in point-to-many or many-to-point. The core based tree (CBT) is a multicast protocol that has been focused intensively on. The head concept of the CBT is to construct a shared tree that loses little throughput and minimize the overhead from not balanced locations in the shared tree. However, the construction of shared trees has the trouble of NP-complete in Steiner minimal tree. This trouble makes the causes to concentrate traffic on core and place core on a poor location.

To cope with the problems, this paper proposes a novel and intelligent anycast protocol to make efficiently use of network bandwidth. For verifying of its feasibility, simulation and evaluation are conducted using a representative simulation tool.

This paper is organized as follows. Section 2 describes the CBT algorithm. In section 3, the anycast routing protocol to use an intelligent method is proposed, and the result of simulation and performance evaluation for the proposed protocol is analyzed in section 4. Finally, section 5 summarizes the paper.

II. CORE BASE TREE

The existing multicast protocols can be divided into the source-based SBT multicast where a tree is constructed for each source and shared tree (ShT) multicast where multiple sources share a tree [5]. The ShT is denoted as (*, G), where * means the whole sources and G the group. The size of the real tree has the value of O(|G|) independently of the number of sources since it is the shared tree. The cost in constructing trees is not expensive, but a serious traffic delay might be caused by the increasing number of sources. The ShT is appropriate when multicast services are supplied in the networks that have somewhat narrow bandwidth traffic but many senders. The CBT is one of the ShT and has a core router on the center of the shared tree. In contrast to the PIM-SM protocol that operates as an uni-direction tree and so has constraints on selecting the optimal routing path, the CBT tree operates as bi-direct tree and has more flexible extensibility of networks in comparison with the existing source-based multicast routing protocols.

The CBT must construct a shared tree that loses very little throughput to transmit traffic and minimize the overhead from not balanced locations in the shared tree. However, such construction of tree has the trouble of NP-complete in Steiner minimal tree and makes two problems to be solved [2],[3].

The first problem cased by the trouble is that traffic is concentrated on core. This phenomenon is observed when large traffic of video, telnet, ftp and so on is concentrated on core router. Fig. 1 shows the phenomenon called traffic concentration.

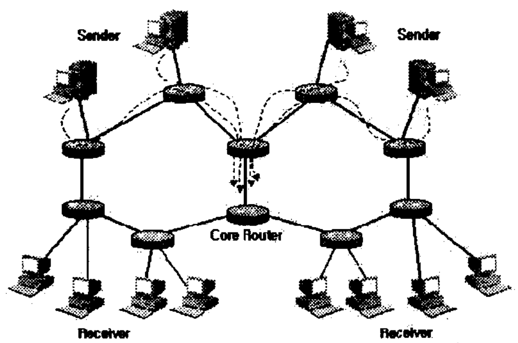

Fig. 1. Traffic concentration.

The second problem is the poor core. The ideal location of core to receive traffic is the center of group. However, if the core is distant from receivers and used independently by them, high bandwidth and large storage are not meaningful anymore and it is impossible to place an appropriate core. Fig. 2 describes the poor core phenomenon.

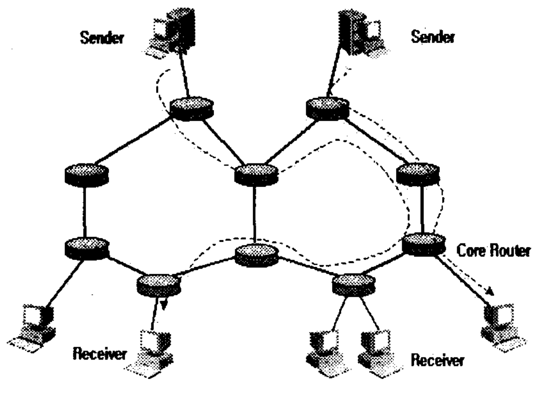

Fig. 2. Poor core placement.

III. Intelligent Anycast Protocol

The intelligent anycast proposed in this paper attempts to solve the two problems from the CBT: the traffic concentration and the poor core placement. This protocol analyzes the characteristics of traffic before groups join in cores and forwards the traffic into the appropriate core. In this anycast, the concentrated traffic is controlled, so the Qos of real-time traffic transmission is efficiently ascertained and it is possible to economically manage the network due to optimization of core distribution [6].

Anycast routers go through two processes. First, the entire traffics are grouped into homogeneous traffics according to their characteristics and router tables are generated from the homogeneous traffics. Second, user profiles are created to manipulate the preference to each source and incoming traffics are estimated from the user profiles. In each anycast router, the router tables generated from traffic characteristics is accessed with an intelligently and hierarchically established mechanism and plural routers share the user-requested traffics with each other by estimating traffics. The atomic processes composing the proposed anycast are as follows:

Traffic retrieval: traffic information saved in router tables is retrieved.

User profile: user information is created from the keywords that morpheme analyzer made to catch up the interests of users.

Traffic grouping: router tables are generated to group into homogeneous traffics according to their contents. Its purpose is to reduce network load and maximize the efficiency of network utility.

Automatic estimation: the retrieval result from the characteristics of source traffics is provided by router tables

IV. Simulation and Evaluation

To simulate the intelligent anycast proposed in section 3, traffic rate on CBT core is estimated and analyzed when bottleneck is made around the CBT core. Based on the theoretical description, this section conducts a simulation to convert the CBT into the proposed anycast according to traffic condition, core links situation and traffic characteristics.

For the simulation, the topology represented by Fig. 3 is constructed. The proposed anycast routing can catch out the condition of core links from the information of router table and protect core from falling into bottleneck. The simulation is based on the PC that has 512MB memory and 1.5GHz Intel Pentium 4 processor, and uses Linux Redhat 7.0 as its operating system. The simulation is implemented on the network simulator version 2 (NS-2) that is prevailed as PC-based simulator. For the performance evaluation of multicast routings, The CBT cores of the given topology are compared with the anycast cores for bottleneck situation. The sizes of packets are selected to 210, 512, 1024 and 1280 bytes to consider the characteristics of multimedia.

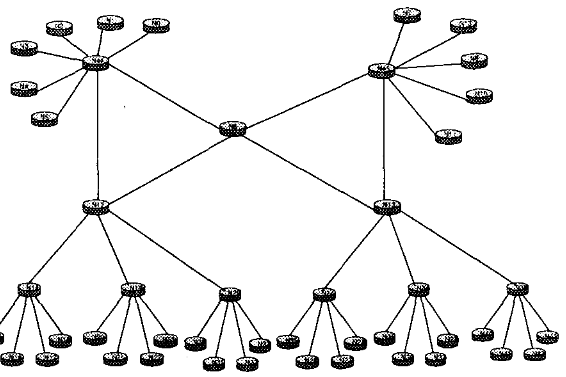

Fig. 3. Topology for the simulation.

For each size of packets, the CBT routing and the proposed anycast are evaluated as changing the numbers of multicast groups and senders. Fig. 4 and Fig. 5 present the delays of CBT core for each packet sizes. From the simulation result, when the sizes of packets are 210 and 512 bytes, the queueing delay is a rather superior. But the sizes of packets, 1024 and 1280 bytes, make delay just after the point to process over 20 packets and raise bottleneck at once.

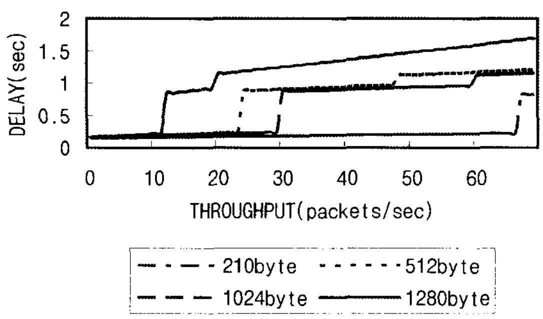

Fig. 4. Packet transmission delays for CBT core.

Fig. 4 displays the packet delays for CBT core. From the result, it is known that multicast tree is initialized and groups are joined or leaved frequently, so the arrival interval of packets becomes shorter and it results in traffic increase. This situation may give a critical impact on the multimedia Qos for real-time transmission. Fig. 5 demonstrates the delays of the proposed anycast protocol with the CBT routing retained. Though the anycast is adopted, the increase of the number of packets makes the delays same to the Fig. 4 with some difference in the generation time of the bottleneck. However, the anycast alleviates the queueing delays slowly at the bottleneck when the packet concentration is suddenly generated after multicast tree is joined in and routing table is updated.

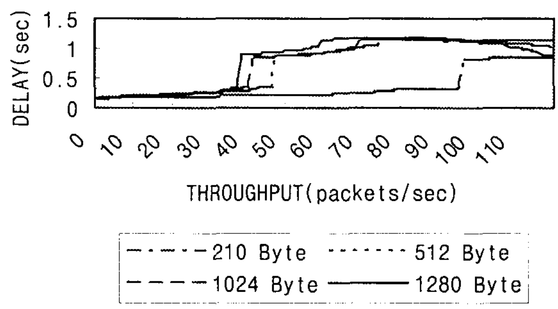

Fig. 5. Packet transmission delays for CBT/anycast core.

V. CONCLUSION

The proposed anycast has attempted to resolve the two problems, traffic concentration and poor core placement, in the CBT multicast protocol by forecasting the characteristics of incoming traffic. As a shared tree routing, the CBT operates effectively in low traffic, but has a trouble in high traffic. To relieve this trouble, this paper proposed the intelligent anycast routing to distribute the increasing traffic. When the method is used in various multimedia services, the existing advantages of multicast and the Qos for multimedia can be obtained at the same time.

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