QOS ISSUES IN MULTICAST COMMUNICATION

Rajeev Dahiya*

Dr. R.P. Garg**

ABSTRACT

The recent rise of QoS-aware group applications over the Internet has accelerated the need for scalable and efficient multicast support within the communication system on the basis of hierarchical layers. In this article we present a multicast "life cycle" model that identifies a variety of issues involved in a typical multicast session. During the life cycle of a multicast session, three important events can occur: group dynamics, network dynamics and traffic dynamics. The first two features are concerned with maintaining a good quality (e.g., cost) multicast tree taking into account member join/leave and changes in the network topology due to node failure. The third aspect is concerned with flow control, congestion control, and error control. The Internet currently offers a best effort service. In this article we present QoS support for multicast communication on the Internet. In this article we examine various issues and solutions for managing group dynamics and failure handling in QoS multicasting, and outline several future research directions.

Keywords: *QoS, Multicast Communication.*

*Research Scholar, Monad University

**Professor, M.M.U. Mullana

1. INTRODUCTION TO MULTICAST COMMUNICATION

In Multicast communication a single data source transmits user data to one or more than one receiver as shown in figure 1. The case of a single receiver represents the special case of unicast. This therefore constitutes an extension of unicast communication and is referred to as **i:n** communication. These group applications include videoconferencing, shared workspaces, IP-TV, distributed interactive simulations (DIS), software upgrading, and resource location. The traditional unicast model is extremely inefficient for such group-based applications since the same data is unnecessarily transmitted across the network to each receiver.

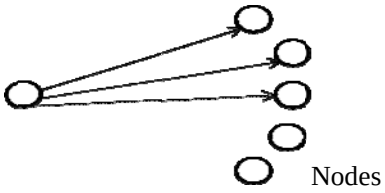

Figure 1 Multicast (1:n)

2. THE LIFE CYCLE OF A MULTICAST GROUP

To utter the different functionalities that such a network must provide, figure 2 shows the various steps and events that can take place in the life cycle of a typical multicast session.

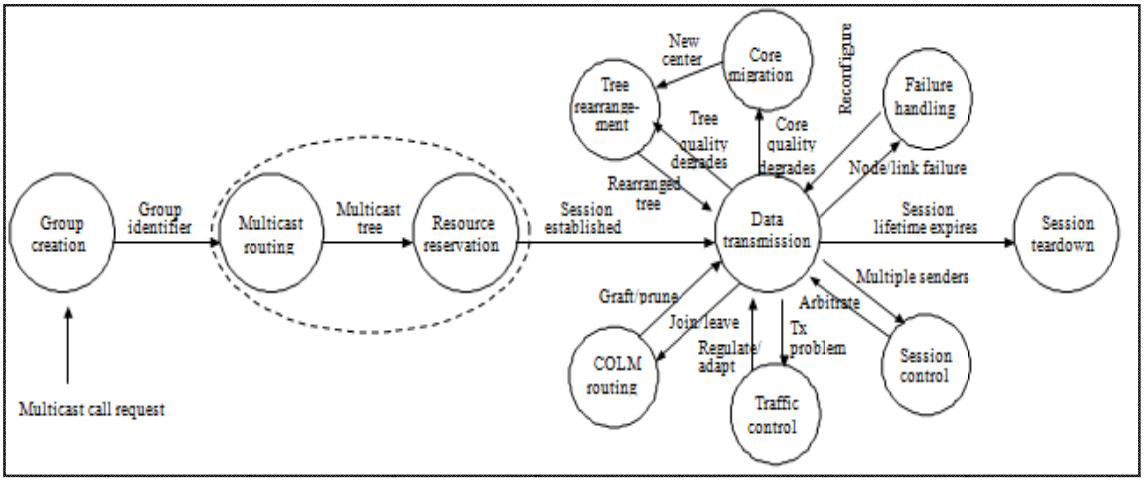

Figure 2 The life cycle of a multicast session

2.1 Multicast Group Creation

The first step in the initiation of a multicast session is assigning a unique address to the multicast group such that the data of one group does not clash with the other groups. Both groups (sessions) and addresses have associated lifetimes [2].

2.2. Multicast Tree Construction with Resource Reservation

Once the group is created, the next phase in the multicast sessions is the construction of a

multicast distribution tree, spanning the source and all the receivers, and reserving resources on the tree. Multicast route determination is traditionally formulated as a problem related to tree construction.

2.3. Data Transmission

Once the above two phases have been completed successfully, data transmission can begin. During data transmission, the following types of runtime events can occur.

2.3.1. Membership dynamics

Since group membership can be dynamic, the network must be able to track current membership during a session's life time. Tracking is needed both to start forwarding data to new group members and to stop the wasteful transmission of packets to members that have left the group, in fig.2 tracking of membership dynamics may be done in either a flooding, centralized, or distributed scheme [3].

2.3.2. Network dynamics

During the lifetime of a multicast session, if any node or link supporting the multicast session fails, service will be disrupted. This requires mechanisms to detect node and link failures, and reconfigure the multicast tree around the faulty nodes (showed as failure handling in figure 2).

2.4. Group Teardown

At some point in time, when the session's lifetime has elapsed, the source will initiate the session teardown procedures. This involves releasing the resources reserved for the session along all of the links of the multicast tree and purging all session specific routing table entries. Finally, the multicast address is released and group teardown is complete in figure 3.

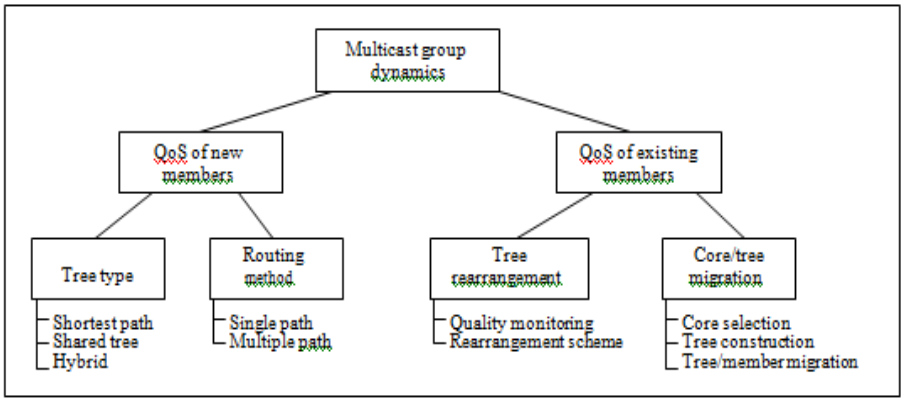

Figure 3 Issues in Multicast group dynamics

3 COMMUNICATION SYSTEM ON THE BASIS OF HIERARCHICAL LAYERS

Dedicated support of group communication can be located in different parts of a communication system. These layers shown in table 1 have responsibility for regulating data transfer and providing a corresponding communication service to applications [1]. Multicast address translation is shown in figure 4.

Table 1 Services of layers

Layer	Type of Service
Transport Layer	UDP, TCP, Port Addressing
Network Layer	Network Addressing
Data Link Layer	MAC

Figure 4 Shows the Multicast Address Translation

4. QOS AND MULTICASTING

With the introduction of applications demanding QoS, the multicast problem becomes more exigent. In addition to requiring scalable and efficient network support, group-based applications also demand rigorous QoS requirements in terms of end-to-end delay, jitter and loss. Although resource reservation protocols such as RSVP [4] Multicast routing protocols can be classified into two main approaches: source-based protocols and center-based protocols [5], dense-mode protocol-independent multicasting (PIM-dense) [6], and Multicast Open Shortest Path First (MOSPF) [7]. The Core Based Tree (CBT) [8] is a well-known example of a shared tree routing protocol.

5. MANAGING GROUP DYNAMICS

The QoS of the multicast tree (receiver-perceived QoS) is not solely affected by the multicast routing protocol. Rather, the QoS of the multicast tree is a function of group dynamics, which includes the following issues:

5.1. QOS aware routing

A multicast tree is incrementally constructed as members join and leave a group. When an existing member leaves the group, it sends a control message up the tree to prune the branch that no longer has active members. When a new member joins the group, the tree must be extended to cover it. The dynamic QoS multicast routing problem can be informally stated as given a new member M_{new}, find a path from M_{new} to an on-tree node that satisfies the QoS requirements of M_{new}.

5.2. Tree rearrangement

In a dynamic multicast session, it is significant to ensure that member join/leave will not disrupt going on multicast session, and the multicast tree after member join/leave will still remain near optimal and gratify the QoS requirements of all on tree receivers.

5.3. Core and tree migration

Another worth of tree maintenance is in core-based multicasting, where core selection is a vital problem because the location of the core influences the tree cost and delay. The quality of the tree based on the current core may get worse over time due to dynamic join and leave of members.

6. CONCLUSION

In this paper we first outline the different issues in multicast communication through tracing the life cycle of a multicast session. Then we spotlight on two key issues: managing group dynamics and failure recovery. These issues have a profound impact on QoS multicast routing and the QoS veteran by the end user.

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