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ROUTERS OPTIMIZATION AND MINIMIZING FORWARDING STATES WITH EXPLICIT MULTICAST FORWARDING

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***Abstract*— Now a day's plenty of algorithms and techniques are available for optimization and multicast forwarding. But in this research we are improving the scalability (Efficiency) of IP multicast and source specific multicast and to reduce the number of routers for required storing the forwarding states. The Multicast forwarding mechanism optimizes the allocation of forwarding states in routers and which can be used to improve the scalability of traditional IP multicast and Source-Specific Multicast. Our mechanism needs fewer routers in a multicast tree to store forwarding states and therefore leads to a more balanced distribution of forwarding states among routers. There are two problems are available here. The first one is by using the MINSTATE algorithm to reduce the sum of the number of routers that store forwarding states in a multicast tree. The Second one is BALANCESTATE to minimize the maximum number of forwarding states stored in a router for all multicast groups. By getting the Optimal Solution for MINSTATE we used distributed algorithm and approximation algorithm for the BALANCESTATE.**

***Keywords*— Multicast, Explicit Multicast, Routers, Forwarding States**

I. INTRODUCTION

Multicast is an efficient way of realizing one-to-many and many-to-many communications. Traditional IP multicast is provided with the host group model and multicast routing protocols. Each multicast group is associated with a class-D IP address, which serves as the destination addresses of data packets. Multicast addresses are assigned in a way that guarantees the global uniqueness of each class-D address. Unlike IP multicasting, Source-Specific Multicast (SSM) treats each one-to- many connections as one multicast channel. Each multicast channel is associated with a channel identifier composed of the sender's address and a class-D address. The class-D address is assigned by the sender and is not required to be globally unique. Both SSM and IP multicast adopt the shortest path tree to deliver multicast data. The routing of a shortest path tree is the union of the shortest paths from all receivers in the group to the tree root. For SSM, the root is the sender, and the tree is a source-based tree. For IP multicast, the root is a router called the core in CBT or RP in PIM-SM, and the tree is a shared tree. Each sender first sends data to the root via unicast, from where the data is relayed to all the receivers. Each router in SSM or IP multicast needs to store a forwarding state for each multicast group. Multiple forwarding states cannot be aggregated into one state, because their IDs may not be contiguous, and their next-hop routers may be different. Therefore, routers may not have enough memory to store all of the multicast states when there are a larger number of multicast groups. Moreover, a router may take a long time to look up the forwarding state for each arriving data.

The rest of this paper is summarized as follows. In section II, we address the related work. In section III, we present the problem description. In section IV, topology construction. In section V, algorithms to minimize the number of routers with forwarding states in each multicast tree. In section VI, we formulate the problem which minimizes the maximum number of forwarding states maintained in a router present our algorithms. In section VII, our numerical results are shown. Finally, we conclude this paper in section VIII.

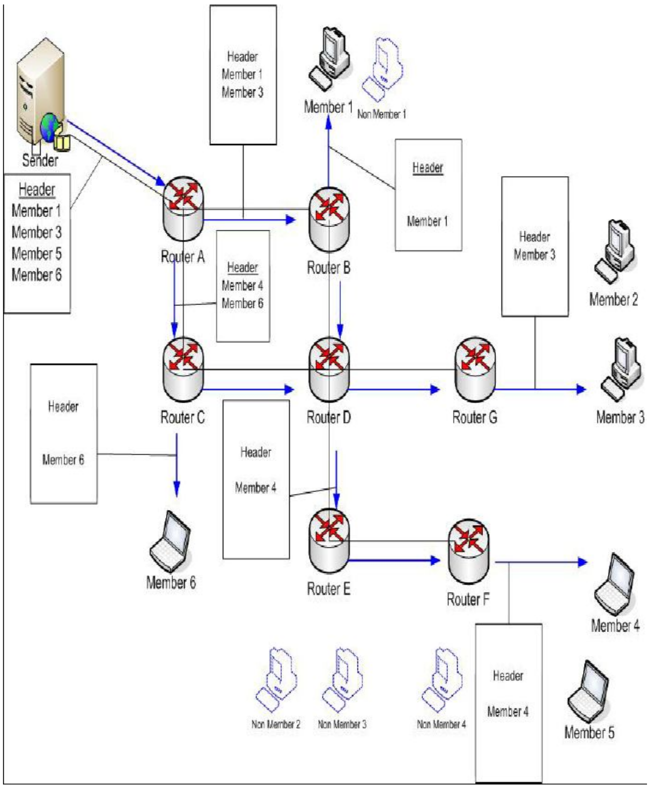

Fig. 1. EXPLICIT MULTICAST FORWARDING

II. RELATED WORK

The branching routers of a multicast tree are assigned to store forwarding states where the branching router is a router with at least two child nodes in the tree [1]. While traditional IP multicast schemes are scalable for very large multicast groups, they have scalability issues with a very large number of distinct multicast groups. [2] This document describes Xcast (Explicit Multi-unicast), a new multicast scheme with complementary scaling properties: Xcast supports a very large number of small multicast sessions. Xcast achieves this by explicitly encoding the list of destinations in the data packets, instead of using a multicast group address.

An adaptive scheme in which a single multicast tree is built to deliver data of multiple groups with similar receivers is proposed. [3] The problem with this approach is that receivers may receive undesired data from multicast groups that they did not join. Hence, one must carefully choose the single tree so as to reduce the amount of undesired data.

[4] In traditional multicast schemes or source-specific multicast, each router in a shortest path tree has to maintain a forwarding state for the group or channel. Multiple forwarding states can be aggregated into one state if their IDs are contiguous and their next-hop routers are the same. The ID of the aggregating state is the common prefix of the IDs of the aggregated forwarding states. Compared with unicast forwarding states, it is more difficult to aggregate multicast forwarding states [9]. The reason is that the ID of a unicast forwarding state is the destination IP address of data packets, and the destination IP address is allocated according to its geographical location.

Several approaches [11] have been proposed to reduce the number of multicast forwarding states stored in a router. The first approach [12] uses a single multicast tree to deliver data of multiple multicast groups with similar receivers. A receiver may receive undesired data from a multicast group in which it does not join. Hence, the multicast tree has to be chosen carefully in order to reduce the amount of undesired data. In the second approach [13], only the branching routers of a multicast tree maintain the forwarding states. A branching router is a router which connects to at least three adjacent routers in the multicast tree. A multicast packet is not duplicated on the path from a branching router to its nearest downstream branching router. Therefore, it is sent via unicast between these two routers, and intermediate routers on the path maintain no forwarding state of the multicast tree.

Compared with the above two approaches, our mechanism can assign the forwarding states more flexibly among routers. Since not all branching routers have to store the forwarding states. Moreover, non-branching routers can also maintain the forwarding states.

III. PROBLEM DESCRIPTION

We propose a new multicast forwarding mechanism based on Explicit Multicast (Xcast) forwarding for SSM and IP multicast. Each IP packet in Xcast can include multiple receiver addresses in the header. Upon receiving an Xcast packet, the router encapsulates multiple receiver addresses in a packet and uses an existing unicast routing protocol to find the neighboring routers to which the packet must be delivered. We focus on two problems and formulate each of them as an optimization problem. Distributed algorithm is proposed to minimize the total number of routers that store forwarding states in a multicast tree and Approximation algorithm is proposed to minimize the maximum number of forwarding states stored in a router for all multicast groups.

It greatly reduce the number of forwarding states stored in a router and balance the distribution of forwarding states among routers. It allows only a portion of branching routers to store forwarding states and also allows non branching routers to store states. Increase the scalability of both SSM and IP multicast with respect to the number of members in a multicast group and the number of multicast groups in a network.

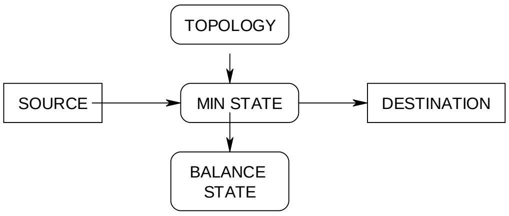

Fig. 2. System Model

IV. PROPOSED METHODOLOGY

As shown in the Fig.2 the system methodology includes 1. Topology Construction, 2. MIN State 3. Balanced State. For every nodes that have logged in is considered for topology construction. The messages are sent between these nodes. Min state which reduces the unwanted node from storing forwarding states. The Balanced state which maintain the work load among the nodes. It equally distributes the work among the nodes in our constructed topology.

A. *Topology Construction*

In this module, we are constructing TREE topology. Topology is constructed by getting the names of the nodes, state nodes and the connections among the nodes as input from the user. While getting each of the nodes, their associated port and ip address is also obtained. For successive nodes, the node to which it should be connected is also accepted from the user.

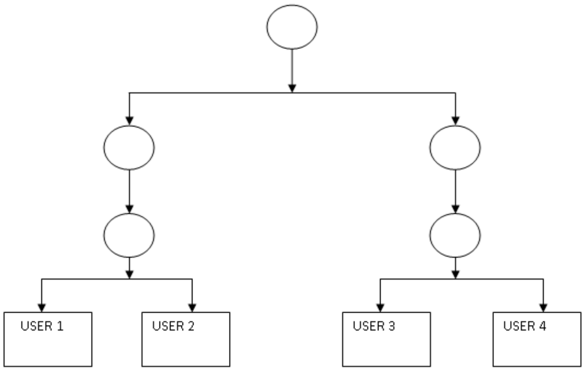

Fig. 3. Tree topology

B. *MIN State*

In this module a distributed algorithm called MINSTATE-DISTRIBUTED is used to find the optimal solution to MINSTATE. Min State is proposed to reduce the total number of state node in a multicast tree.

The MINSTATE-DISTRIBUTED algorithm works as follows:

1) At any instant, each state node independently decides whether it can perform two operations.

2) They are REMOVE and MOVE.

3) The node first tries to remove its forwarding state if the number of destination addresses in each Xcast packet sent from the upstream state node u does not exceed maximum number of destinations of a state node. This operation reduces the number of state nodes.

4) If it fails, then it tries moving the forwarding state to its parent node if the parent node of d is stateless and the number downstream state nodes is no more than maximum number of destinations of a state node. This operation packs the state nodes such that more state nodes can remove forwarding states.

5) The MINSTATE-DISTRIBUTED Algorithm stops when all state nodes are no longer able to perform the above two operations.

Each state node in MINSTATEDISTRIBUTED only stores the addresses of its upstream state node, parent node, child nodes, and destinations from each interface instead of the whole multicast tree. The algorithm does not restrict the sequence of the nodes that perform the above two operations. This merit enables the algorithm to be implemented in a distributed manner.

Auxiliary variable xtm dictates whether node m in t is required to decide if it can remove or move a forwarding state. The algorithm stops when xtm is zero for each node m.

C. *BALANCED State*

The proposed algorithm for MINSTATE minimizes the number of state nodes in a multicast tree, but the distribution of forwarding states among routers may be highly unbalanced. Since it is difficult to aggregate multicast forwarding states, some routers may not have enough memory to store all forwarding states and experience high forwarding delay for multicast packets, but some may be underutilized and able to store more forwarding states. In this module the problem of balancing forwarding states among routers, namely BALANCE-STATE is considered. APPROXIMATION algorithm is designed to balance the forwarding states.

In BALANCE State two multicast trees are allowed to use some common routers in the tree. Thus all the work load of a single router is distributed in balanced manner. We first propose an Integer Linear Programming (ILP) formulation BALANCESTATE-ILP for the problem. We then design an approximation algorithm of the ILP formulation, where our approximation algorithm is based on rounding the optimal solution to the linear relaxation on the formulation.

This BALANCESTATE algorithm works as follows:

1) At step 1, function FINDSUBTREE finds all sub trees in a set of sub trees. Initially, the node of a sub tree includes only child nodes. These child nodes are the leaves of sub tree. We add sub tree to set of sub trees, if the number of leaves is more than maximum number of destinations of a state node. Otherwise, we include each child node of each leaf node in sub tree in each of the following iterations. We stop expanding the sub tree if the number of leaves is larger than maximum number of destinations of a state node.

2) Step 2 uses the set of sub trees to design BALANCESTATE-ILP and finds the optimal solution to the linear relaxation on BALANCESTATE-ILP.

3) Step 3 simply assigns state nodes based on rounding the optimal solution obtained at Step 2.

V. SIMULATION RESULT

In this section, we show the simulation results of the above two optimization problems with the proposed algorithms.

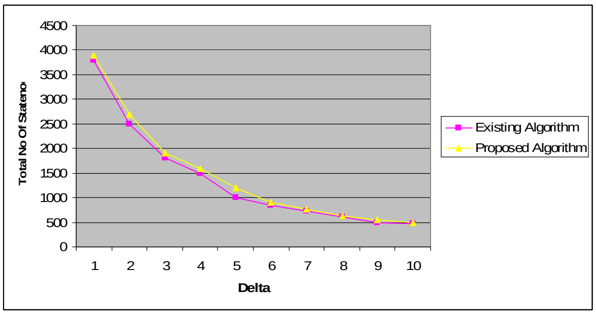

Fig. 4. Existing Algorithm Vs Proposed Algorithm

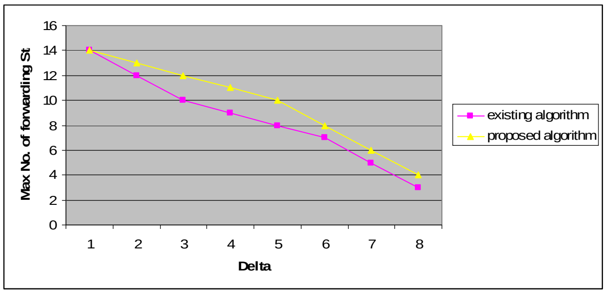

Fig. 5. Performance of the proposed algorithm

VI. CONCLUSION

In this paper, we have proposed a scalable and adaptive multicast forwarding mechanism for SSM and IP multicast. Our mechanism is more scalable in terms of both the number of members in a multicast group and the number of multicast groups in the network. Multicast packets are sent between these routers via Xcast. For the whole network, BALANCESTATE minimizes the maximum number of forwarding states stored in a router. For MINSTATE, we design a distributed algorithm that finds the optimal solution. We design an approximation algorithm and a distributed algorithm to solve the problem.

Our simulation results show that our mechanism uses fewer forwarding states, and the distribution of forwarding states among routers is more balanced as compared with previous approaches in both artificial and realistic networks. Therefore, our mechanism can improve the scalability of SSM and IP multicast.

Our future process will be scalable in the large network. We can implement by using static network as broadcast communication.

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