An Efficient Multicast Routing Protocol for Mobile Hosts

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Abstract

In this paper, we present an alternative design, Eff-MM(Efficient Mobile Multicast), for efficiently supporting multicast for mobile hosts on the Internet. Recently, providing multicast services to hosts becomes popular and many multicast protocols have been proposed for mobile hosts. But the delivery tree whenever a member moves occur will the problem, either a non-optimal delivery route and overheads caused by the frequent reconstruction of a multicast routing tree . To solve problem like this, in this paper used the tunneling range and search method to routing paths around migration places withy simple message. The result provides the shortest routes for delivery of multicast datagrams to mobile hosts and reduces frequent reconstruction of the multicast tree reconfiguration.

1. Introduction

The current multicast protocols on the Internet, DVMRP[6], MOSPF[4], CBT[1], and PIM[2], implicitly assume static hosts when building a multicast delivery tree. They do not consider the dynamic member location. Reconstructing the delivery tree every time a member moves will involve the overhead, while leaving the tree unchanged can result in inefficient, incorrect, or even failure of multicast datagram delivery. Thus, they are not suitable for the mobile environment. The IETF Mobile IP Working Group proposed the Mobile IP to support unicast IP routing for mobile hosts in an IP internetwork[8]. The current version of Mobile IP proposes two approaches to support mobile multicast. There are remote subscription and bi-directional tunneling.

In remote subscription, a mobile host has to subscript to multicast groups whenever it moves to a foreign network. It is simple, and does not require any encapsulations. This scheme has the advantages of offering an optimal routing path and nonexistence of duplicated packets. Howerver, when the mobile host is highly mobile, its multicast service may be very expensive because of the difficulty in managing the multicast tree. The update frequency of the multicast tree will depend on how often the mobile handoff occurs. The overhead is the cost of reconstructing the delivery tree while a handoff occurs. Furthermore, the extra delay incurred from rebuilding a multicast routing tree can create the possibility of a disruption in multicast data delivery.

In bi-directional tunneling, data delivery is achieved

0-7695-1153-8/01 $10.00 © 2001 IEEE

by unicast Mobile IP tunneling via the home agent: when the home agent receives a multicast datagram destined for a mobile host, it encapsulates the datagram twice and then transmits the datagram to the mobile host as a unicast packet. This approach is in fact hides host mobility from all other members of the group. Therefore, the multicast delivery tree will not be updated because of member's location change. The main drawback of the approach is the routing path for multicast delivery which can be far from optimal, In addition, the HA must replicate and deliver tunneled multicast datagram to all its MHs, regardless of at which foreign networks they reside. Therefore, the network resource will be wasted.

When compare to this two approach of problems is a large amount of overhead by reconstruction and non-optimal delivery route.

Eff-MM intends to deliver on the near-shortest paths without the high overhead of reconstruction the multicast tree, and as result, the mobile hosts receives multicast service near static hosts.

The basic idea in our protocol is the use of "Tunneling range" and "multicast routing search message" to limit the length of the routing paths of the multicast services and to control the frequency of reconstructing the multicast tree.

The rest of this paper is organized as follows. Section 2 presents the previous works which will be compared with our protocol. Section 3 introduces our Eff-MM protocol. Section 4 discusses some details of Eff-MM. Section 5 evaluates the performance and compares Eff-MM with the other protocols. Finally, we conclude this paper in Section 6.

2. Related Works

RBMoM[7] intends to trade off between the shortest delivery path and the frequency of the multicast tree reconfiguration.

RBMoM has a router, called *multicast home agent*(MHA), that is responsible for tunneling multicast datagrams to the foreign agent to which the MH is currently attached. RBMoM addresses a concept of "range" for each MHA. The *range* of a MHA means the service range to its MHs. That is, a MHA can only serve the mobile hosts which are roaming around the foreign networks which are within its service range, or the network to which the MHA is attached.

When the MH2 is out of the service range of MHA, it must join the multicast group, that result must be reconstruction of a multicast tree. For optimal route when reduce service range do gradually increase frequency update of the multicast tree.

The update frequency of the multicast tree will depend on how often the mobile handoff occurs. The overhead is the cost of reconstruction the delivery tree while a handoff occurs.

3. Effective Mobile Multicast (Eff-MM)

In mobile networks, When MH was did increase movement, increase reconstruction routing path and by reason of it caused of many overheads occurrence. For solution this problem we search to routing path in the neighborhood as being use the routing search messages. The result decrease to multicast tree rerouting and the multicast data delivery path length do interrupt to more distant at optimal.

Eff-MM has a "tunneling range" for each MFA similarly with RBMoM. The range of a MFA means the tunneling range to its MHs. That is, a MFA can only serve the mobile hosts which are roaming around the foreign networks which are within its service range, or the network to which the MFA is attached. If a mobile host is out of its MFA tunneling range, then MH search routing path at neighborhood and it received the service at new MFA. The MFA information of a mobile host is recorded at its HA. When a MH reaches a foreign network, it locates the FA and registers with it according to Mobile IP. Then FA contacts its (permanent) HA to locate the MFA serving the MH. The FA calculates the distance to MFA,

The first case, when mobile host MH1 in the MFA1 move into the FA1, the MH1 is still within tunneling range. The FA just informs the MFA1 of the FA currently serving it.

The second case, When mobile host MH2 in the MFA1 move into the MFA2, the current FA(MFA2) has already been in the multicast group, we can update the MFA to be the MFA2.

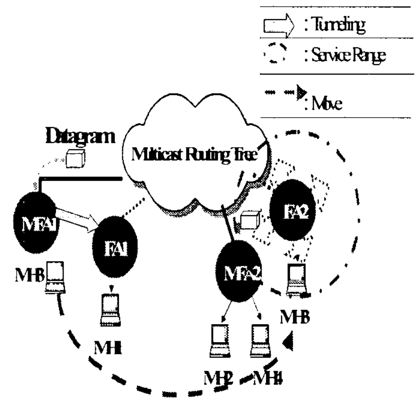

Figure 1. Movement out of MFA

The third case, When mobile host MH3 in the MFA1 move into the FA2 like Figure1, the current the FA2 is out of the tunneling range, it must be selected to a new MFA take over the work. The FA2 do transmission to the routing search message at the neighborhoods which of FA2 can receive to multicast datagrams as tunneling range of FA2. The result found out the MFA2 in the tunneling range. The FA2 has to inform the HA to update the MFA2 currently serving the MH3.

4. Eff-MM Protocol Details

When a MH arrives at a foreign network, the current MFA serving the MH is recorded at the home agent. A MFA has to keep a list of mobile hosts which need to be served. When the MFA is changed, the new MFA must inform the old MFA to delete the record of the mobile host. Figure 2 shows the detail operations of the FA when a new visitor enters its network.

```
When a MH arrives at a foreign network :
1. The mobile contacts the FA and registers according
     to Mobile IP.
2. FA  contacts the HA to get the location of MFA.
3. FA computes the hop distance to MHA; and

If(Distance(FA, MFA) < R)
   Inform MFA of the FA currently serving it;
Else if (FA == HA && Join to multicast tree)
          MFA <- FA;
Else {
          "Routing search Message" transmission ; /*
in tunneling range*/
          if(neighborhood MFA == 1 ) { /*MFA Is at
             the neighborhood */
             MFA <- neighborhood MFA;
          }
          Else {
             MFA <- FA;
             Join to multicast tree .
          }
   }
   Inform HA of the FA currently serving it;
   Inform HA of the MFA currently servicing it;
   Inform old MFA to delete all data structures about
   the MH.
}
```

Figure 2. The operations of FA when a mobile arrives at a foreign network

After a mobile host move out of its MFA tunneling range, defined message format like figure3 for search to multicast routing path at neighborhood. This message is defined to simplicity for reduce the overhead.

Type	Tunneling Range	Checksum
Group address		

Figure 3. Routing Search Message

• Type : there are two types of the routing search message.

1 = Query (send from the FA)

2 =Response (send from the neighborhood router of same multicast group).

• Tunneling Range : multicast routing search range (send message an extent tunneling range).

• Group address : group address for search.

• Checksum : The checksum is the 16-bit one's complement of the one's complement sum of the 8-octet.

The Routing search messages are transmitted within IP datagram, as shown in Figure4

IP header	Routing search message

Figure 4. Routing search message IP Datagram

Destination address of IP Header used the reserved multicast address. As destination address can used "224.0.0.4"(all DVMRP router), "224.0.0.5"(all OSPF router), "224.0.0.13"(all PIM router), "224.0.0.14"(all CBT router) according to multicast routing protocol. It is for transmission once the same time at the some multicast router. The result decreases to the message transmission overhead.

5. Simulation

We have evaluated our approach to mobile multicast using a discrete-event simulation tool constructed for this purpose.

Table 1 summarizes the main network and workload parameters used in simulation experiments.

Table 1 : Network and Workload Parameters

Parameter	Description	Value(s)
N	Number of LANs	5...20
H	Hosts per LAN	10...20
p	Fraction of hosts	1.0
M	that are mobile	1...8
g	Number of multicast	1...50
s	groups	1

We do several experiments to assess the performance of Eff-MoM. It is compared with RBMoM and MoM by changing group size

The first simulation experiment shows the average tunneling range. Figure 5 shows the simulation result.

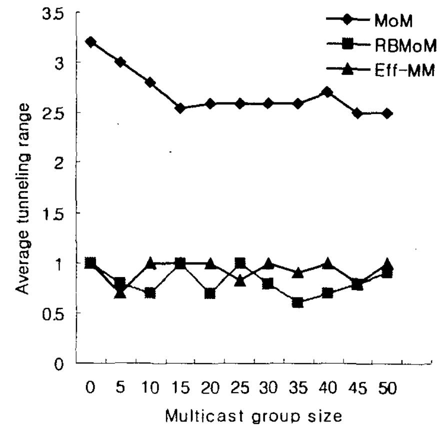

Figure 5. The average tunneling range

MoM has the worst performance among the three protocols because there is no limit for the tunnel length. RBMoM has the optimal performance because each delivery path is always shortest. Eff-MM has the similar performance as RBMoM. The tunneling range limits the tunnel length.Thus the delivery paths are shortest. In average, the routing path is near optimal.

The second simulation experiment show the

number of DMSP handoff events that take place during the simulation. Figure 6 shows the simulation result. This simulation is used oldest-HA as DMSP selection algorithm and tunneling range is 2.

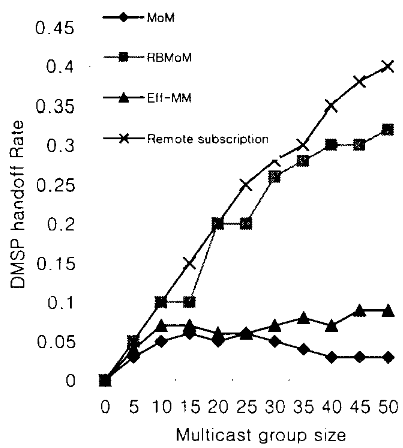

Figure 6. The DMSP handoff rate

Remote subscription and RBMoM is very frequent. When a MH moves in a foreign network, Eff-MM is better than the RBMoM. When the number of mobile group members increases, the number of DMSP handoffs of MoM and Eff-MM increase first and then decreases.

6. Conclusion

In this paper, we propose an efficient multicast protocol supporting host mobility.

Eff-MM get the shortest delivery path by controlling the tunneling range of the multicast forwarding agent and the reduced frequency of the multicast tree reconfiguration by used routing path search message.

Importantly, as the multicast tree update is not frequently, the tree maintenance overhead can be much reduced. And the tunneling range can be controlled in order to adapt to the change of the mobility and the number of the mobile members.

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