무선 이동 애드 혹 망에서 네트워크 라우팅 정보를 이용한 멀티캐스트 방안

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Efficient Overlay Multicast Protocol using Unicast Routing Information in Mobile Ad Hoc Networks

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1. Introduction

Group communications in mobile ad hoc networks (MANET) has become increasingly important because some applications require that the mobile nodes work as a group. To support these applications, many related researches have been proposed for group communications in MANET. In early proposed multicast routing protocols for MANET, to support multicast functionality, all nodes must maintain multicast information as routers of existing wire-line networks [2][3][4][5]. However, due to the dynamic topology of MANET, many control messages are required for frequently state reconfiguration in these multicast routing protocols. Thus conventional multicast routing protocols designed for wire-line networks cannot be directly adopted in MANET.

Therefore, to adapt the dynamic topology of MANET, many overlay multicast approaches for MANET have been proposed as a solution for the problems mentioned above. In these approaches, only member nodes perform multicast operations, and an overlay network forms a virtual network which only consists of the member nodes on the physical infrastructure. Also, overlay multicast can minimize data delivery failures caused by the dynamic topology because multicast data is encapsulated in unicast packets and transmitted between group nodes. As a result, overlay multicast has more stable protocol operation, robustness and low control overhead even in a highly dynamic environment [1]. Several overlay multicast routing approaches in MANET have already been proposed e.g. [6][7][8][9][10][11][12][13][14].AMROUTE [6] initially builds underlying mesh structure and then constructs multicast tree over mesh. The data packet is encapsulated in a form of unicast packet and relayed toward other group members. PAST-DM [7] addresses the resource efficiency of overlay multicast in MANET, and then proposed a modified Steiner-Tree algorithm to construct a resource efficient overlay data delivery tree. Location guided tree (LGT)[8] builds an overlay multicast packet distribution tree on top of the underlying unicast network routing protocol using a geometric distance between group members. Sub-optimal location-aided overlay network (SOLONet) [13] is a designto build sub-optimal overlay multicast trees, where the physical topology is divided into smaller cells having a local leader to perform various tasks. On-Demand Overlay Multicast Protocol (ODOMP) [9] is a reactive multicast protocol. It only creates an overlay topology using delayed forwarding when it is needed. Overlay multicast based on heterogeneous forwarding (OMHF) [10] build another type of overlay data delivery tree and apply a heterogeneous forwarding scheme depending on the density of group members.

However, overlay data paths in the overlay multicast protocols can remain static even though the underlying physical topology is changing. Overlay multicast may lead to sub-optimal overlay data paths, since the communicating group members are not aware of the underlying physical topology. Therefore, overlay multicast requires periodic control messages for the overlay data path management in dynamic environment.

2. The proposed algorithm

In this paper, we propose an efficient overlay multicast protocol (EOMP) using unicast routing information. This protocol has optimal overlay data path (ODP) and low control overhead using unicast routing information. First, the ODP creation in EOMP is based on next hop and hop counts of unicast routing table. The sender classifies group members with same next hop and selects group members that have the shortest hop counts among the classified group members. The sender chooses the selected nodes as receiver nodes, and forwards a copy of the packet to each of the selected group members. Therefore, multicast data packets between group members are delivered through the overall optimal paths in physical networks. Also, the ODP in EOMP can be managed without periodic control messages in the dynamic environment. When the unicast routing information of one group member is updated due to mobility of nodes, the group member utilities an expanding ring search mechanism to locate the closest member among the group members. And if the group member detects another group member which is more closed multicast source than previous group member, the ODP reconstructs by the updated unicast routing information. EOMP has low control overhead because that is not periodic control messages. EOMP solves previous overlay multicast problems which are inefficient the ODP and periodic control messages. Therefore, EOMP has enhanced packet delivery ratio, low end-to-end latency and low control overhead.

3. Conclusions

We presented an efficient overlay multicast protocol for MANET called EOMP. EOMP has optimal overlay data path and low control overhead using unicast routing information. First, the overlay data path creation in EOMP is based on next hop and hop counts of unicast routing table. The shortest path information is obtained from the unicast routing tables. Therefore, multicast data packets between group members are delivered on more the optimal paths than the previous overlay multicast protocols. Also, the overlay data path in EOMP is managed without periodic control messages in the dynamic environment. When the group member moves, it reconstructs the overlay data path by updated unicast routing table. Therefore, EOMP has low control overhead because there is no periodic control messages. Simulation results show that EOMP achieves the overall high performance to other protocols in terms of packet delivery ratio, average end-to-end latency, forwarding efficient and control overhead.

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