# Multicasting in MANET using Stateless Protocol with Parameter Tuning

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## *ABSTRACT*

Multicast routing protocols typically rely on the a priori creation of a multicast tree (or mesh), which requires the individual nodes to maintain state information. Stateless receiver-based multicast protocol that simply uses a list of the multicast members, network addresses, embedded in packet headers, it enable receivers to decide the best way to forward the multicast traffic. Stateless protocol exploits the knowledge of the geographic locations of the nodes to remove the need for costly state maintenance for overall communication network areas (e.g., tree/mesh/neighbor table maintenance), making it ideally suited for multicasting in dynamic networks. It can achieve high success rates, low latency, and low overhead in terms of the number of bits transmitted in the network for both static and dynamic scenarios, it makes multicasting well suited for both mobile and stationary ad-hoc network environments than other protocols. Hence for multicasting between two networks, stateless protocol can be used in wireless network. During wireless packet transmission between two networks there may be loss of packets or drop of packets. To avoid this problem during multicasting the packets, parameter tuning can be used between the two networks during packet transmission.

*Index Terms*—Mobile ad hoc networks, protocols, routing, modeling and analysis, multicast, stateless, receiver-based communication.

## 1. INTRODUCTION

In our daily life, several applications require data delivery to multiple destination nodes, where the use of multicast routing is an ideal approach to manage and reduce network traffic. These applications range from member-based TV/Video broadcasting to push media such as headlines,weather, and sports, from file distribution and caching to monitoring of information such as stock prices, sensors, and security. Oftentimes these services are required over highly dynamic networks, such as mobile ad hoc, vehicular, or wireless sensor networks (WSNs). These networks are dynamic due to the mobility of the nodes in the network and/or the random sleep/awake cycles that are often utilized to minimize energy dissipation of the devices. Providing robust multicast routing in such dynamic network environments is an important design challenge for supporting these applications. In some wireless multicast applications, the source and intermediate nodes are mobile, but the multicast recipients' locations are fixed and known.

For example, fixed, roadside stations may require traffic updates from cars in a vehicular ad hoc network. Similarly, applications including habitat monitoring, wildfire detection, and pollution monitoring utilize data from mobile sensors that must be sent to stationary sinks in the region. In all of these applications, the locations of the particular set of destinations for some data are fixed and known a priori by the nodes in the network. In other wireless multicast applications, all nodes, including the multicast destinations, are mobile. In this case, in order to support any type of multicast service to particular devices, the source nodes must know the locations of the multicast destination nodes. This can be provided by a service discovery protocol that sits outside the routing protocol, updating the source(s) with the current location of the sink nodes. In either case (fixed sink nodes or mobile sink nodes with a service discovery protocol providing updates on the sinks' locations), the routing protocol can assume knowledge of the sinks' locations.Wecan exploit this knowledge to design a stateless multicast routing protocol. In this paper, we extend our work on a Receiver-Based Multicast protocol, RBMulticast, which is a stateless crosslayer multicast protocol where packet routing, splitting packets into multiple routes, and the medium access of individual nodes rely solely on the location information of multicast destination nodes [1]. RBMulticast includes a list of the multicast members' locations in the packet header, which prevents the overhead of building and maintaining a multicast tree at intermediate sensor nodes, because all the necessary information for routing the packet is included within the packet header. Additionally, the medium access method employed does not require any state information such as neighbor wake-up time or any a priori operations such as time synchronization. No tree creation or maintenance or neighbor table maintenance is required, making RBMulticast require the least state of any multicast routing protocol, and it is thus ideally suited for dynamic networks. RBMulticast is a receiver-based protocol, which means that the relay node of a packet transmission is decided by the potential receivers of the packet in a distributed manner. This routing approach does not require routing tables and enables the use of the current spatiotemporal neighborhood; this can be compared to proactive and reactive routing protocols where the route is decided using the latest available information, which can be stale. This is a crucial property, especially for dynamic networks. In RBMulticast, receivers contend for the channel based on their potential contribution toward forwarding the packet, which is inspired by the cross-layer protocol XLM [2], a receiver based unicast protocol designed for wireless sensor networks. Nodes that make the most forward progress to the destination will contend earlier and hence have a higher chance to become the next-hop node. In RBMulticast, the multicast routing uses the concepts of "virtual node" and "multicast region" for forwarding packets closer to the destination multicast members and determining when packets should be split into separate routes to finally reach the multicast members. The total number of hops that packets travel to reach their destination is an important performance metric for routing protocols, as it provides an indication of bandwidth usage and of the energy efficiency of the protocol. In this paper, we derive a mathematical model for the lower and upper bounds on average hop count realized by RBMulticast given the network parameters: target area, node density, duty cycle of the nodes, number of multicast members, and the communication range.

## 2. RELATED WORK

Existing multicast protocols for WSNs and MANETs generally use a tree to connect the multicast members [3], [4], [5], [6], [7], [8]. For example, the Takahashi-Matsuyama heuristic can be used to incrementally build a Steiner tree for multicast routing [9], [10]. Additionally, multicast algorithms rely on routing tables maintained at intermediate nodes for building and maintaining the multicast tree [11], [12]. In location-based approaches to multicast routing [13], [14], [15], nodes obtain location information by default as an application requirement (e.g., a home fire detection sensor would know where it is located) or as provided by a system module (e.g., GPS or a location-finding service). If location information is known, multicast routing is possible based solely on location information without building any external tree structure.

## 3. Multicasting the packets

Multicasting in MANET is the process of

transmitting the packets under single source and multiple destinations. Based on the mobility, nodes locations are updated. Packets are transmitted from single source to multiple destinations.

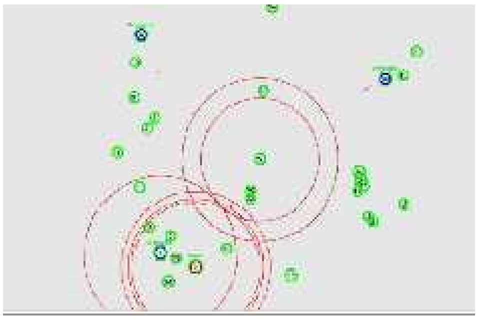

Figure 1. Multicasting the packets

In Figure.1 Node 0 is considered as the source node and nodes 8, 4 and 16 are considered as the destinations. The packets are transmitted from single source node 0 to multiple destinations such as node 8, node 4 and node 16.

## 4. Stateless RBMulticast protocol

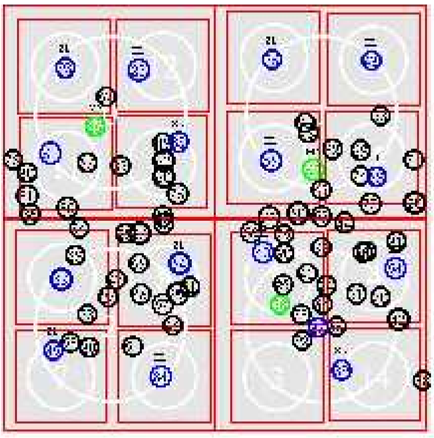

Figure.2 Stateless protocol

Figure.2 shows that nodes 63, 48, 58 and 86 are the group management nodes (M1, M2, M3,M4), each zone consist of zone leaders (ZL).

*Stateless Protocol*

RBMulticast is a receiver-based cross-layer protocol that performs multicast routing based on receiver-based geographic unicast protocols such as XLM. The receiver based unicast only needs the sender node's location and the final destination node's location, which are provided in the MAC packet, to decide the next hop along the route. Assume that the "void" (hole) problem in geographic routing is solved implicitly by using the right-handed rule.

Assume that the multicast members are stationary, such as multiple stationary sinks in WSNs or stationary road side access points in vehicular ad-hoc networks. The intermediate nodes can be either static or mobile. Although mobile intermediate nodes result in route breaks in conventional multicast protocols, since no multicast tree or mesh is used in RBMulticast, mobile intermediate nodes are supported at no additional cost in RBMulticast. Mobile destinations (multicast members) create a challenging problem for multicast protocols.

*Multicast Regions*

Once a node receives a multicast packet (from the application layer or from a previous hop node), it divides the network into multicast regions and it will split off a copy of the packet to each region that contains one or more multicast members.

There is no method that is clearly best. Influencing factors include the sink node locations and how the relay nodes are distributed. For the quadrants approach, the multicast region decision only needs two comparisons (X and Y axes) for each multicast member and is extremely fast. It is preferable for systems with low computational capacity such as wireless sensor nodes.

*Group Management*

RBMulticast supports multicast group management where nodes can join or leave any multicast group. Some nodes manage the multicast groups and act as the group heads. Nodes join and leave a group by sending "join" and "leave" packets to the group head. Join and leave packets are multicast packets with destination lists that contain only the group head address. RBMulticast supports Many-to-Many multicast mode and thus every node in a multicast group can multicast packets to all other nodes in the same group. The extra burden is that the node must maintain group node lists for groups it has joined.

In the case of nodes joining or leaving, the group head must send "update" packets including a list of its updated multicast group members to all group nodes. Nodes send "join" packets periodically to the group head and nodes that die without sending"leave" packets are removed from the list after a time-out period.

*Reference Point Group mobility (RPGM)*

This model is used to model group mobility. Each group has a logical "center" ;.]=called a reference point and group members (nodes). In each group, nodes are uniformly distributed within a certain radius R from the reference point. To achieve this, assume that each node moves according to the RW model with V [m/s] (maximum speed) within that range. Specifically, a node's movement vector is composed by adding the movement vector based on the RW model for the node to that based on the RWP model for the reference point.

## 5. Multicasting in Multiple Stateless Networks

Stateless protocol is suitable for multicasting the packets without any memory overhead than the tree based and mesh based protocols [16]. Our proposed work is based on multicasting in multiple stateless networks without any memory overhead. During the packet transmission between multiple networks, there may be chance for packet loss. This problem is avoided in multiple networks by tuning the parameters such as data rate, bandwidth and packet delivery ratio.

## 6. Conclusion

Multicasting in MANET using stateless protocol requires the least amount of state maintenance than any other existing multicast protocol. It can achieve high success rates, low latency and low overhead in terms of the number of bits transmitted in the network for both static and dynamic scenarios. It makes Multicasting well suited for both mobile and stationary ad-hoc network environments than other protocols. Hence for multicasting between two networks, stateless protocol is used in wireless networks. During wireless packet transmission between two networks there may be packet loss occur. To avoid this problem during multicasting the packets, parameter tuning can be used between the two networks during packet transmission.

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