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Receiver Based Multicasting Protocol for Wireless Sensor Networks

Madesha M
Assistant Professor, Department of CSE
Sahyadri College of Engineering and Management

Chaya T D
Lecturer, Department of CSE
H.M.S Institute of Technology

Abstract- **Multicasting is purely based on the creation and maintenance of structures called tree or mesh for routing of packets. Each individual node has to maintain state information about these structures. In wireless sensor networks, the maintenance of this information leads control overhead. So that, the new protocol called receiver based multicasting protocol is developed which does not require any state information for routing the packets. The routing depends only on the location information of the multicast members (destinations) and the list of multicast members is added in packet header. This removes maintenance of state information. The Receiver Based Multicasting (RBMulticast) Protocol is implemented in Network Simulator (NS2). The results and performance analysis shows the improvement in packet delivery and less energy consumption.**

1. INTRODUCTION

The Wireless Sensor Networks (WSN) is the recent application of ad hoc networks that is expected to increase the deployment, as they are reliable in monitoring and analysis of infrastructure less environments. These networks are called as data centric networks. In the traditional networks the data is requested from a specific node, but in the data centric network data is requested based on certain attributes. The routing protocols proposed for all the traditional networks are point to point and so these protocols are not well suited for wireless sensor networks.

The wireless communication in sensor networks is having the limited energy capacity of the individual sensor nodes. The total number of packets transmitted throughout the network reduced and it is essential for power conservation. For the sensor networks with multiple sink nodes, the multicast routing is an ideal approach to manage and it reduces the network traffic. The reducing of the number of packets transmitted when multicasting data requires both shorter routing paths from the multicast source to the multicast members and improved efficiency in terms of the total number of links the packets traverse to get to all the multicast members. The packet should be split off to different routing branches only if there is demand. Shorter routing paths lead to reduced packet delay and improved efficiency leads to a reduction in the energy consumption from transmitting fewer packets [1].

The Multicasting technique is an efficient technique for the packet forwarding. To reduce the number of packets transmitted in multicast, a good protocol should provide short routing paths from the source to the multicast members and efficiency in terms of the total number of links the packets traverse to get to all the multicast members. The packet should be split off to different routing branches if there is demand. Shorter routing paths lead to reduced packet delay and improved efficiency leads to a reduction in the energy consumption from transmitting fewer packets.

The Receiver-based routing is a relatively new method of routing whereby receivers contend to be the next-hop node. This enables stateless routing and is ideal for sensor networks, since the transmitter does not need to know which receivers are currently available. The existing multicast protocols for WSNs and ad hoc networks generally use a tree to connect the multicast members. The multicast algorithms rely on routing tables maintained at intermediate nodes for building and maintaining the multicast tree. The sensor node's location is known as reasonable assumption [2]. The receiver based multicasting is the one in which many receivers contend to forward packets in the particular region. The nodes in RBMulticast creates multicast regions. There are several ways to create these regions, but for simplicity it can be assumed that each multicast region corresponds to one quadrant of the network, for a grid centered at the nodeThe simulation results shows the better performance in the packet delivery and less energy consumption without maintaining any state information.

2. RELATED WORK

Existing multicast protocols for wireless sensor networks such as Greedy Perimeter Stateless Routing

(GPSR) [3], Position Based Multicast(PBM) [4], Scalable Position Based Multicast(SPBM) [5], Om-Demand Multicast Routing Protocol (ODMRP) [6], An Efficient Geographic Multicasting Protocol(EGMP)[7], and Forwarding Group Multicast Protocol (FGMP) [8] uses a tree to connect the multicast members. Additionally, multicast algorithms depending on routing tables maintained at intermediate nodes for building and maintaining the multicast tree. In the location based method for routing the packets, nodes will get the location information by default (GPS module). If the location information is known, the routing of packets can be done depending only on location information. Scalable Position-Based Multicast (SPBM), an ad-hoc multicast routing protocol comprising a multicast forwarding strategy and a group management scheme to determines the location of the members of a multicast group are. The forwarding strategy uses information about the geographic positions of group members to make forwarding decision. In contrast to existing approaches it neither requires the maintenance of a distribution structure (tree or a mesh) nor resorts to flooding. The group management scheme uses knowledge about geographic positions for a hierarchical aggregation of membership information. The EGMP uses a hierarchical structure to implement scalable and efficient group membership management. The network-range zone-based bi-directional tree is constructed to achieve a more efficient multicast delivery to destinations. The position information is used to guide the hierarchical structure building, the multicast tree construction and multicast packet forwarding, efficiently reduces the overhead for route searching and tree structure maintenance. The EGMP does not depend on any specific geographic unicast routing protocol of wireless networks. Several methods are assumed to further make the protocol efficient for the networks.

Receiver Based multicasting protocol is differed from the above approaches and it uses only location information and there is no creation and maintenance of any structure for the routing of packets. RBMulticast includes a list of the multicast members 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.

3. RECEIVER BASED MULTICAST PROTOCOL DESCRIPTION

The receiver based multicasting is the one in which many receivers contend to forward packets in the particular region. The nodes in RBMulticast create multicast regions. There are several ways to create these regions, but for simplicity it can be assumed that each multicast region corresponds to one quadrant of the network, for a grid centered at the node [1].

The user initiates a request to send a packet to a multicast group and the data is passed down to the RBMulticast module in the protocol stack. Once the RBMulticast module gets this packet, it retrieves the destination list from, assigns the nodes to the multicast regions based on their locations and using these locations, calculates a virtual node location for each multicast region. The RBMulticast replicates the packet for each multicast region that contains one or more multicast members and appends a header consisting of a list of destination nodes (multicast members) in that region. The destination of a replicated packet is the virtual node of the corresponding multicast region, which can be determined in several ways, for example as the geometric mean of the locations of all the multicast members in that multicast region. In the end, all packets for all multicast regions are inserted in the queue and are then broadcasted to the neighborhood. The node closest to the virtual node will take responsibility for forwarding the packet.

3.1 System Architecture

The system architecture is the representation of all the modules connected one another. The architecture mainly focuses on following modules, which are interrelated to each other. The modules are given below.

- The deployment of networking environment
- The multicast region splitting
- Multicast send
- RB Multicast receive

The system architecture of the proposed system is shown in the Figure 1 and the networking environment containing number nodes is configured by the user. The multicasting regions are created by the four quadrant approach mentioned. The different multicast region has the different number of nodes. When the node received the packet, it sends the packet to RBMulticast module. It replicates the packet depending on the number of regions and forwards the packet to the region.

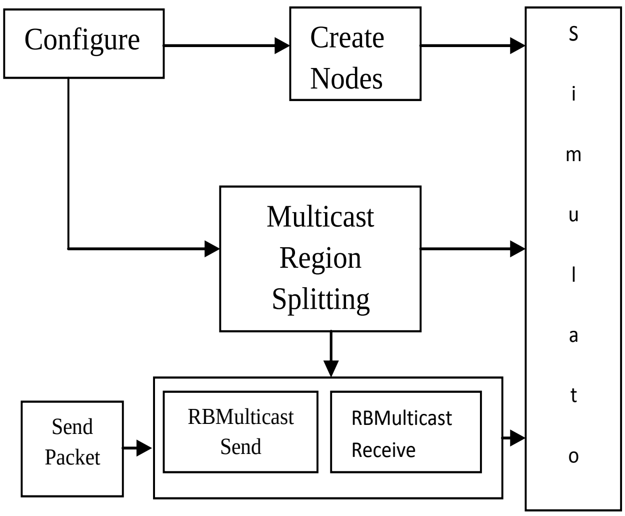

Figure 1: System Architecture

3.2 The Deployment of Network Environment

The wireless sensor networking environment is deployed by the pre-deployment approach. In the pre-deployment approach the nodes are configured by the setting x, y and z axis positions in the NS2 (Network Simulator 2) grid. The simulation of the nodes considered only x and y position and the positions of z is set to 0. The position of the x and y varies from 0 to 900 as a minimum and maximum value. All the nodes are static with their positions. The Figure 4.2 shows the nodes deployed and present in different regions.

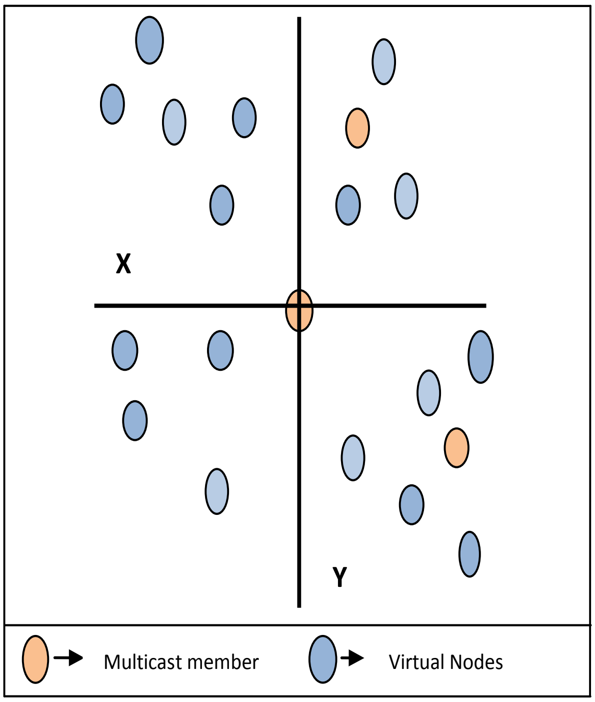

Figure 2: Network Deployment

3.3 Multicast region

Once a node receives a multicast packet 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.The two possible divisions of the network into multicast regions is shown in the below figures. Dividing space into three 120 degree pieces is a straightforward approach because it resembles a Steiner tree in that every node has three branches. To separate space into 120 degree regions, the angle to each destination node has to be calculated. Calculating this angle relies on trigonometric calculations and hence requires floating point operations. Most CPUs (Control Processing Units) in current sensor nodes do not support floating point operation due to the demand for low power and low cost and hence floating point operations must be simulated by integer operations and are expensive. This will becomes an excessive burden on sensor nodes and is therefore unacceptable. The Figure 3 shows the 120 degree angle approach.

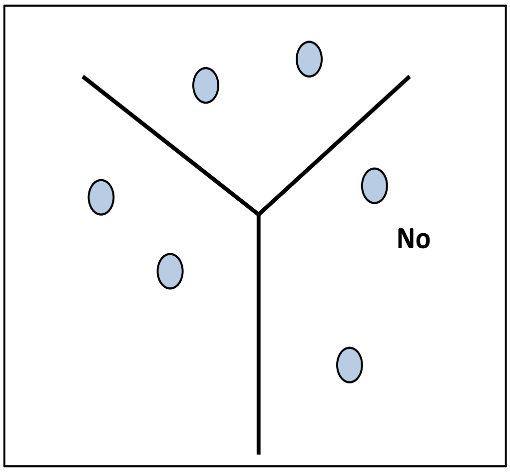

Figure 3: The three quadrants approach

The multicast region calculation only needs two comparisons (X and Y axes) for each multicast member and is extremely fast.

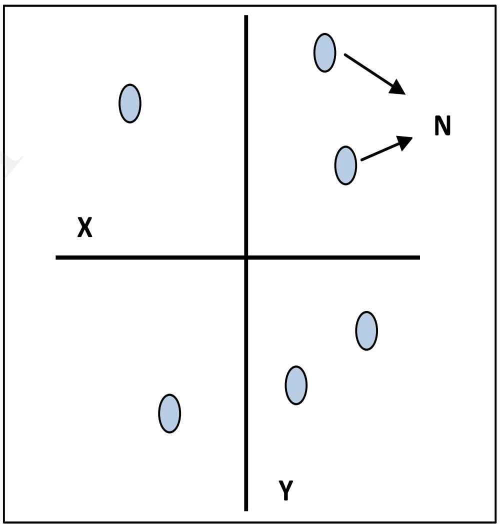

Figure 4: The three quadrants approach

The Figure 4 shows the 4 quadrants approach in our implementation of the RBMulticast protocol. The space for creating nodes is divided into 4 regions. These four regions can be created with respect to one node.

3.4 RBMulticast Sending

The RBMulticast send is for sending the packet to multiple destinations present in different regions. The Figure 5 shows the flowchart for the RBMulticast sending packets. The number of nodes is n and the multicast regions are R. In this the nodes are present in the different regions. The nodes present in regions may be multicast members (destinations) or virtual nodes. The source node and the multicast members can be selected randomly. In the flowchart the packet forwarding is depends on multicast member, if the multicast member is present in the particular region then will only it forwards the packet.

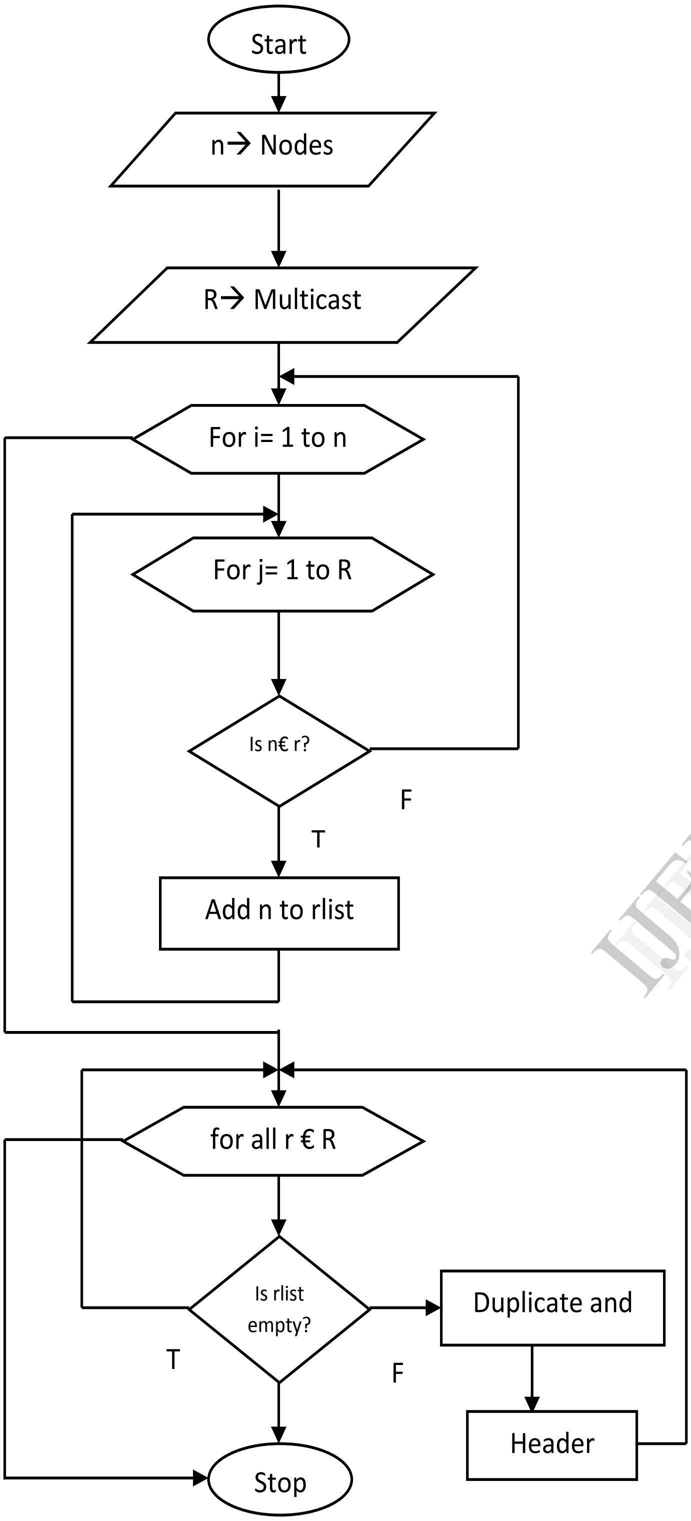

Figure 5: The RBMulticast Sender

For the multicast regions the copy of the packets is forwarded if the multicast member is present. If the destination is directly reachable, it sends the packet and if the destination is not reachable directly, it forwards the packet through virtual nodes (intermediate nodes). The selection of the intermediate nodes depends on the nearest node of the location information (pixel values). The rlist is having the destinations to which the packet has to send.

3.5 RBMulticast Receive

The Figure 6 shows the flowchart for the RBMulticast receiving module. In this the packet header is containing the destination list D, TTL (Time To Leave) and the checksum. The packet is dropped if the TTL value is 0 and corrupted. If the multicast member is present in the destination list, multicast member receives the packet.

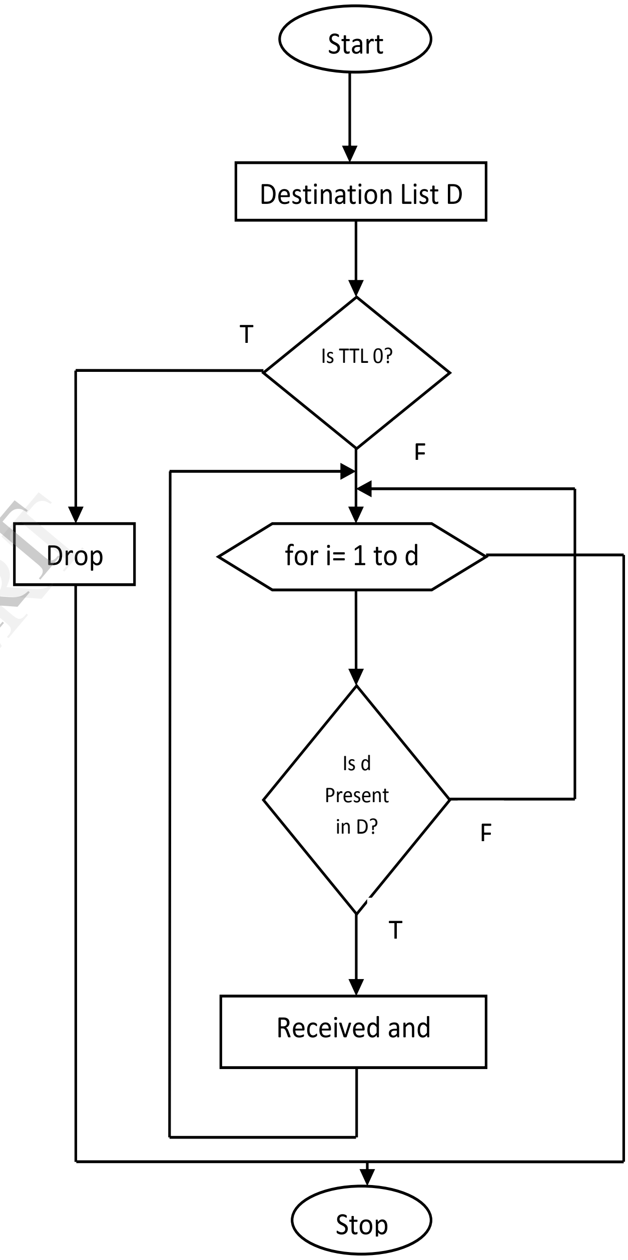

Figure 6: The RBMulticast Receiver

4. EXPERIMENTAL RESULTS

This paper is implemented in Network Simulator 2 (NS2). The experimental result shows the performance of this protocol compared to existing protocols. The Receiver Based Multicasting Protocol provides high packet delivery ratio and less energy consumption.

4.1 Performance Analysis

The simulations is investigated to evaluate the performance of RBMulticast using static nodes with the source located at (0, 0) and destinations located at different regions.

Delivery Ratio

The average packet delivery ratios observed for varying numbers of nodes are shown in Figure 7. As seen in the figure, the packet delivery ratio is very low for a small number of nodes. The delivery ratio increases as the number of nodes increased as shown in the below figure. The delivery ratio is calculated for the different set of nodes. The x axis and y axis represents the number of nodes and delivery ratio.

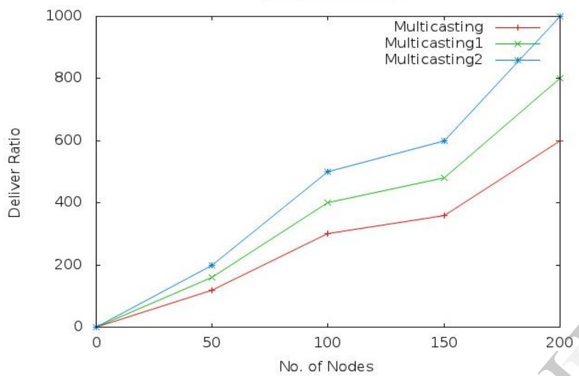

Figure 7: Delivery ratio v/s Number of nodes

Energy Consumption

The Figure 8 shows energy consumption of the nodes with the time. The energy of the nodes is consumed as the time increases. The number of packets forwarded from the node is increased as time. The x and y axis are energy consumed in joules and time in seconds.

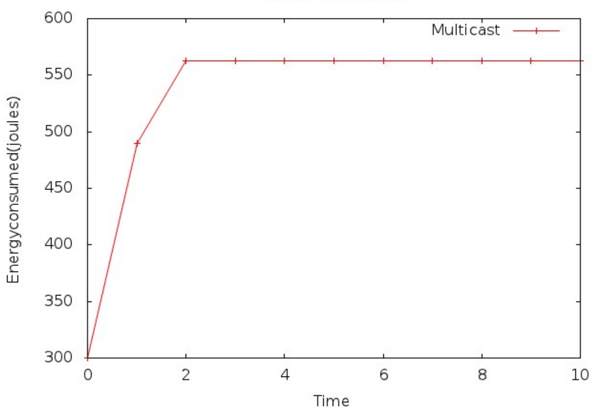

Figure 8: Energy consumption v/s Time

5. CONCLUSION AND FUTURE SCOPE

In this, the new stateless multicast protocol for wireless sensor networks called Receiver Based Multicast (RBMulticast) has been developed. The RBMulticast uses the geographic location information to route multicast packets to destinations, where the nodes divide the network into geographic multicast regions and split off packets depending on the locations (pixel values) of the multicast members. The RBMulticast stores a destination list inside the packet header. This destination list provides information on all multicast members to which this packet is to be send. Thus, there is no need for a multicast tree and therefore no tree state is stored at the intermediate nodes. Thus RBMulticast requires the least amount of state of any existing multicast protocol. After being developed, simulations of RBMulticast show that it can achieve low latency, high delivery ratio and low energy consumption in terms of the amount of generated traffic for static scenarios, making RBMulticast well suited for the sensor networks environments.

5.1 Future Scope

Simulation results show that the performance of RBMulticast is closely related to the location of the sinks. The RBMulticast performs better when sinks in the same region than when they are sparsely distributed. Therefore, RBMulticast can be extended to improve performance when sinks are sparsely distributed.

REFERENCES

[1] Chen hasinag feng, Wendi B Heinzelman, “RBMulticast: Receiver Based Multicast for Wireless Sensor Networks”, *IEEE transactions on mobile computing*, 2011, Volume 11.

[2] Carlos de morais cordeiro and Dharma P. Agarwal, “Survey on Ad-hoc Networks”, pp 1-40.

[3] B. Karp and H. T. Kung, “Greedy perimeter stateless routing for wireless networks”, In *Proceedings of the ACM/IEEE, International Conference on Mobile Computing and Networking (MOBICOM)*, August 2000, pp 138-143.

[4] M. Mauve, H. Fubler, J. Widmer and T. Lang, “Position-based multicast routing for mobile ad-hoc networks”, *Poster section in ACM MOBIHOC*, June 2003.

[5] Mattais Transier, Holger Fubler, Jorg Widmer, Martin Mauve and Wolggang Effelberh, “ Scalable Position-Based Multicast for Mobile Ad-hoc Networks”, *Poster section in ACM MOBIHOC*, June 2004.

[6] Sung Ju Lee, Mario Gerla and Chun Chang Chiang, “On-demand multicast routing protocol

(ODMRP) for ad hoc networks", *Internet drafts*, *draft-ietf-manet-odmrp-02.txt*, 2000.

[7] X. Xiang, X. Wang, and Y. Yang, "An Efficient Geographic Multicast Protocol for Mobile Ad Hoc Networks", *ieee transaction on mobile computing*, April 2011. Vol. 10, No. 4.

[8] C. C. Chiang, M. Gerla and L. Zang, "Forwarding group multicast protocol (FGMP) for multihop, mobile wireless networks", *AJ. Cluster Comp, Special Issue on Mobile Computing*, 1998, pp 187-196.