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A Multipath Rings Routing Protocol with Groups for Wireless Sensor Networks

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Abstract— Wireless sensor networks are evolving rapidly as their use is increasing and such networks are proving themselves in some really serious research and application fields. Since these networks have limitations of net work life time, communication protocols, limited memory, and environments in which actually these are to be implemented, still routing of data packets remains an important issue. Lack of sufficient amount of memory imposes more difficulties to routing protocols. In this paper we are introducing a routing protocol for these networks which not only tries to optimize the reliability of data transmission but also optimizes the amount of energy consumed by network, without any use of extra memory, or changing the standard packet size.

Keywords— Multipath rings routing protocol, groups , wsn , groups;

I. INTRODUCTION

Wireless Sensor Networks is physically distributed, densely deployed and autonomously organized network .A wireless sensor network (WSN) which consists of light-weight, low-power, computation-limited small size sensor nodes monitor physical or environmental conditions, such as temperature, sound, and pressure, and light intensity etc. WSNs are used in many domains like military situation awareness, battlefield and underwater surveillance, radars, fire detectors, warning systems, aviation, machine health monitoring and so on. The transmission range of each sensor node is limited so it can not send their data directly to base station. WSN uses multi-hop communication to send their data to base station. Several routing protocols are proposed and implemented for routing purpose in wireless sensor network. Each sensor node contains a battery. Since this battery is not rechargeable(generally) or in other words the amount of power that can be stored is limited, so the network lifetime is one of the most important criteria for these networks as it is not possible to replace or recharge the battery regularly. This point makes the life of wireless sensor network very difficult.

Routing protocol in these networks should take care of mainly

1. Reliable (all the transmitted packets should be delivered to their respective destinations)
2. The amount of packets breakdown during the transmission should be low due to any reason like interference or the low sensitivity.
3. Energy consumption should be minimal.
4. The size of packets (data or control) should remain minimum as much as possible due to memory and buffer limitations.
5. Scalability and network lifetime.

One of the main proposed and widely used wireless sensor networks protocol is Multipath Rings Routing protocol. The other commonly applied approach for the routing in WSNs is Bypass routing. In Bypass routing any particular node bypasses any received packet by itself if the packet was not destinated for it. Although the energy consumed in this method is very low, but the reliability of correct transmission is very low. In Multipath Rings Routing Protocol each sensor node initializes one or more than one flows which can be classified according to their requirements of reliability, throughput, delay and transmission rate. QoS metrics include bandwidth, latency or delay, jitter and throughput. These metrics or their variants will be used for WSNs depending on the application requirement. For a delay-sensitive application, WSNs may also require timely delivery of data. The types of traffic vary from simple query and reply events which are periodic to unpredictable sudden bursts of event messages that are generated by the sensor nodes .The messages are to be delivered within the deadlines otherwise they lose their significance. The multipath routing provides multiple path among the nodes for reliable transmission. The multipath routing algorithm described by Romer [1] solves a certain number of problems related to the temporal order event delivery in WSN. Romer's algorithm is almost 20 times more energy efficient than algorithms implemented in classical distributed systems. The failure of nodes or the presence of nodes that are not able to accomplish the routing mechanism due to low energy is covered by this algorithm.

II. WORKING OF MULTIPATH RINGS ROUTING PROTOCOL

Node does not have a defined parent in Multipath Rings Routing [2]. A node just gets a level ring number during topology formation. Ring number indicates the hop distance of source node from Sink node. The first topology setup packet sent from the Sink (base station) has *ring number 0.* Any node that receives this topology setup packet, it will increment ring number of received packet by *1* and rebroadcast it. This process continues until all packets get ring number. Eventually all connected nodes will have a ring number.

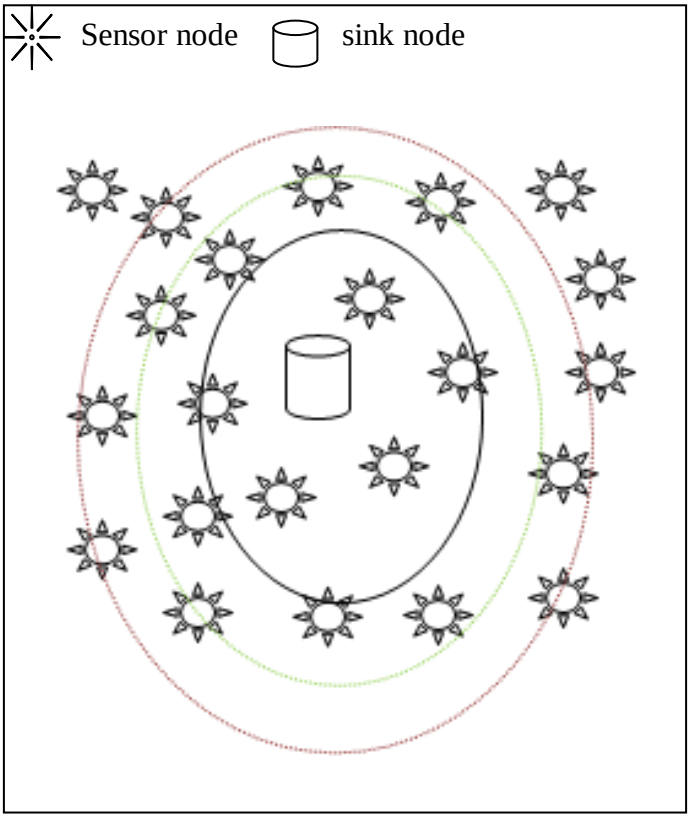

Figure 1. Multipath Rings Routing

As shown in figure 1 that almost all equidistant sensor nodes from the sink node make a virtual ring, and share a ring number, which may change if the node gets mobile. This protocol configures itself according to topology of sensor nodes. All equidistant (in terms of number of hops) nodes from sink form a virtual ring. Multipath rings routing protocol is a kind of proactive routing protocol because in multipath ring routing protocol network initialization is done prior to the data dissemination and route discovery is also not required before data transmission [3][4]. It is assumed that all nodes are distributed randomly in space to collect the data from the environment and base station (Sink Node) stores data from all sensor nodes. All sensor nodes contain batteries for power supply and it cannot be replaced or recharged (generally). There are two steps in Multipath Ring Routing protocol

1. Topology setup phase
2. Data Dissemination phase.

In Topology setup phase network organizes according to each node‟s hop distance from Sink node i.e. at the end of this phase each node will come to know that how many hop, Sink is away from it. After completion of topology setup phase data transmission from source node to sink node can take place.

III. SIMULATION AND ENVIORNMENT SETUP

Castalia [6][7] is a simulator for Wireless Sensor Networks (WSN), Body Area Networks (BAN) and generally networks of low-power embedded devices. Castalia is framework designed especially for wireless sensor networks. It is an Omnet++[8] based simulator and uses inherited features of Omnet++ along with specially implemented features for wsn, body area networks and other low power consuming wireless and embedded networks. Castalia also provides great facility to run more than one configuration concurrently so it makes comparison of different simulations easier. In addition to this Castalia uses CastaliaPlot facility which is inherited by highly efficient GNU Plot to plot the results. Castalia provides a generic reliable and realistic framework for the first order validation of an algorithm before moving to implementation on a specific sensor platform.

IV. MULTIPATH RINGS ROUTING WITH NEIGHBORING NODE GROUPS

This routing protocol is the mixture of Multipath Rings Routing protocol and Simple Bypass Routing. This protocol uses the better energy efficiency and network lifetime of Bypass Routing Protocol and higher reliability of packet transmission of Multipath Rings Routing Protocol. The idea behind this protocol is to divide the nodes into further level by keeping them in specific group. We use following two steps for the implementation of his protocol.

1. There is no need to use a routing protocol if two nodes are near to each other and direct transmission is possible between them. This can be done by keeping such nodes in same group.
2. If the two nodes are far from each other and do not share same group then we need to use Multipath Rings Routing Protocol.

We use a variable GroupSize to define the number of nodes present in a group. This protocol turns into simple Bypass Routing Protocol if

GroupSize→1 (GroupSize!=0)

And this protocol turns into Multipath Rings routing protocol if

GroupSize→TotalNumberOfNodes (GroupSize!=0)

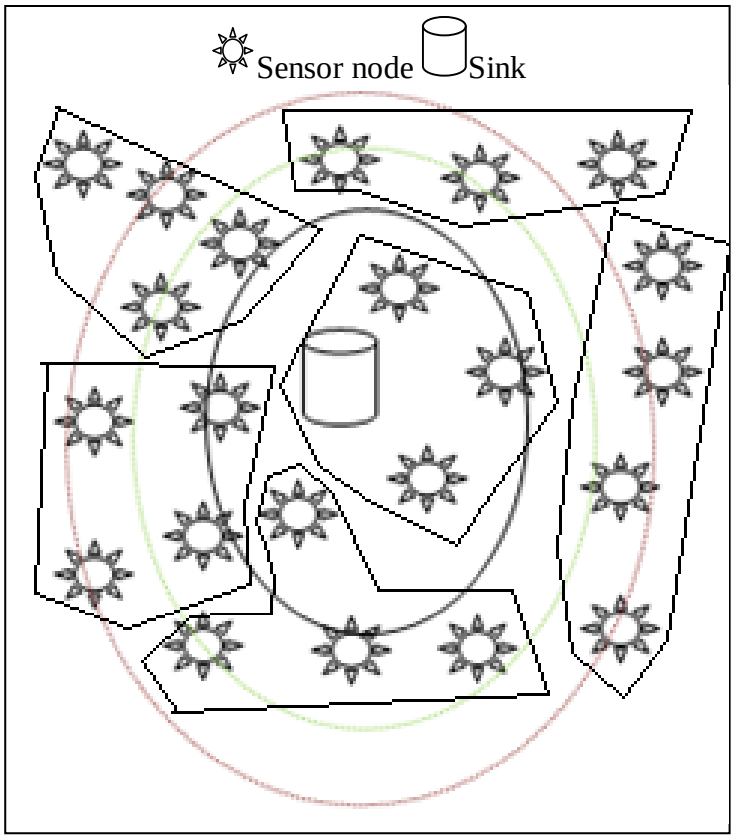

Fig 2. Nodes divided into groups for routing

The grouping in this Routing Protocol provides a balancing gear for energy consumption, network lifetime and reliability. Figure 2 gives rough idea about the groups in this protocol. The nodes enclosed under the polygon represent a group. The nodes present in same group uses Bypass Routing Protocol if the packet has destination address of same group member node. For the experiment purpose the nodes from Index Number to IndexNumber + GroupSize are kept in the same group.

In case when the packet is transmitted to some different group then we use Multipath Rings Routing Protocol. Figure 3 shows the algorithm flow chart for multipath rings routing with groups.

This flow chart shows that the group number of receiver node is matched with the sender node's group number if it is equal than the packet is again checked whether the receiving node is sink node, if it is than the packet is processed else the packet is bypassed. This is a simple process and uses both Multipath Rings Routing and Bypass Routing protocol intelligently. One important need of this Multipath Rings Routing Protocol with Groups is that all the belonging to same group must be arranged in close proximity else the effectiveness of this protocol may decrease, but this can be maintained easily by keeping the indexNumbers of nodes in regular manner. Execution of data dissemination phase in Multipath Rings Routing with Groups protocol is shown in flow chart in figure3.

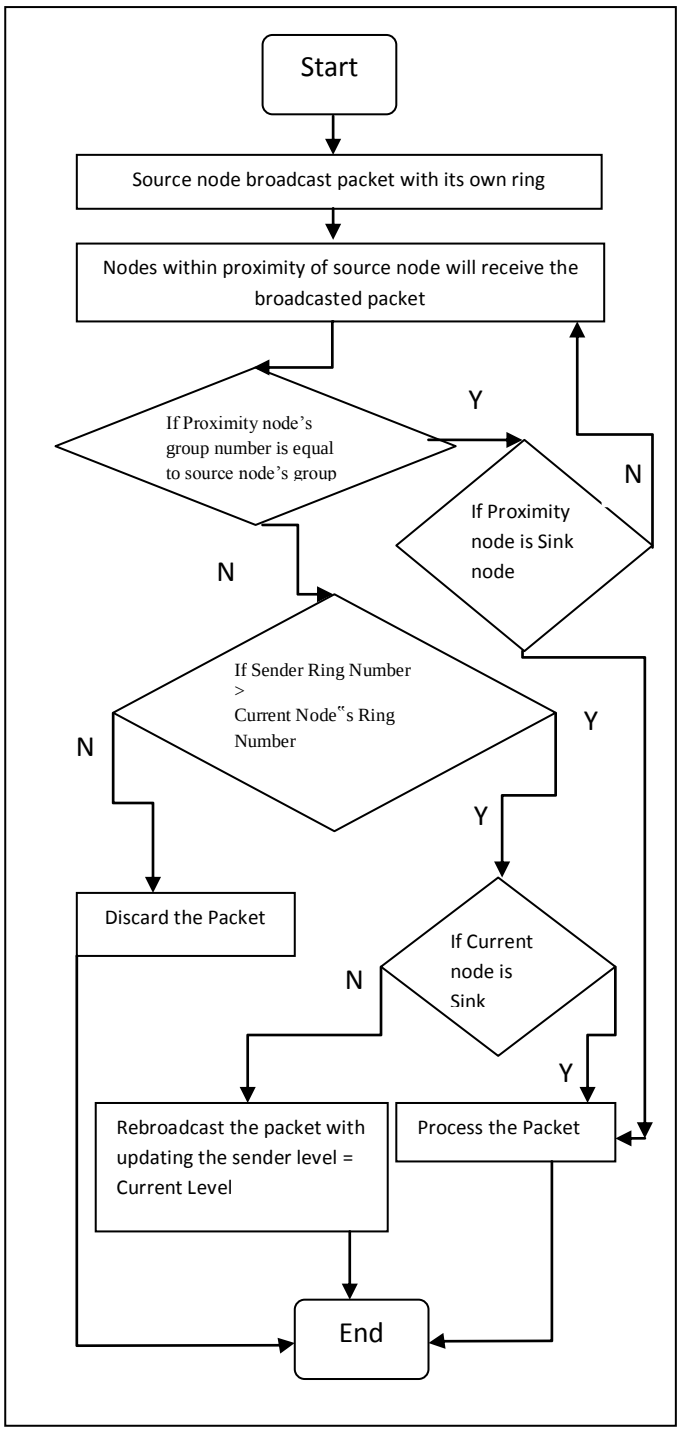

Fig 3. Execution of data dissemination phase in Multipath Rings Routing with Groups protocol

V. **RESULTS AND ANALYSIS**

There are three important parameters to compare the performance of these routing protocols.

1. The success and failure of report reception
2. The success and failure of reprogram reception (version Packets).
3. The energy consumption

We examine all these factors for all three Routing procols one by one and compare the performance. For this simulation all three routing protocols use TMAC protocol which is a standard mac layer protocol for wireless sensor networks. The configuration for the sensor nodes arrangement have 31 (30 general sensor nodes and 1 Sink node) mounted on 100×30 m^2 Bridge (a Bridge Test Simulation in Castalia) . The sink node is located in the middle of the field, and all sensing nodes will try to deliver their reports to the sink. Every 5 minute (on average) a car appears in the simulation field (CarsPhysicalProcess is used, which creates objects moving in lines). A passing car is guaranteed to trigger all sensing nodes along its path, thus creating a traffic flow towards the sink node in the network.

Multipath Rings Routing with Groups have GroupSize 4 for this particular experiment this value can still optimized. Optimized GroupSize can be used for any type and size of arrangement and all three above discussed parameters are necessary to be considered to find optimized GroupSize. All three routing protocols are executed and run simultaneously as Castalia provides the facility to do so.

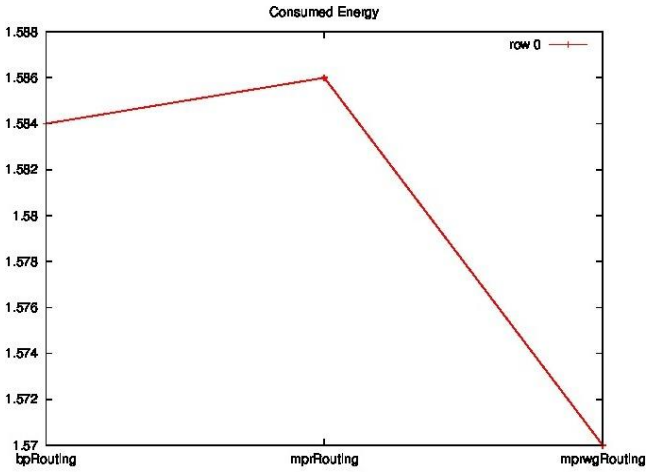

Fig 3. Energy Consumption

Figure 3 shows that the energy consumption by the mprwgRouting is lesser than other two routing protocols. Energy consumption is one of the major issues in wireless sensor networks.

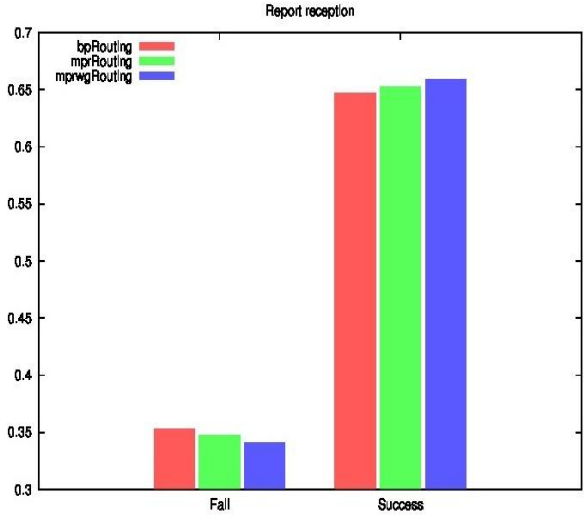

Fig 4 Report Reception

Figure 4 shows report reception of all three routing protocols here as the fail percentage of packets for mprwgRouting(Multipath Rings Routing with Groups) goes down the percentage of successful packets goes up.

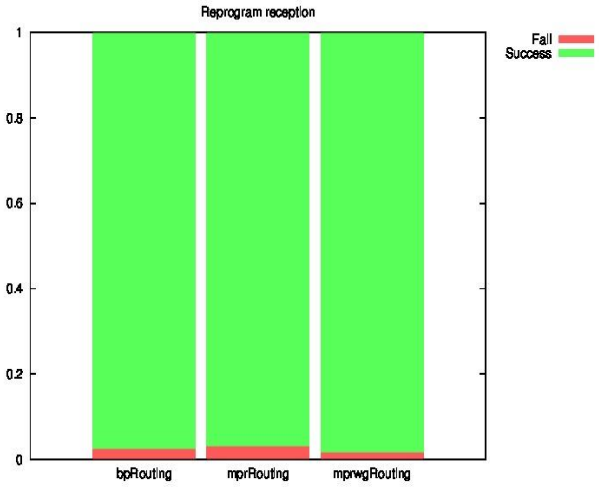

Figure 5 Reprogram reception

Figure 5 shows the similar result in case version packets also. These are duplicate packets. There is a clear improvement the performance of mprwgRouting in comparison to bpRouting and mprRouting.

The only drawback of Multipath Rings Routing Protocol with groups is when some of the nodes are mobile; in this case the performance may decrease.

VI. CONCLUSION

Although the routing protocols does not play a prominent role in wsn because of several factors and not much emphasis is given on routing protocols in literature in the area of wireless sensor networks. Size of memory and hardware limitations make the implementation of large and complex routing algorithms very difficult. The Multipath Rings Routing Protocol have been modified and improved in several ways but introduction to groups in this protocol improves the energy efficiency and network lifetime. As this protocol does not use any extra resource and does not use any change in message or packet size. So it is very easy to implement on existing system.

Referneces

[1] K.Romer – "Robust and energy efficient temporal order event delivery in wireless sensor networks", http://www.inf.ethz.ch/vs/publ/ Submitted for publication, March 2002

[2] Anand Pandya, Mrudang Mehta, "Performance Evaluation of Multipath Ring Routing Protocol for Wireless Sensor Network," UACEE International Journal of Advances in Computer Networks and its Security, vol. 2, no. 2, pp. 53-58, August 2012.

[3] Guimin Huang , Wujin Tao, Pingshan Liu, Siyun Liu "Multipath ring Routing in Wireless Sensor Networks"

[4] Chunting Liu, Hong Huo, Tao Fang, Deren, Li, Xiao Shen, "Classification Fusion in Wireless Sensor Networks," ACTA AUTOMATIC ASINICA, vol. 32, no. 6, pp. 947-955, November 2006.

[5] Stefan Dulman, Tim Nieberg, Paul Havinga, Pieter Hartel, "Multipath Routing for Data Dissemination in Energy Efficient Sensor Networks".

[6] Yuri Tselishchev, Athanassios Boulis, Lavy Libman, "Experiences and Lessons from Implementing a Wireless Sensor Network MAC Protocol in the Castalia Simulator," submitted to IEEE Wireless Communications & Networking Conference 2010 (WCNC 2010), Sydney, Australia.

[7] Castalia website and user manual, http://castalia.npc.nicta.com.au/ .

[8] Omnet++ website,http://www.omnetpp.org

[9] Ying-Hong Wang, Chih-Hsiao Tsai*and Hung-Jen Mao, HMRP: Hierarchy-Based Multipath Routing Protocol for Wireless Sensor Networks.

[11] I.F. Akyildiz, W. Su, Y. Sankarasubramaniam, E. Cayirci, "Wireless Sensor Network :A Survey", Broadband and Wireless Networking Laboratory, School of Electrical and Computer Engineering, Georgia Institute of Technology, Atlanta, GA 30332, USA

[12] R. V. Kulkarni, A. Förster, and G. Venayagamoorthy, "Computational Intelligence in Wireless Sensor Networks: A Survey", IEEE Communication Surveys & Tutorials, vol. 13, No. 1, pp. 68-96, 2011.

