International Journal of Engineering & Technology, 7 (3.29) (2018) 173-176

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper

Multicast routing for mesh-based using DSR in wireless sensor network

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Abstract

Multicast routing is helpful to establish group communication for sharing, transmitting the data or message from one stream to another stream within a network. The Multicasting Routing protocol is a vast challenging research area. Different routing algorithms erect based upon various domain or various applications. Some common on-demand multicasting routing algorithms are DSR, DSDV and Wireless Routing Protocol (WRP). The usage of multicasting in DSR has many advantages. It can reduce the cost of transmission and improves efficiency when transmitting information between wireless networks. The major complexity for designing a routing protocol in network is the dynamic change in the topology, due to random movement of nodes. When large number of nodes is deployed over a network, we use multicast approach to find the optimal path to the multiple destinations. In this paper, using MATLAB tool, find the parameters like time and energy consumed for mesh network using DSR mesh-based routing protocol and find optimal path using energy efficient multicast approach.

Keywords: *Multicasting; DSR; Mesh-Based Networking; Energy Efficiency; Ad-Hoc Networking.*

1. Introduction

A sensor network consists of multiple stations called sensor nodes which are portable and sensitive. Each sensor node consists of power source, controller which performs specific operation and to store the sensor output, transceiver receives the commands and transmits information to computer, and transducer to generate electrical signals based on sensed effects. There are many characteristics and challenges when developing and improving various parameters in multicast routing protocols [1, 2, 3] like bandwidth, security, network topology, node deployment, energy constraint and different characteristics in wired which uses physical cables to share data between devices and wireless sensor networks which uses infrared and radio frequency signals to share the information [4-5], and network scalability, due to these parameters multicast routing protocols are necessary. Multicasting is a method used for data sharing by routing data from one stream to another stream between huge quantity of destinations. As the restoration of nodes in dynamic networks like on-demand multicast approach and routing protocols like tree-based multicast structure, mesh-based multicast structure etc., can be applicable depending on various applications which are highly not fixed in ad-hoc routing protocols.

In this paper, to find the Energy consumed by the Multi-cast approach using mesh-based network, [5] sections are carried out. Section-2: describes about network formation and node deployment, Section-3: explains the working of DSR and algorithm to determine the optimal path to multiple destinations, Section-4: explains the implementation of DSR and the parameters like energy and time consumed are calculated and in section 5: the results are discussed to determine the optimal path using energy efficient multicast approach.

2. Network formation and node deployment

Mesh-based multicast protocol is a linked device on an network containing all the receivers connected in a group [6]. Mesh-based networking is comparatively a novel technology in ad-hoc networking research challenges like limited scalability, difficulty in choosing an appropriate routing protocol, security issues and lack of suitability to real-time applications. In this paper, mesh-based networking study has been carried out using MATLAB simulation tools. At each and every access point, mesh-based networks are self-configuring components that are connected in wired method so that the communications can relay messages to other nodes [7]. In this approach, we find a mesh-based network with static deployment of the sensor nodes in the network using for simulation [8].

The mesh-based network is formed and the sensor nodes can be deployed in the network. The deployed nodes are formed in a static manner. The deployed node can be placed in a defined space in mesh-based network. The number of nodes deployed can be varied starting minimum (40) to maximum (60). It is assumed that minimum number of nodes is 40, medium number of nodes is 50 and maximum number of nodes is 60. The figure 1 shows the mesh-based network with minimum number of nodes (i.e., 40) deployed.

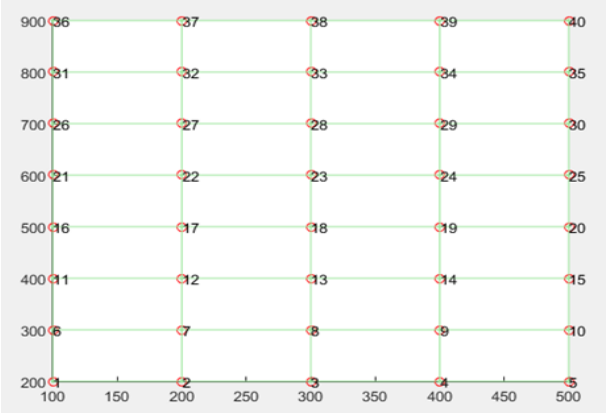

Fig. 1: Mesh-Based Network with Nodes Deployed.

3. DSR routing protocol

DSR is one of the source-based on-demand routing protocol [9], where in DSR the routing path of the source routes keeps the information in the packet and the path can be predetermined by the source node based on the concept of source routing and keeps the information itself independently without the intervention of human administrators. In this approach, DSR protocol is used to find the optimal path by multicasting. We use DSR protocol in this paper since DSR guaranties loop-free operation as intermediate nodes efficiently and do not keep routing information as shown in below figure 2:

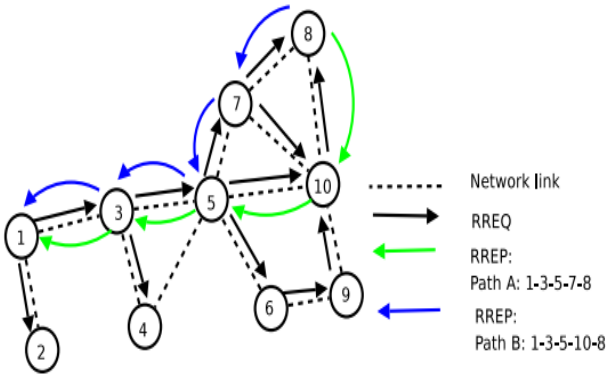

Fig. 2: Route Discovery for DSR.

DSR uses two different mechanisms: Route-Request Mechanism (R-REQ) and Route-Reply Mechanism (R-REP). Firstly, by using flooding, the DSR creates a Route-Request (R-REQ) route from node-1 to node-8 [10 - 11] in the network. After creating the route, it traverses back the full path a Route-Reply (R-REP) to source node-1 in the routing packet. As the R-REQ is forwarded towards the destination i.e., to node-10, a node will only forward an R-REQ. If the node is not the target, it won't forward the packet previously and it does not find its own address in the route record. Once final destination is reached, the packet is delivered to the network layer of that host [12]. The advantage of using this protocol is to avoid miss-communication, it makes use of a immediate approach which does not need flooding the network to update the message information periodically. The main disadvantage of this protocol is – in case of any broken links in a network, the route maintenance mechanism is not helpful to repair a broken links.

3.1. Algorithm for DSR

DSR Protocol is more suitable for mesh-based network. The route request & reply mechanism is to find the path to the destination is shown in the following steps:
STEP 1: Source S have to transmit packet to destination D.
STEP 2: Source creates route request (RREQ) packet.
STEP 3: The packet will have source IP address, source current sequence number, destination IP address, destination sequence number, broadcast ID.
STEP 4: At every point in time broadcast ID is added to a source, which generates RREQ.
STEP 5: Source transmit RREQ packet via flooding.
STEP 6: when RREQ reaches the intermediate nodes, the node establishes reverse route to the source and the entry is maintained in its route table.
STEP 7: The RREQ reaches destination, the destination sends RREP via unicasting.
STEP 8: In the similar way the path to multiple destination is found by sending RREQ via unicasting and getting back the RREP packet. The time and the energy consumed for each iteration is calculated.

4. DSR implementation

The experimental results of DSR setup is discussed in this section to assess parameters like energy consumption using mesh-based network. It is simulated by taking multiple destination nodes adjacent to each other in mesh-based network. The DSR will find the best possible path from the source to destination in unicast manner in a network. For multiple destinations, DSR sends route request packet separately for each node and the optimal route is calculated independently as of the source node. Then, energy and time consumed is calculated for each iteration. The below figure 4.1 and 4.2 shows the DSR implementation to find the path from starting node (i.e., 1) till multiple destinations (i.e., 36, 37, 38). The path is represented by red line and energy consumption.

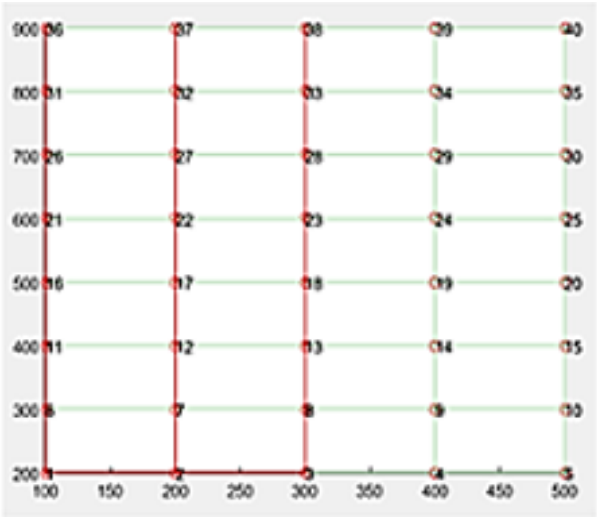

Fig. 4.1: DSR Implementation.

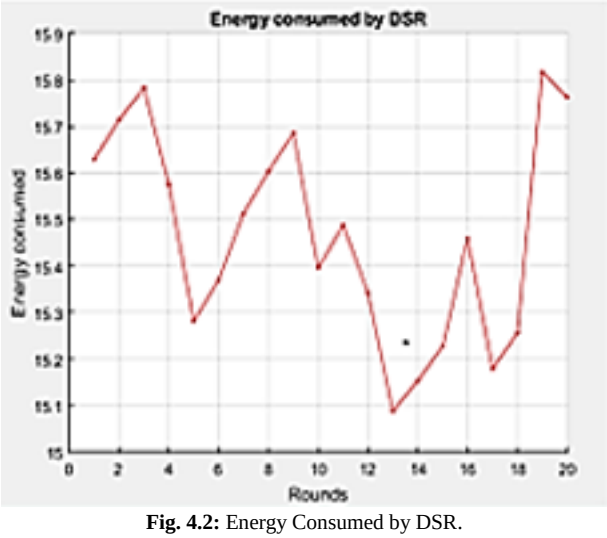

Fig. 4.2: Energy Consumed by DSR.

5. Optimal path using energy efficient multicast approach

Multicast approach [13] will determine the optimal path in more energy efficient manner [14]. This approach is simulated by taking multiple destination nodes adjacent to each other in mesh-based network. The Energy Efficient Multicast Approach [8] [15-17] finds the best possible path from starting node till destination node by using multicast techniques. Energy Efficient Multicast Approach will find the route to multiple destinations using two methods. First, it uses unicast to find the nearest node with minimum hop-count to multiple destinations adjacent to each other. Second, from that nearest node it implements multicasting to reach the multiple destination nodes in single broadcast. Then, the energy and time consumed is calculated for each iteration. The optimal path to multiple destination is determined in the following steps:

STEP 1: Source S have to transmit packet to destination D.
STEP 2: Source creates route request (RREQ) packet.
STEP 3: The packet will have source IP address, source current sequence number, destination IP address, destination sequence number, broadcast ID.
STEP 4: At every point in time broadcast ID is added to a source, which generates RREQ.
STEP 5: Source transmit RREQ packet via flooding.
STEP 6: when RREQ reaches the intermediate nodes, the node establishes reverse route to the source and the entry is maintained in its route table.
STEP 7: The RREQ reaches the nearest single node for the intended multiple destination using unicast. This nearest single node should have minimum hop-count the multiple destinations.

The Energy Efficient Multicast Approach implementation is to find the optimal path from the sensor starting node (i.e., 1) to the multiple destinations (i.e., 36, 37, 38). The unicast path to the nearest node is represented by red lines and the multicast to the destination nodes are represented by blue line. Initially, the route request packet is send to each node and the route to destination as shown in figure 5.1 and 5.2 along with the energy consumed for each destination by considering 20 iterations in Energy Efficient Multicast Approach to find the optimal path to the multiple destination.

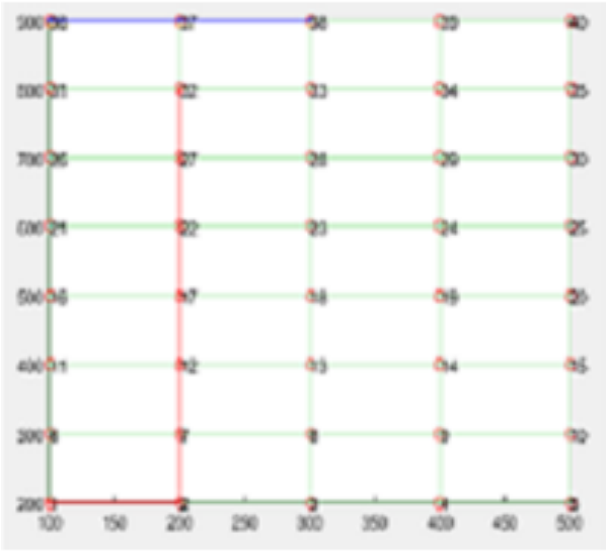

Fig. 5.1: Energy Efficient Multicast Approach Implementation.

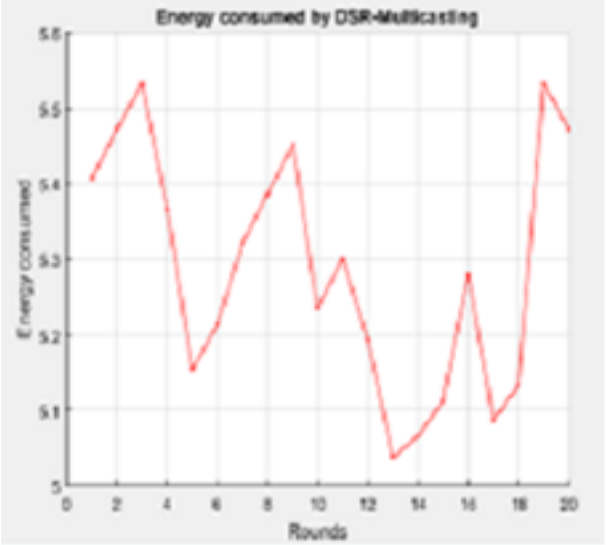

Fig. 5.2: Energy Consumed by Multicast Approach.

Energy consumption for different nodes is calculated. In the Table 1, Energy consumed for different nodes values are recorded from the simulation and results are displayed. Energy consumption graph shows as the number of nodes increases energy consumption will be more.

Table 1: Energy Consumption for Deterministic Node Deployment

No of nodes	20	40	60	80	100
Energy consumed	2.1676	3.6676	4.6676	6.1676	9.6676

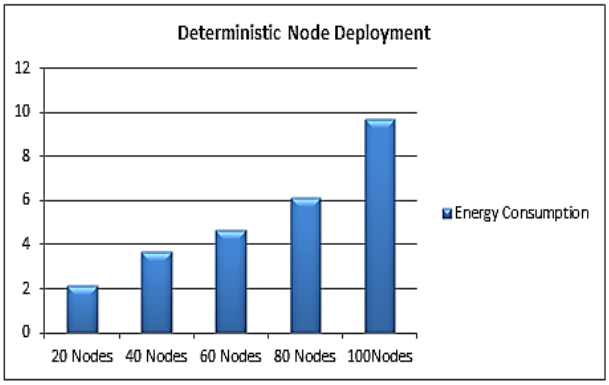

Fig. 5.3: Energy Consumption for Deterministic Node Deployment.

6. Conclusion

DSR provides an excellent performance for routing using mesh based network which adopts quickly to routing changes and less frequency. In large scale wireless sensor network, finding energy efficient and reliable path raised to be an issue. In this paper, energy efficient multicast approach in WSN is analyzed. This approach finds energy efficient and reliable paths in the network with deterministic nodes placement. Further, in research work this approach can be applied to large networks to analyze energy consumption of overall network. End to end delay and packet delivery ratio can also be implemented for efficiency of network.

Acknowledgement

Authors would like to thank Hon'ble Chairman, Chancellor, Vice-Chancellor, Registrar, Dean and to all the faculty members of Jain University, Bangalore for encouragement, motivation, innovative

ideas for successful progressive research work. And also sincere thanks to the central library for their continuous support in all respects. This is a part of our research work and corresponding author is manjucr123@gmail.com.

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