Energy Efficient Node-Disjoint Multipath Route Discovery Mechanism for Wireless Sensor Networks

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Abstract. To increase the operational lifetime of the wireless sensor network is the major objective of energy efficient routing protocols. Mutlipath routing protocols enhance the lifetime of the wireless sensor network by distributing the traffic among multiple paths instead of single optimal path. This Work proposes a low control overhead route discovery mechanism for Energy Efficient Node-disjoint Multipath Routing Protocol. The number of control messages used in the route construction is minimized. The energy spent on the route discovery mechanism is also minimized.

Keywords: Wireless Sensor Networks, Multipath Routing, Low Control Overhead, Route Discovery.

1 Introduction

Routing the sensed data from the source to sink node in a resource constrained environment in Wireless Sensor Network (WSN) is still a challenge. There were many attempts are made to route the data in the resource constrained scenarios. Optimal path between the source and destination is selected by the routing protocols to satisfy the resource constraints such as energy, bandwidth and computation power. The routing protocols take into account the metrics like minimum hop, minimum transmission cost, high residual energy etc. to route the data. Many routing protocols attempt to reduce the energy usage in the nodes to increase the network life time. This provides an optimal path between source and destination. Selecting an optimal path between the source and destination and sending the data through that path may not increase the life time of the network. The energy usage in such an approach is not as efficient as that in multipath approach.The multipath routing protocols select the available possible paths between the source and destination. The data is distributed among the multiple paths and the usage of the energy for the data transmission is spread among the number of nodes on multiple paths. The transmission delay is reduced as portion of the data is being sent in different paths. The multipath routing protocols provide the effective load sharing among the multiple paths to satisfy the resource constraints and to meet the requiredquality of service in the wireless sensor

networks. The multipath routing increases the probability of reliable data delivery. In multipath routing, the energy cost overhead for data retransmission due to link failure or node failure and alternate path constructions are minimized. In this work it is proposed to minimize the number of control messages needed for the route discovery so that the energy spent on route discovery is also reduced. The rest of this paper is organized as follows. In section 2, the existing work is discussed. In section 3, the energy efficient node disjoint multipath route discovery mechanism is proposed. In section 4 results and discussions are provided and conclusions are drawn in section 5.

2 Related Works

Ad Hoc On-Demand Multipath Distance Vector Routing (AOMDV) is a reactive and source initiated routing protocol [1]. Route discovery is initiated by broadcasting the route request (RREQ) packets to its neighboring nodes. Source node waits for the route reply (RREP) packet from destination node or intermediate node which has the valid route to the destination. The intermediate node receiving the RREQ packets sets up a reverse path to the source using the previous hop of the RREQ as next hop on the reverse path. As AOMDV is reactive protocol and most of the wireless sensor networks are static in nature, route discovery process has to initiate by sensor nodes, when it wants to send the data to the sink node. The message overhead in the route discovery is high for the wireless sensor networks. Ke Guan et al [2] proposed Energy-Efficient Multi-Path Routing Protocol for Wireless Sensor Networks. It is a reactive routing protocol. In the network, every node may act as a source and a sink node. The assumption of the common base station is eliminated. The route discovery mechanism provides the multiple paths between source and destination using shared nodes in the query tree and search tree. The number of control messages used in the multiple route construction is high, because, to construct query tree and search tree, query messages and search messages are to be broadcast in the network. These messages are sent from the sink and source nodes respectively.Choon-Sung Nam et al [3] proposed an efficient path setup and recovery in wireless sensor networks. The mechanism is a sink initiated, query based routing protocol. It is a variant of directed diffusion routing protocol. This mechanism finds the optimal path between source and destination based on minimum number of hops. However, the route set up is efficient, setting up of the multiple paths are not shown. Marjan Radi et al [4] proposed Low-Interference Energy-Efficient Multipath Routing (LIEMRO) for wireless sensor networks. It is a source initiated event-based, reactive routing protocol. LIEMRO finds the multipath between the source and destination. However, these multipaths exclude the node disjoint property. LIEMRO proposes the load balancing algorithm. Load balancing is done based on the, average interference level, average residual battery and estimated transmit energy (ETX) value of each path.Power aware node-disjoint multipath source routing [5] (PNDMSR) is a reactive, source initiated routing protocol. The route discovery in PNDMSR is similar to route discovery in dynamic source routing (DSR)[6]. In PNDMSR, only the destination node is allowed to send the route reply to source node, while in DSR, the route replyis sent by the intermediate and destination node. The node cost field is added in the RREQ packet and carries the cumulative cost. The proposed routing protocol is a sink initiated