ISSN:0975-9646

Time Efficient Neighbor Discovery Protocol for Wireless Sensor Networks with Multipacket Reception

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Abstract-Wireless Sensor Networks of spatially distributed autonomous sensors to monitor physical or environmental conditions and to cooperatively pass the data through a network to a main location. Due to slow advance in battery technology power remains a bottleneck to limit wide applications of wireless sensor networks. Among all extensive studies on minimizing power consumption, Neighbor Discovery is one of the fundamental components focusing on communication and access. Most existing neighbor discovery assume a single packet reception model where only a single packet can be received successfully at a receiver but Multipacket Reception (MPR) networks that allow multiple packets to be received successfully at a receiver. A simple ALOHA-Like algorithm used to discover all neighbor with high probability in a network. Rival method FRIEND is used in neighbor discovery, in which a prehandshaking strategy is used to know neighbor discover activities. Performance is evaluated using simulation tool NS2.

1. INTRODUCTION:

In wireless sensor network power consuming is main challenge issue. Total working time of a sensor gives the life time period of the wireless sensor network. Now a days power consuming is the major problem. Minimizing of power consumption in wireless sensor networks is the main achievement. Due to slow advance in battery technology power remains a bottleneck to limit wide applications of wireless sensor networks. Among all extensive studies on minimizing power consumption, Neighbor Discovery is one of the fundamental components focusing on communication and access. Neighbor discovery is one of the first steps in configuring and managing a wireless network. By reducing the time taken for discovering neighbor node in the wireless sensor network will reduce the power consumption of the battery. By achieving the time taken for neighbor discovery in a short period of time, reduces the energy conversation and QoS can also be achieved.

Most existing approaches on neighbor discovery assume a single-packet reception model where only a single packet can be received successfully at a receiver. In proposed model by introducing the Multiple packet Reception (MPR) technique i.e., multiple packet can be received successfully at a receiver. Neighbor discovery can be achieved in short time compared to single-packet reception model.

2. EXISTING APPROACH:

In existing approach a novel randomized protocol FRIEND is used. In which a prehandshaking Neighbor Discovery (ND) protocol is used. Neighbor discovery is designed to know about a node's neighbor's state and these momentous and crucial for configuring wireless networks.

Nodes can be of three states

- Silent
- Listen
- Transmit

By reducing the idle slots of the node, the ND time will reduce tremendously. In exisint approach the key idea is twofold.

- Prehandshaking
- Reception status feedback

1. Prehandshaking:

Before the normal transmission of a node it helps the node to know about the neighbor node activities. So, to avoid collisions and idle slots can be of higher probabilities.

To conduct prehandshaking, we add some sub slots before each normal slot. By transmitting an anonymous election signal each node will decide to whether to transmit discovery message on normal slot or not and catches its neighbor's signal simultaneously.

2. Reception Status Feedback:

Reception status feedback can be easily achieved. By using full-duplex nodes reception feedback status can be achieved successfully.

3. ALGORITHMS:

The following two algorithm shows how Prehandshaking and Neighbor Discovering.

3.1 Algorithm 1:

Algorithm 1 FRIEND-GR (Prehandshaking)
1: If $Af = 1$ **then** $>A$ has successfully sent *Md*.
2: *A* will keep silent in TR and exit.
3: **end if**
4: Node *A* decides to send *Ms* by probability $1/An$ and keep listening by probability $1 - 1/An$.
5: **if** *A* sends *Ms* **then** *A* hopes to send *Md* in TR.
6: **if** *A* does not receive *Ms* during GR **then**
7: *A* will transmit *Md* in TR;
8: **else** *A* receives *Ms* from other nodes
9: *A* will transmit *Md* in TR by probability 1/2.
10: **end if**
11: **else** *A* does not send *Ms*
12: **if** *A* does not receive *Ms* during GR **then**
13: *A* will transmit *Md* in TR by probability $1/An$;
14: **else** *A* receives *Ms* from other nodes
15: *A* will keep silent in TR.
16: **end if**
17: **end if**

3.2 Algorithm 2:

Algorithm 2 FRIEND-TR (Neighbor Discovering)
1: **if** *A* plans to send *Md* **then**
2: *A* sends *Md* and monitors the channel meanwhile.
3: **if** *A* does not receive *Md* during TR **then**
4: *Af* = 1. *A* will keep silent from now on
5: **else** *A* receives *Md* from other nodes
6: Current iteration is invalid.
7: **end if**
8: **else** *A* does not plan to send *Md*
9: *A* keeps listening.
10: **if** *A* does not receive *Md* during TR **then**
11: Current iteration is invalid.
12: **else if** *A* receives a single *Md* **then**
13: Record the ID in *Md*.
14: *An* = *An* − 1. *A* records one of its neighbors.
15: **else** There is a collision at *A*
16: Current iteration is invalid.
17: **end if**
18: **end if**

Notations:

- A= Node A.
- GR= Greeting Process
- TR= Transmission Process
- M_s= Message of election signal
- M_d= Message discovered
- A_f= Flag Variable
- A_n=Undiscovered Neighbors

By implementing the prehandshaking and neighbor discovery algorithms the time taken for discovering the neighbor can be reduced tremendously. In this approach no Multipacket Reception (MPR) technique is used.

4 PROPOSED APPROACH:

In proposed approach the property of nodes is changed i.e., Nodes have given new additional property of Multipacket Reception (MPR). Multipacket Reception means each node can receive more than one packet at a time and reply is given in first come first serve process.

By giving this property to node the feedback mechanism can be given in short period of time and discovering of neighbor node can be done easily and thus reduces power consumption of the node and network can be shown. $2^{(i-1)}$

$$\sum_{i=1}^{log2\ln n} O\left(\frac{n\log\log(\frac{n}{2(i-1)})}{k2(i-1)}\right) + O(\frac{\frac{n}{\ln n}\log\left(\frac{n}{lnn}\right)\log log\ (\frac{n}{lnn})}{k})$$

Notations:

- K= Total number of Multipacket Receivers.
- N= Total number of nodes.

By using the above mathematical formula, the results show that the total time need for discovering is speedup with a factor of log n.

5 CONCLUSION:

In this paper we analyzed prehandshaking ND protocols FRIEND with the nodes having Multipacket Reception property. And our results shows that the time taken to neighbor discovery is more lesser than the existing system. It also overcomes ALOHA-Like protocol also. Both theoretical analysis and simulations proved that by giving the MPR property to node it significantly decreases the time needed to finish the ND process.

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