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Influence Intrusion of Bouncing Process Node Discovery Algorithm for Heterogeneous Wireless Sensor Networks

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I. INTRODUCTION

Currently, a vast majority of research work done in the area of WSN assumes that the networks are homogeneous, i.e. all sensor nodes are the same. A small group of researchers see the heterogeneity of the networks only in uneven distribution of the residual energy. However, we argue that as the number of WSNs grows, more and more of the networks will be heterogeneous on hardware level. Especially, as the old networks will be extended or upgraded. The nodes already deployed might not be available any more so new; more powerful nodes are added to the network. This causes the network to become heterogeneous.

Heterogeneity brings new challenges to in-network data stream processing. When choosing a node which will process all data streams we need to take into consideration not only where the node is located but also whether it is capable of processing data from a given number of data streams. In the scenario described above, when new sensors are added, more data streams must be processed. The old generation of nodes might not be capable of such computation. During the process when a new processing node is chosen, only the new, more powerful, nodes should be considered.

Keywords: Node Discovery Algorithm, Sensing range, Wireless Sensor Networks.

II. CONTRIBUTION

We describe and evaluate our Processing Node Discovery Algorithm for heterogeneous networks. We present one algorithms for heterogeneous networks. We compare their performance in terms of energy spent on discovering the processing node and the optimality of the discovered processing node. We compare our solution with the state-of-the-art frameworks for WSNs.

III. HETEROGENEOUS NETWORK ALGORITHM

Processing Node Discovery for Heterogeneous Networks

1) *Preamble:* on receiving a message of type Query do execute Receive Query
2) *Query:* a structure representing a query received from a user communicating with the node via cell phone

a) procedure Receive Query (query)
b) retrieve all possible processing nodes for query
c) repeat
d) retrieve the cost from the closest processing node
e) if the cost < minimal cost then
f) store the processing node
g) else
h) bounces ← bounces – 1
i) end if
j) until bounces = 0 or all processing nodes have been requested
k) node Id ← the node with the lowest cost node
l) packet. Query ← query
m) Send Forwarded Msg (packet, nodeId) Send the query to the node with the lowest cost. The node will become the processing node.
n) end procedure

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The main case of heterogeneous networks the possible processing nodes are arbitrary number of hops away. Therefore, instead of using broadcast, a reliable multi-hop forwarding algorithm,

In all of the proposed algorithms for heterogeneous networks we investigate a scenario where a forwarding node is allowed to inspect the packet and, if a condition is met, act on behalf of the destination node by bouncing the message back to the sender. By allowing a message to be bounced back before it reaches the destination node it is possible to further reduce the search space and speed up the discovery process. However, if the message is bounced back under false assumptions, it may lead to discovering sub-optimal processing node. While evaluating our algorithms we investigate the influence of the bouncing conditions on the optimality of the discovered processing node.

IV. EVALUATION OF ALGORITHMS FOR HETEROGENEOUS NETWORKS

In the evaluation of algorithms for heterogeneous networks we focus on two metrics: i) cost stretch, i.e. percentage increase in the cost of the discovered processing node vs. the optimal processing node, ii) the number of messages required to discover the processing node. To the best of our knowledge, there is no other framework supporting in-network processing for heterogeneous networks, therefore we compare our query and traverse algorithms with the simplest solution - processing at-the-base. We assume that the base-station is the most powerful node, capable of processing any number of data streams.

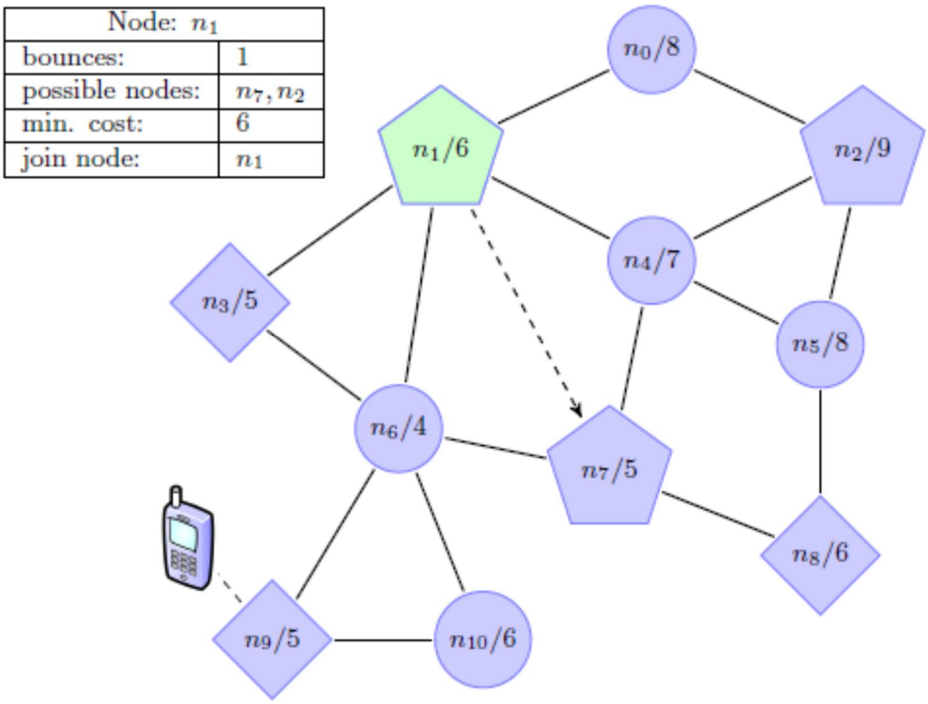

Figure 4.1: Influence intrusion of bouncing on the Processing Node Discovery algorithms for heterogeneous Networks.

In our experiments we also study the influence of bouncing the messages which can significantly narrow down the search space. We illustrate how a message could be bounced on Figure. Here, the coordinating node n1 is sending an assignment message to node n7.Cost of processing data streams at node n1 is c1 = 6 while at node n7 it is c7 = 5.

In our evaluation we study the influence of the bounces variable on the search quality. We vary the initial value of the variable and we set it to bounces = {100%; 50%; 25%} of the number of the possible processing nodes. In practice it means that at least 100%; 50%; or 25% of the possible processing nodes are queried for their cost.

To evaluate the algorithms for heterogeneous networks we use the same query as for the homogeneous network to retrieve the list of source nodes and their selectivity's. After retrieving the list the initializing node issues the following query:

SELECT id FROM dsat WHERE y > 80.

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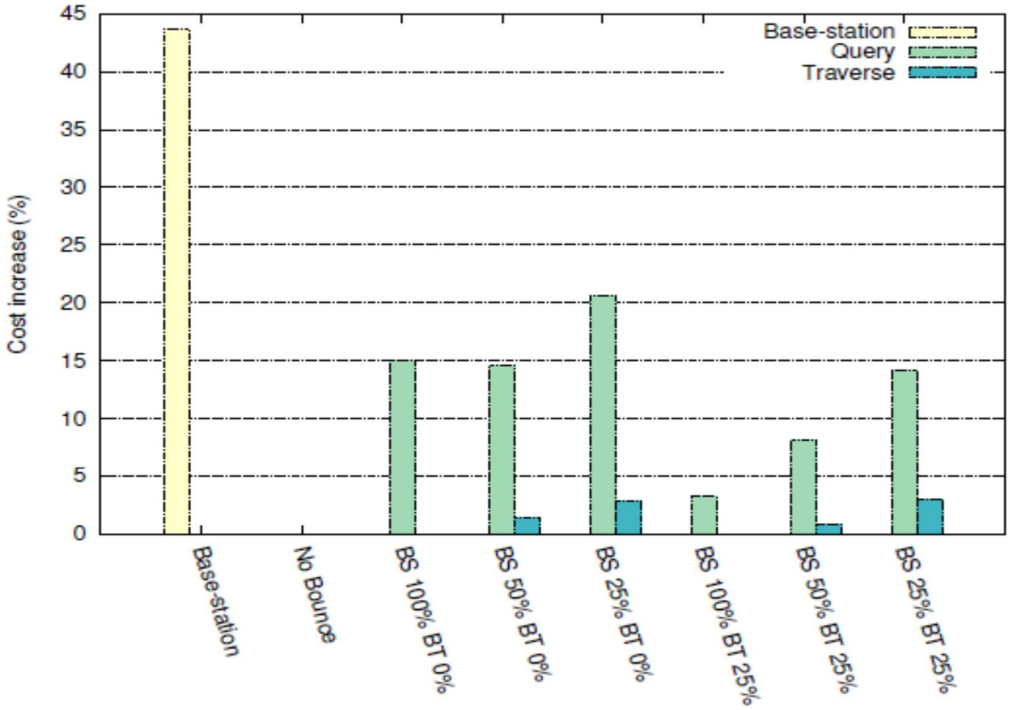
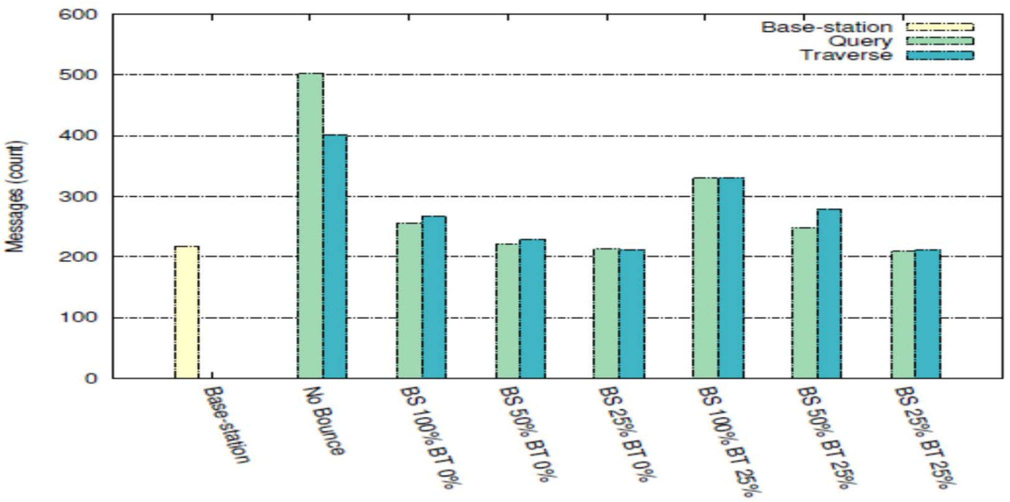


(a) Cost Stretch



(b) Message

Figure 4.2 : Comparison of Query and Traverse algorithms with processing at the base-station the comparison is for Query which leads to selection of a smaller number of possible processing nodes. “BS" stands for “Bounce Size" and “BT" stands for “Bounce Threshold".

V. CONCLUSION

In-network data processing has been shown to be a very challenging problem in WSNs. Choosing the right strategy can significantly decrease the number of messages transmitted within the network, hence increase its lifetime. However, current approaches assume traditional WSN where nodes are accessible only via a base-station which serves as a gateway between a user and the network. Unfortunately, this node also represents a single point of failure. Additionally, these approaches heavily rely on the base-station to perform part of the computation or to have a global knowledge about the network.

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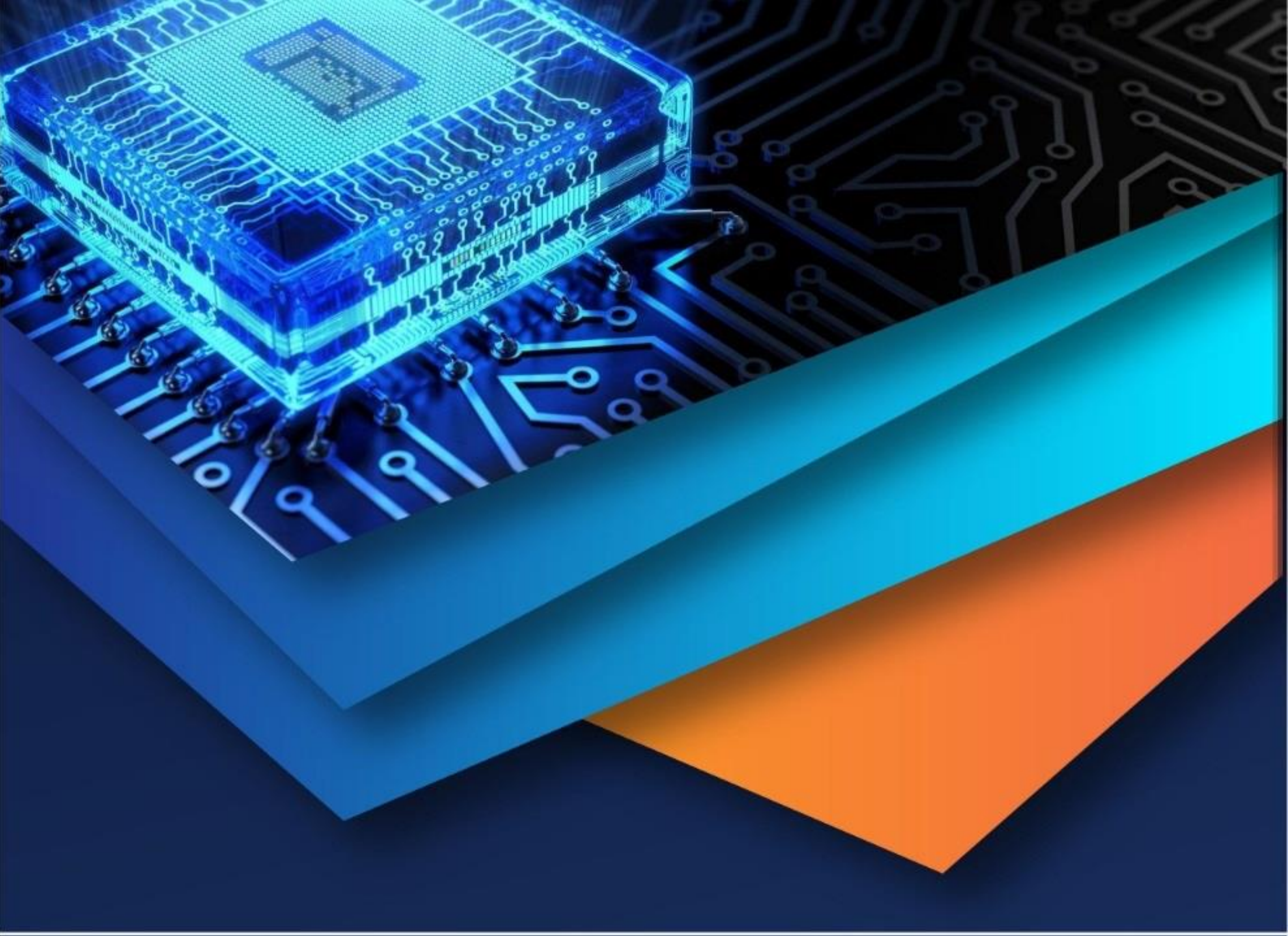

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