

A Framework for Evaluating the Best Achievable Performance by Distributed Lifetime-Efficient Routing Schemes in Wireless Sensor Networks

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Abstract: An energy-efficient routing is implemented in this paper for wireless sensor networks. Most of the existing routing schemes assign energy-related costs to network links. The main objective in this paper is to reduce the energy consumed by the network links and to obtain the shortest paths for the nodes to balance the flowing traffic within the network and increase its lifetime. Most of the existing schemes are not known the optimal link cost values and the maximum achievable lifetime. So framework is provided in this work to analytically derive the best achievable performance that can be obtained by Lifetime efficient routing algorithm based on the shortest-path approach. Given a network configuration and an energy consumption model, the framework provides the optimal link cost assignment which yields the maximum lifetime in a distributed shortest-path routing strategy.

Keywords: Node deployment, Routing table formation, Flood Routing Algorithm, Distributed Lifetime Efficient Routing Algorithm, wireless sensor networks.

I. INTRODUCTION

Wireless sensor network systems have attracted much attention in different areas of science and engineering as an emerging research area. Applications of sensor networks include home energy management, monitoring environmental phenomena and traffic control. Utilization of sensor networks in data gathering applications deals with several aspects of network performance like capacity and lifetime efficiency. Performance optimization is basically carried out by adopting a proper resource management strategy for the sensors as stand-alone battery powered devices. Specifically, lifetime optimization is typically carried out by formulating the energy consumption of a sensor and defining the network lifetime accordingly. A commonly used definition for the network lifetime is the time it takes for the first sensor to run out of battery. Maximizing the capacity and the network lifetime are two conflicting goals. Increasing the network capacity requires increasing the data transmission rates at the nodes which increase the energy consumption and hence, reduces the network lifetime. Lifetime improving routing strategies in wireless networks usually set a fixed throughput level at the transmitting nodes and optimize the network lifetime by efficient routing. The trade-off between the network lifetime and its capacity.

In data gathering applications, the sensors are required to continuously measure environmental variables and transmit them to a base station (sink node) in a cooperative fashion. This requires a proper routing scheme to establish a route from any node in the network to the sink node. The information transmitted by each node includes its own data stream as well as the intended traffic received from other nodes in the network. The overall performance

measure of a network (e.g., energy consumption and network lifetime) highly depends on the routing strategy. Lifetime-optimizing routing strategies are basically network layer protocols which aim at balancing the traffic load in wireless networks by finding efficient paths from the source (or relay) nodes to the sink nodes. To achieve better lifetime performance, several classes of strategies have been introduced, which involve combining route selection and resource allocation schemes. Such classes utilize mobility, topology control or cross-layer design in addition to route selection.

II. SOFTWARE USED

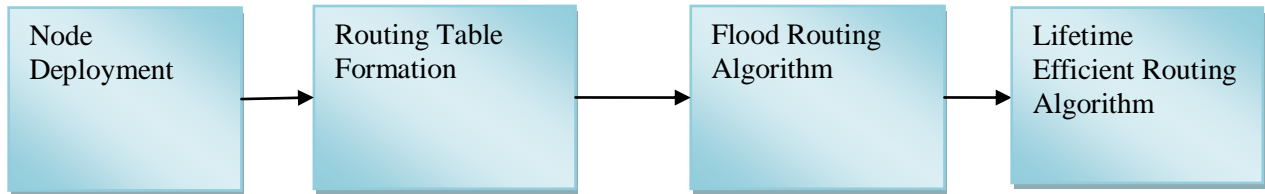
MATLAB is a high-performance language for technical computing. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation. MATLAB is an interactive system whose basic data element is an array that does not require dimensioning. In Academic environment, it is the standard instructional tool for introductory and advanced courses in mathematics, engineering, and science. In Industry, MATLAB is the tool of choice for high-productivity research, development, and analysis.

MATLAB features a family of add-on application-specific solutions called toolboxes. Very important to most users of MATLAB, toolboxes allow us to learn and apply specialized technology. Toolboxes are comprehensive collections of MATLAB functions (M-files) that extend the MATLAB environment to solve particular classes of problems. Areas in which toolboxes are available include

signal processing, control systems, neural networks, fuzzy logic, wavelets, simulation, and many others. MATLAB has extensive facilities for displaying vectors and matrices as graphs, as well as annotating and printing these graphs. It includes high-level functions for two-dimensional and

three-dimensional data visualization, image processing, animation, and presentation graphics. It also includes low-level functions that allow you to fully customize the appearance of graphics as well as to build complete graphical user interfaces on your MATLAB applications.

III. METHODOLOGY



Comparison of Flood and Lifetime Efficient

- 1) End to End Delay
- 2) Total Hops
- 3) Energy Consumption
- 4) Number of Alive Nodes
- 5) Number of Dead Nodes
- 6) Residual Energy

In the previous approach namely Flood all the possible paths for about 2 neighbour set levels are discovered by using the process of flooding and forwarding. For each of the possible paths the routing metrics especially end to end delay is computed which is directly proportional to bandwidth. Finally the path which has the lowest set of end to end delay is chosen to send the packets.

In the current approach Distributed Lifetime-Efficient Routing algorithm is proposed which computes the link cost based on energy as one metrics and hop count as the other metric. After the measure it picks the forward node based on the cost metric of the link.

A. NODE DEPLOYMENT

The Node Deployment is the algorithm which is used to place the nodes in the network across a given area.

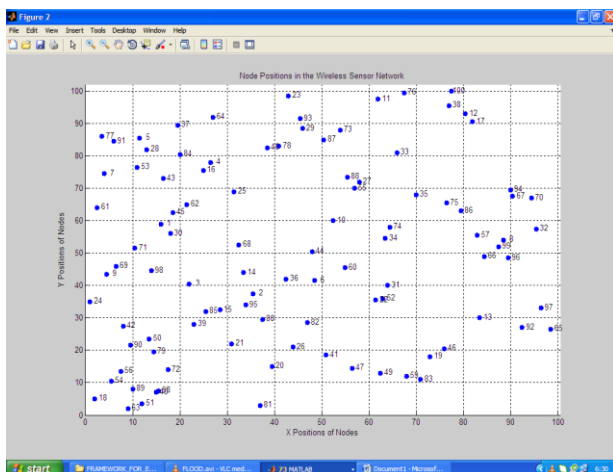


Fig. 1. Nodes position in wireless sensor network

Each of the router topology is based on randomized placement of nodes using node deployment algorithm.

B. ROUTING TABLE FORMATION

The routing table formation algorithm helps in route discovery process from the perspective of neighbour discovery.

The Global Routing Table flowchart is responsible for generation of routing tables for all the nodes in the network.

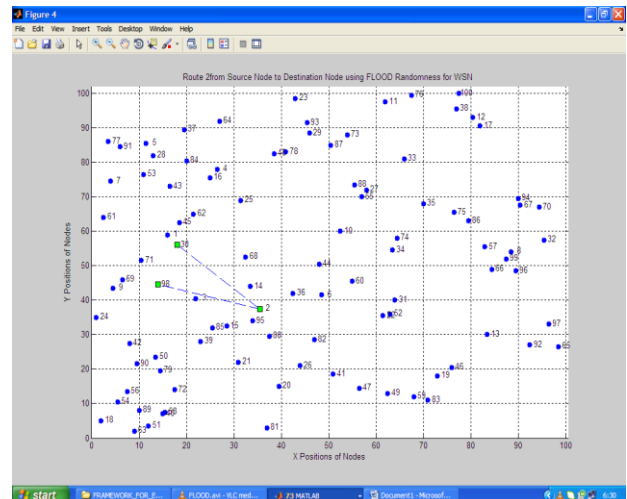
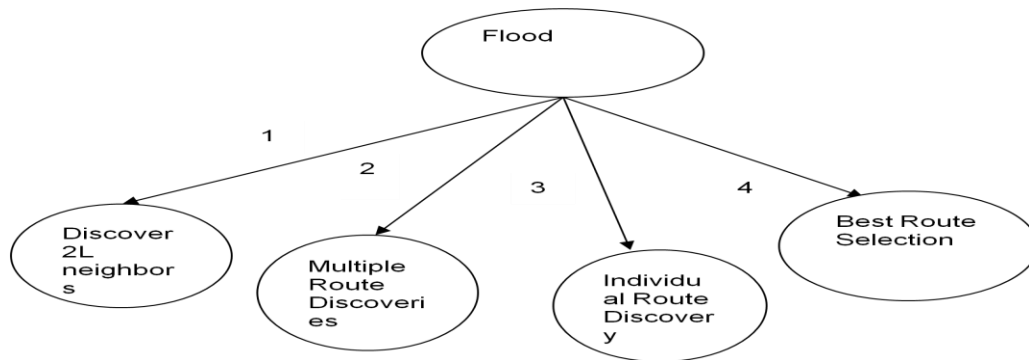


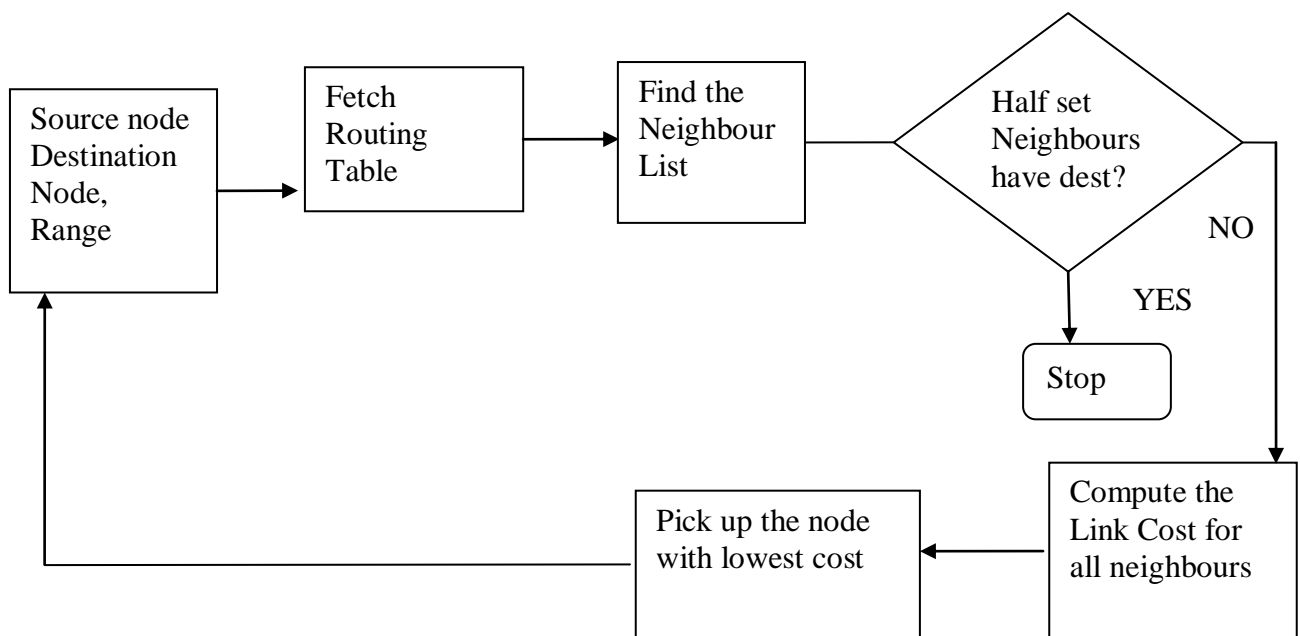
Fig. 2. Routing table formation

C. FLOOD ALGORITHM

The Flood algorithm consist of the following phases as shown in the below



D. LIFETIME EFFICIENT ALGORITHM



IV. COMPARISION

The process followed proves to be more efficient than the existing flood algorithm approach with respect to various parameters namely end to end delay, number of hops, energy consumed, number of alive node, number of dead nodes and residual energy of the network.

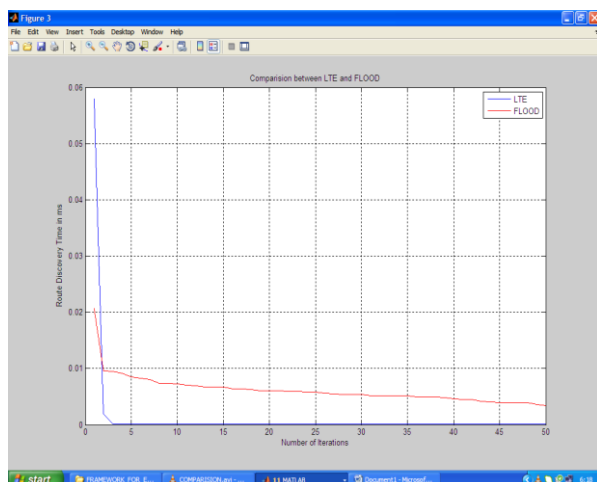


Fig. 3. Shows X axis as number of iterations and Y axis as route discovery time in ms

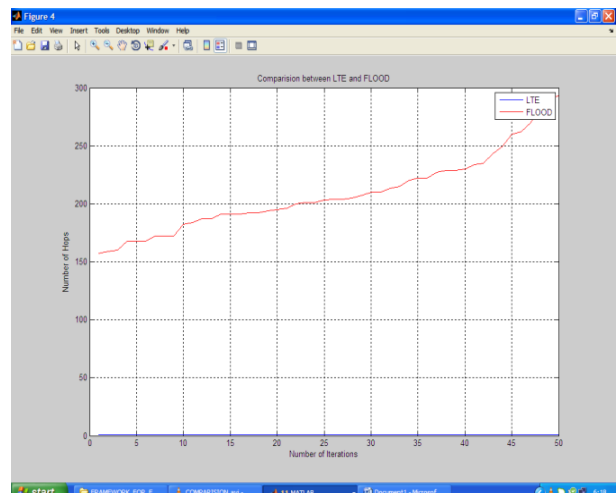


Fig. 4. Shows X axis as number of iterations and Y axis as number of hops

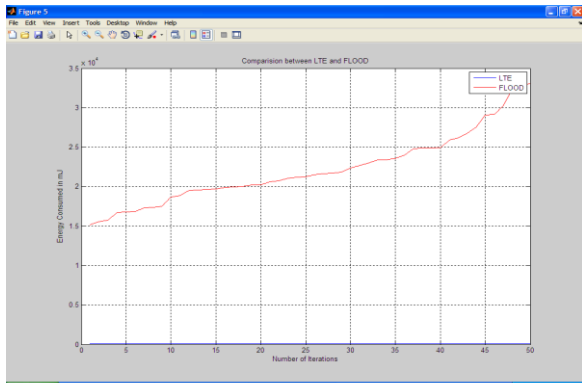


Fig. 5. Shows X axis as number of iterations and Y axis as energy consumed in mj

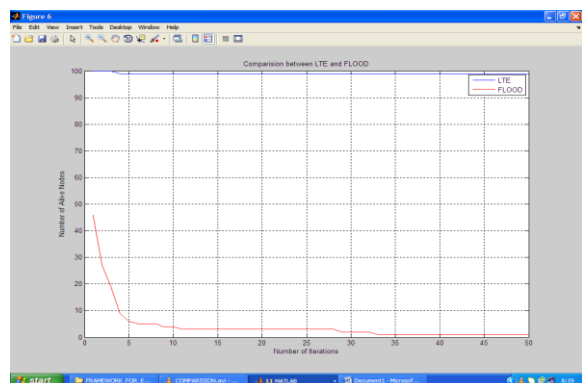


Fig. 6. Shows X axis as number of iterations and Y axis as alive nodes

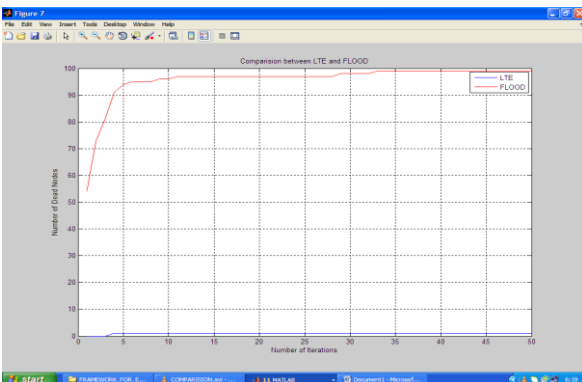


Fig. 7. Shows X axis as number of iterations and Y axis as dead nodes

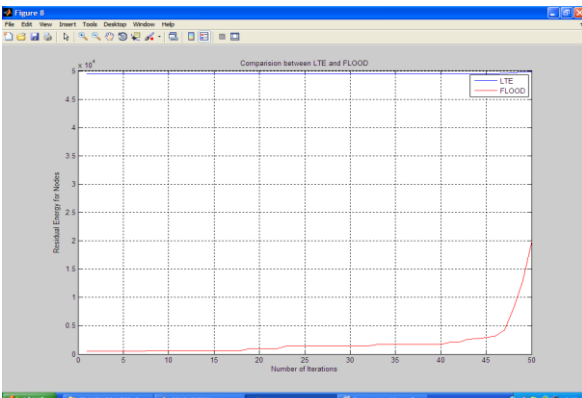


Fig. 8. Shows X axis as number of iterations and Y axis as residual energy of nodes

V. CONCLUSION

The optimal solution to distributed minimum-cost routing problem in sensor networks was presented. The analytical solution can be used to determine the impact of the assigned link cost values and the resulting directed sub graphs on the energy consumption and lifetime of the network. The energy consumption pattern for the network nodes was also developed. This pattern was then utilized in a general lifetime optimization framework, where the network configuration can switch between different digraphs. The maximum achievable network lifetime under any distributed shortest-path routing approach with variable link cost assignment was subsequently obtained. As future work, one can develop a routing algorithm which finds the optimal link cost values in a distributed fashion, resulting in the optimal performance. Furthermore, it is desirable to implement the optimal routing strategy without any a priori knowledge of the nodes data generation rate.

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