Energy Efficient dynamic Clustering schemes for Mobile Wireless Sensor Network

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Abstract:

Wireless sensor networks are remote networks and works in Ad-hoc manner. Sensor collects the information sensed by them self and send it to cluster head created in clusters. Further cluster heads use to send this information to the sink where data fetched use to complied and processed according to application used. In our research, we will propose scheme to find the energy efficient routing protocols. Sensor nodes are normally energy constrained and cannot be replaced in most cases. The need for energy efficiency in wireless sensor network is increasing considerably. This research will propose a new model to reduce the energy consumption by the sensor nodes. Proposed model distributes the energy consumption evenly among all sensor nodes to increase the life-time of the network. Most of the energy saving schemes has static nature as sensors are stationary in all. We will implement the scheme of energy efficiency for clustering based on the mobile wireless sensor nodes. Experimentation will be done with various mobility profiles to find the performance of the proposed network. Mobile devices will be move within the cluster only. Range for mobile nodes will be decided by uniform equal distance from the cluster head.

Keywords: *Wireless Sensor Nodes, Mobile Sink, Leach Protocol, Multi-hop Communication*

1. Wireless Sensor Networks

Wireless sensor networks consist of collections of small, low-powered nodes that interface or interact with the physical environment. Once deployed sensor networks are expected to operate for extended periods of time without any human intervention. [3] Substantial research effort has been directed toward increasing network lifetime by reducing radio communication, the largest source of energy drain.

Wireless sensor networks (WSN) are networks usually comprised of a large number of nodes with sensing and routing capabilities [1]. Multi-hop routing is usually implemented for the transport of the sensed data to special data collection nodes (the sinks). Among the challenges posed by the problem of data delivery to the sinks one that has recently received considerable attention concerns the minimization of the node energy consumption for increasing the overall network lifetime.

Previous research aimed toward this major goal has been prevalently concerned with developing techniques for topology control [1], energy efficient MAC and routing. Networks does not improve network lifetime since the conventional clustering scheme assumes the cluster heads to be fixed, and thus requires them to be high-energy nodes. To alleviate this deficiency, an adaptive clustering scheme called Low-Energy Adaptive Clustering Hierarchy (LEACH) is proposed in [3] that employ the technique of randomly rotating the role of a cluster head among all the nodes in the network. The operation of LEACH is organized in rounds where each round consists of a setup phase and a transmission phase. During the setup phase, the nodes organize themselves into clusters with one node serving as the cluster head in each cluster. The decision to become a cluster head is made locally within each node, and a predetermined percentage of the nodes serve as local cluster heads in each round, on average. During the transmission phase, the self-elected cluster heads collect data from nodes within their respective clusters and apply data fusion before forwarding them directly to the base station. At the end of a given round, a new set of nodes becomes cluster heads for the subsequent round. Furthermore, the duration of the transmission phase is set much larger than that of the setup phase in order to offset the overhead due to cluster formation. Thus, LEACH provides a good model where localized algorithms and data aggregation can be performed within randomly self-elected cluster heads, which help reduce information overload and provide a reliable set of data to the end user.

2. Energy Efficient Maximum Lifetime Routing Algorithm

The proposed routing algorithm uses shortest energy cost path that maintained the energy balance for entire network. For energy efficiency algorithm uses greedy heuristic path. For energy efficient greedy heuristic optimal path algorithm calculate the energy cost of each and every link in the network. [11] This means it finds a subset of the links that forms an optimal path that includes every node, where total cost of all the links in that path is minimized. The information of energy available in the nodes is used to compute greedy heuristic path, and to balance the energy consumption across all nodes. Node that has minimum battery power will drain out their battery power quickly and would be the first one to die. So node with less energy can be added later in greedy heuristic optimal path because energy cost for a transmission from this node will be the maximum. [11]

When network is setup each node can broadcast their residual energy information. All the nodes in network know the residual energy of neighboring nodes. Initially we assume that base station is in greedy heuristic optimal path. Algorithm can calculate greedy heuristic path using the energy cost function defined in equation (1). The node of the network added to the optimal path at each point is that node adjacent to a node of the optimal path by the link of minimum energy cost. The link of the minimum cost becomes in a path are connecting the new node to the path.

When all the nodes of the network have been added to the optimal path, a greedy heuristic route is constructed for a network. All the nodes of this greedy heuristic network can transmit their data on energy efficient path. [13] After transmitting the 'θ' amount of data flow on that path new routing path is computed. After every transmission, residual energy $\tilde{E}m$ of node m changes, so after 'θ' amount of transmission energy cost of each node is recalculated. With the updated energy costs the greedy heuristic path is recalculated and procedure is repeated until any node drain out its residual energy power.

3. Multi-hop routing algorithms for wireless sensor networks

The basic function of a routing algorithm is to select the path from a set of available paths that is most efficient based on specific criteria. Intuitively, to maximize the WSN's network lifetime, the path that achieves minimum power consumption while ensuring fair power consumption among individual nodes should be used. Much effort has been focused on WSN multi-hop routing algorithms, and many algorithms have been proposed [15, 16, 17, 18]. These may be widely categorized as flat multi-hop routing algorithms and hierarchical multi-hop routing algorithms. In the upcoming subsections, we present a discussion of them.

3.1. Flat Multi-hop routing algorithms

In Fig.1, an illustration of how flat multi-hop routing algorithms are used to send data is shown. In the illustration, each sensor node has the ability to communicate over a bounded area within its maximum transmission range to other sensor nodes, and an arrow's thickness is proportional to the amount of data being transmitted over that corresponding link.

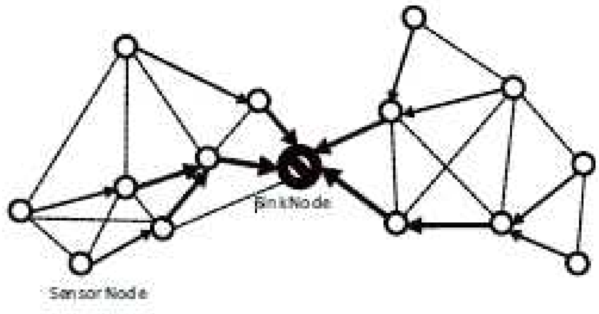

Figure 1: Flat multi-hop routing.

In practice, link utilization differs greatly between different routing algorithms. For example, algorithms proposed in [14, 15] have been designed to minimize the total power consumption of the network as an objective, in this kind of algorithms the cost of using a communication channel

3.2. Hierarchical multi-hop routing

Flat multi-hop routing algorithms are excellent in terms of their capability of using power-aware metrics to choose minimum power consuming paths. However they fail to take advantage of the highly correlated nature of the data collected from the WSN. The relatively high node density of the WSN and the application scope of the WSN (e.g., temperature readings collected from geographically close locations have a high probability of becoming similar), make data aggregation a very attractive technique in WSN. Hierarchal multi-hop routing algorithms successfully utilize the data aggregation to decrease the volume of data flowing in the network. In hierarchical multi-hop routing algorithms, sensor nodes assume different roles which can be changed with time. Here, we briefly review the most notable example of hierarchical multi-hop routing algorithms, dubbed Low-Energy Adaptive Clustering Hierarchy (LEACH) [13], as an example for illustration.

4. Energy Efficient Algorithm

Every sensor node is power constrained, and is very impossible to recharge the batteries once they have deployed in the environment; therefore the lifetime of WSN is limited. This leads to a big challenge that how to design an energy efficient protocol that makes use of less battery and in turn increases the chances of lifetime of WSN. Hierarchical or clustering method is the best way to reduce the energy consumption. The process is to divide or organize the sensor nodes of whole network or the environment into several zones of equal size. Once the zones are created, we need to elect one cluster head (CH) for each zone. CH can be elected using either randomized method or formulating method. But there are few disadvantages in randomized method. First, the number of CH nodes generated is not fixed, and there may be possibility that more than one node can become CH node in a single zone. Second, it may also be possible that randomized elected CH node could be located nearby edges, if this will be the scenario, then these zones consume more power than normal routing protocols.

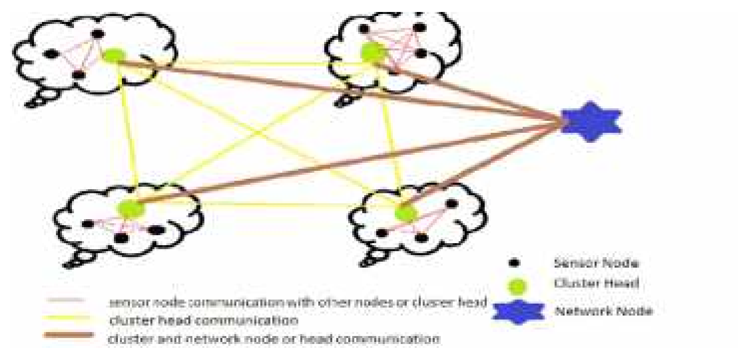

Figure 2: Clustering approach

To address this type of issues, we propose a new algorithm, called CH selection algorithm using distance formulation method.

5. Power Aware Routing Protocol (PARP) for Wireless Sensor Networks

Each robust node can arrive at nearby robust nodes directly. When a robust node goes out of a grid, it initi-ates a robust node election process in the grid and a new robust node will be selected.

Each Robust node holds a table of node power. Each Robust node can calculate the end-to-end power from itself to any other robust nodes. The node delay is estimated and updated periodically by each robust node.

In case a source node S needs to setup a route to a destination D. It is considered by the case where the source node S itself is a robust node. In this case, first the robust node S needs to know about the current location of the destination node D. With the information of D's location, S knows about the grid Ld where D stays, and the Robust node Ltd in the grid Ld.

Then S calculates the minimum power between S and Ltd by means of the power table, and also discovers the route with the minimum power. If the minimum power is greater than the required power, then the route cannot be established. The source sensor node generates a unique req_id for each route request. When an intermediate node obtains the REQ packet, it adds the powers of the incoming link and itself to t_power, and compares the updated t_power with the max_power. If t_power is less than the max_power, it adds up itself to the route_list, and forwards the REQ packet to the neighbors. If t_power is greater than max_power, the node will drop the REQ packet.

If the minimum power between S and Ltd is less than the maximum power, sensor node S will notify Ltd to locate a route to the destination D. Then Ltd will up-date the t_power by adding the power between Ltd and D. If the updated t_power is less than max_power, a valid route is found. Ltd will send an ACK (acknowledge) packet to S along the reverse path to ascertain that the route is setup. And each node in the route will updates its node power. After that S can start sending data.

If S is not a Robust node, then S will first discover a path to the nearby Robust node with less power than re-quired. Node S sends out the route request (REQ) packet by flooding to all the sensor nodes in its grid. Only sen-sor nodes in the same grid will process and forward the REQ packet. When a node gets the REQ packet, it will update the power from source to their locations (t_ power). If t_power is less than max_power, it adds itself to the route_list, and forwards the REQ packet to the neighbors. If t_power is larger than max_power, the node will drop the REQ packet. When the Robust node in this grid gets the first REQ packet, it also updates the t_power and compares it with max_power. If t_power is less than max_power, it will calculate the minimum power between itself and the robust node which is near-est to the destination. The remaining steps are the same as above.

Sensor node power and current location information of robust nodes has to be updated and distributed among all robust nodes. The distribution is done periodically, and the length of the updating period depends on the network dynamics, such as sensor node mobility, sensor network traffic, sensor node communication capability, etc.

6. Conclusion

This paper explains the concept of power aware routing and further explains about the details of policies used in various protocols for power saving routing. In our near future we are developing similar power aware routing to save energy consumption in wireless sensor network.

References

[1] Z. Maria Wang, Stefano Basagni, Emanuel Melachrinoudis and Chiara Petrioli, ''Exploiting Sink Mobility for Maximizing Sensor Networks Lifetime'', Proceedings of the 38th Hawaii International Conference on System Sciences, IEEE Computer Society, 2005.

[2] E. H. Callaway, Jr," Wireless Sensor Networks: Architectures and Protocols", Boca Raton, FL: Auerbach Publications, August 2003.

[3] Thanos Stathopoulos, Rahul Kapur, Deborah Estrin, "Application-Based Collision Avoidance in Wireless Sensor Networks", Conference of Computer society, pp. 335-343, July-December 2005.

[4] K. Padmanabhan, Dr. P. Kamalakkannan," Energy-efficient Dynamic Clustering Protocol for Wireless Sensor Networks", International Journal of Computer Applications, Vol. 38, Issue. 11, January 2012.

[5] S. R. Das, C. E. Perkins, and E. M. Royer, "Ad hoc on-demand distance vector (AODV) routing", IETF Internet draft, draft-ietf-manet-aodv- 13.txt, Feb 2003.

[6] Shio Kumar Singh, M P Singh , and D K Singh , "Routing Protocols in Wireless Sensor Networks –A Survey," International Journal of Computer Science & Engineering Survey (IJCSES) Vol.1, No.2, November 2010.

[7] Poonam Tyagi, Ravinder Prakash Gupta, Rakesh Kumar Gill," Comparative Analysis of Cluster Based Routing Protocols used in Heterogeneous Wireless Sensor Network", International Journal of Soft Computing and Engineering (IJSCE), Vol. 1, Issue. 5, November 2011.

[8] Luis Javier García Villalba , Ana Lucila Sandoval Orozco, Alicia Triviño Cabrera and Cláudia Jacy Barenco Abbas " Routing Protocols in Wireless Sensor Networks ", www.mdpi.com/journal/sensors, 2009.

[9] Debnath Bhattacharyya, Tai-hoon Kim, and Subhajit Pa, "A Comparative Study of Wireless Sensor Networks and Their Routing Protocols", www.mdpi.com/journal/sensors, 24 November 2010.

[10] Fahed Awad, Eyad Taqieddin, Asmaa Seyam," Energy-Efficient and Coverage-Aware Clustering in Wireless Sensor Networks", Wireless Engineering and Technology, pp. 142-151, Vol. 3, 2012.

[11] Sourabh Jain, Praveen Kaushik, Jyoti Singhai,"Energy Efficient Maximum Lifetime Routing For Wireless Sensor Network", International Journal Of Advanced Smart Sensor Network Systems (IJASSN), Vol 2, No.1, January 2012.

[12] Beena BM, Dr C.S.R Prashanth, B V Vinay,"Power-Aware Localized Routing Algorithms for Wireless Sensor Networks", International Journal of Research and Practices in Engineering Sciences (IJRPES) , pp.01-05, Vol. 1, Issue 1, Mar-May 2012.

[13] V. Raghunathan, C. Schurghers & M. Srivastava, (2002) "Energy-aware Wireless Micro sensor Networks", IEEE Communication Magazine, pp. 40-50.

[14] Heinzelman, W., Chandrakasan, A., Balakrishnan, H., Application specific protocol architecture for wireless micro sensor networks. Wireless Communications, IEEE Transactions on 1 (4), 660 – 670, Oct. 2002.

[15] Al-Karaki, J., Kamal, A., 2004. Routing techniques in wireless sensor networks: a survey. Wireless Communications, IEEE 11 (6), 6 – 28.

[16] Luo, H., Liu, Y., Das, S., 2007. Routing correlated data in wireless sensor networks: A survey. Network, IEEE 21 (6), 40–47.

[17] Khan, I., Javed, M., 2008. A survey on routing protocols and challenge of holes in wireless sensor networks. In: Advanced Computer Theory and Engineering, 2008. ICACTE '08. International Conference, pp. 161 –165.

[18] Akkaya, K., Younis, M., 2005. A survey on routing protocols for wireless sensor networks. Ad Hoc Networks 3 (3), 325 – 349.

