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Analysis of AODV and Cluster Based Routing in Wireless Sensor Networks Using NS2 Simulator

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Abstract: ***Wireless sensor networks (WSNs) finds wide range of applications such as industries, military environment, disaster management, medical and health care etc. They consist of number of intelligent sensor nodes and one or more base stations. These nodes are small in size and can perform many important functions, including sensing attribute, information processing, and data communication. Sensors are generally equipped with non-rechargeable batteries, and it is difficult and sometimes not possible to replace these batteries, so energy efficiency is a major design issue. In this paper, we aim to analyze and improve performance of routing algorithms in WSNs for a wide network.***

Keywords: Cluster heads, energy, hierarchical, routing, wireless sensor networks

1. Introduction

A WSN (Wireless sensor network) is a network made up of not just few number but hundreds and thousands of sensor nodes. These nodes are deployed in the network with limited energy supply. Also, they have short communication range, and insufficient memory in certain cases. Nodes in the network sense parameters like temperature, pressure, humidity etc. Figure 1 shows the typical view of WSN. In the figure, it depicts how nodes communication occurs within that area. There are many problems with the sensors. Since energy supply of sensor nodes is limited, it is a major problem, since, if the node energy is not sufficient then it results in loss of data packets. So, proper approaches are required in order to solve this problem. Also, sensor once placed in the network are left without examining them regularly and are expected to perform their function correctly. If the sensors limited energy problem is addressed, then no human intervention will be required such as replacing batteries frequently. WSN architecture have been classified into flat and hierarchical architecture. In flat architecture, all the nodes have same role to play. They sense the attribute and forward it to the base station. Whereas in case of hierarchical architecture, cluster-based routing is being used. Flat have been found to be better for smaller network. But as the network size increases, then more energy gets wasted in flat architecture. Hence for larger network mostly hierarchical architecture is preferred.

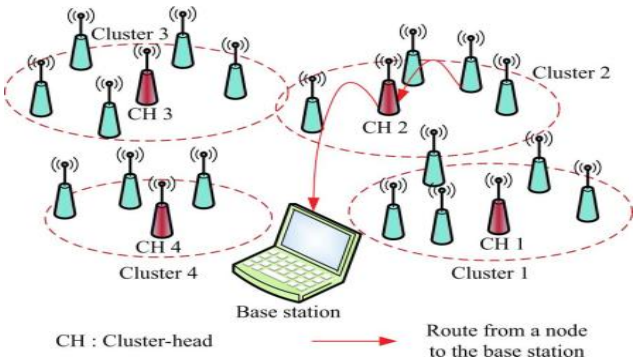

Figure 1: Typical view of WSN

a) Routing in Wireless sensor network

Due to large number of sensor nodes in WSN and because of the harsh environment in which they are placed, many issues occur with the sensor nodes. Nodes should be energy efficient in order to carry out communication without losing data. They have to send the sensed attribute to the base station. So major problem here, is how they are going to do this, using less consumed energy. At this point, routing comes into the picture. Routing decides the route through which nodes are going to forward the data packets to the base station. Efficient routing is a major aim of any network. Many routing algorithms exists in both flat and hierarchical architecture. Some of algorithms in flat type are AODV, DSDV, DSR etc. and that under hierarchical type are LEACH, PEGASIS, TEEN, APTEEN etc. [5].

b) Clustering Process

In order to make wireless sensor networks work efficiently, several routing algorithms have been proposed. One such technique is clustering used in hierarchical architecture of wireless sensor networks [8]. In clustering approach, sensor network is divided into groups of nodes called as clusters. So, there are many clusters formed in hierarchical architecture. Within each cluster, a node is selected as the cluster head. The job of this cluster head is to collect all the data from all the nodes within that cluster and forward it to the base station. Cluster based sensor network are more preferred over flat architecture since all nodes need not utilize their energy for sending data over long distance base station. They forward data to the cluster head.

2. Hierarchical Routing in WSN

LEACH (Low Energy Adaptive Clustering Hierarchy) was the clustering protocol developed for WSNs [4]. It a cluster based hierarchical protocol wherein the cluster head selection is done based on probabilistic model. Network is divided into many clusters. And a threshold was set. Cluster head is responsible for data aggregation and routing purpose. [3]. Algorithm works in two main phases. They are set-up phase and the steady phase.

This algorithm performs better in terms of energy as compared to other architecture algorithms due to cluster

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formation mechanism in it. The operation of algorithm is as explained below:

a) Operation

As mentioned earlier, there are two phases for working of LEACH algorithm. In set-up phase, cluster head selection occurs. Whereas in steady-state phase, data transmission occurs. The probabilistic model used, has threshold which is given as follows:

$$T(n) = \begin{cases} \dfrac{p}{1 - p * (r \bmod \frac{1}{p}),} & \text{if } n \in G \\ 0 & \text{otherwise} \end{cases} \quad (1)$$

Where, p is the probability with which node is selected as cluster head, r indicates the current round. G is set of nodes which have not become cluster head till current round. Threshold equation is given above in equation 1. The basic idea of the algorithm is that the clustering process is cyclical and cluster heads are chosen randomly with probability. The nodes are regarded as cluster head according to their probability values. Because a cluster head has a heavy burden, since it has to take data from all nodes within cluster, after one round of operation, the protocol reestablishes the process of clustering and each sensor node can average the energy consumption of the network, which can reduce the network energy consumption.

However, this algorithm has few limitations. Since, the cluster head are selected randomly, there might be situation wherein the node having least energy may get elected as cluster-head. And if this happens, then after that node dies, all the data which was collected by that node may also get lost. To overcome these limitations, we have to select cluster head in a manner which has the highest energy among all the nodes within that cluster.

3. Flat Routing in WSN

In flat routing, base station is used to send queries to some selected regions and waits for data from sensors that are located in those regions. As queries are used for the requested data, attribute-based naming in order to specify the properties of data is necessary. There are various routing protocols in flat type. One such algorithm is Ad-Hoc on-demand Distance Vector (AODV).

a) AODV routing

This routing protocol is a reactive routing protocol which is a combination of Dynamic Source Routing (DSR) and DSDV protocol. It is a distance vector routing protocol and is capable of both unicast and multicast routing. It will maintain the routes only between the nodes which need to communicate.

The routing information will be maintained as routing tables in each node. A routing table entry in the routing table will check whether there is a current route to the destination node or not. If there is a route, then the packets will transmit to destination node in that path.

4. Simulation Results

In this paper, we have simulated flat based AODV and cluster based routing environment for wireless sensor network using ns2 simulator (ns-2.35). In order to carry out simulation, few assumptions have been made which are as follows:

- All nodes have same initial energy nodes level.
- Nodes have sufficient transmission range.

In our simulation, nodes are mobile at few instants of the simulation time. Clusters of nodes are formed and a node is selected as cluster head depending upon the highest energy, unlike in Leach protocol, where cluster heads are randomly selected.

Fig.2 depicts the simulation environment for AODV protocol for 100 nodes scenario, whereas fig. 4 depicts the simulation environment for cluster-based routing scenario. Table 1 shows the simulation parameters used for AODV routing protocol, and table 2 shows the simulation parameters used for cluster-based routing.

Fig.3 and fig. 5 shows the trace file output obtained for AODV and cluster-based routing protocol respectively.

Trace file format has events which are as follows:
's' indicated that the packets are sent, 'r' depicts packets are received, 'd' indicates packets are dropped. Following this, next event indicates node number, simulation time, type of message, energy values. 'e_i' is the energy when nodes are idle, 'er' and 'et' are received and transmitted energy respectively.

AODV have been simulated for 100 nodes network and the cluster-based routing have been analyzed for 20 nodes network.

Table 1: Flat Routing (AODV)

Sr. no.	Simulation environment parameters	
1.	Simulation Area	500 x 500
2.	Simulation Time	100 seconds
3.	Initial energy of nodes	400 joules for node 1000 joules for base station
4.	Channel Type	Channel/wireless channel
5.	Radio propagation model	Two Ray Ground

Table 2: Hierarchical Routing (Cluster-Based)

Sr. no.	Simulation environment parameters	
1.	Simulation Area	800 x 650
2.	Simulation Time	250 seconds
3.	Initial energy of nodes	2 joules
4.	Channel Type	Channel/wireless channel
5.	Radio propagation model	Two Ray Ground

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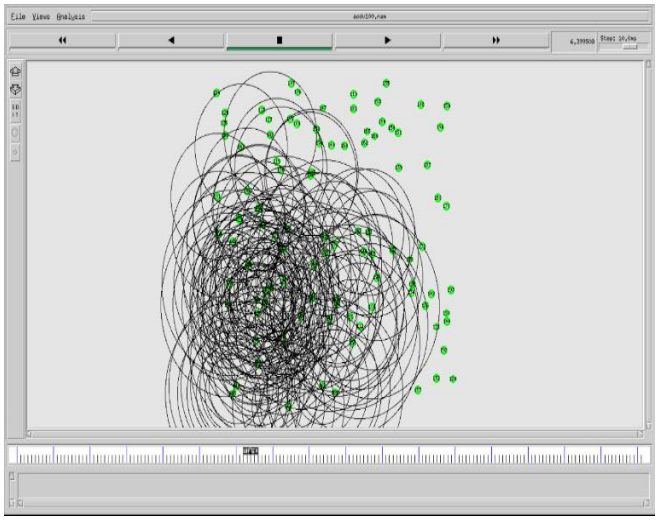

Figure 3: NAM window showing sensor node scenario for AODV

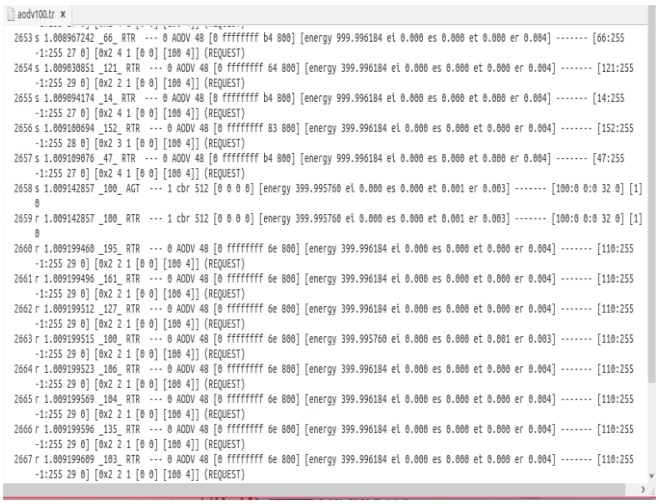

Figure 2: Trace file for AODV routing protocol

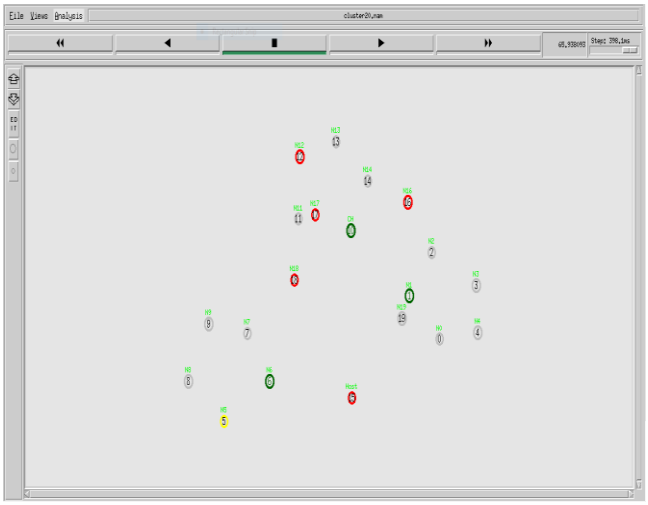

Figure 4: NAM window showing sensor node scenario for cluster-based routing.

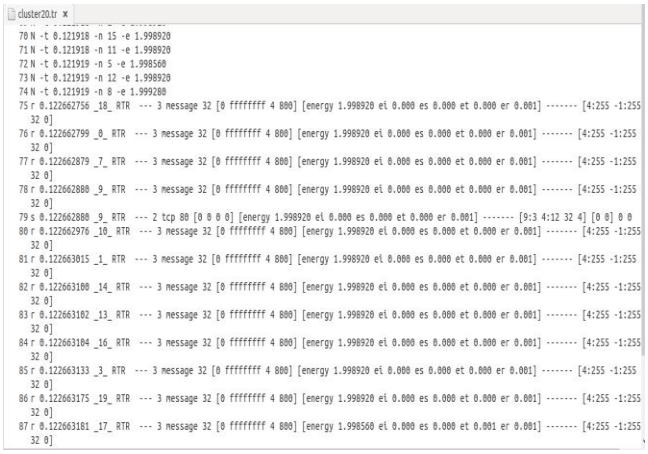

Figure 5: Trace file output for cluster-based routing

5. Conclusion

Wireless sensor network is a great of interest. For its reliable operation, routing needs to be done efficiently. Various routing algorithms have been proposed in both flat and hierarchical architecture of WSN. In this paper, we have carried out simulation for AODV routing protocol which comes under flat category. Simulation have been done for 100 nodes scenario. Also, cluster-based routing approach have been analyzed for 20 nodes. In traditional clustering protocol, cluster-heads were selected randomly. In our paper, cluster-head are selected based on highest energy. Simulation parameters used were listed in the table and simulation environment scenarios were depicted in NAM window.

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References

[1] Payal Goyal, Umang Singh," Hierarchical based routing protocol in WSN", International Journal of Computer Applications (0975 8887) Next Generation Technologies for e-Business, e-Education and e-Society (NGTBES-2016)
[2] Parminder Kaur, Mrs. Mamta Katiyar,"The Energy-Efficient Hierarchical Routing Protocols for WSN: A Review", International Journal of Advanced Research in Computer Science and Software Engineering , Volume 2, Issue 11, November 2012 ISSN: 2277 128X
[3] Reshma I. Tandel, "Leach Protocol in Wireless Sensor Network: A Survey "',International Journal of Computer Science and Information Technologies, Vol. 7 (4) , 2016,1894-1896..
[4] W. R. Heinzelman, A. Chandrakasan, H. Balakrishnan, "Energy-Efficient Communication Protocol for Wireless Microsensor networks", IEEE Proc. Hawaii Int'1 Conf. Sys. Sci., Jan 2000, pp. 1-10..
[5] Jamal N. Al-Karaki, Ahmed E. Kamal, "Routing Techniques in Wireless Sensor Networks: A Survey"..

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[6] Archana Jangra, ”A Review on Different Routing Protocols on Wireless Sensor Network”, International Journal of Computer Applications (0975 8887) Volume 149No.12, September 2016
[7] Sirwan A. Mohammed, Prof. Dr. Sattar B. Sadkhan, ”Design of Wireless Sensor Networks Based on ns2”, Journal of Global Research In Computer Science, Volume 3, No.12, December 2012,ISSN-2229-371X
[8] Shilpa Mahajan, Pushpender Kumar Dhiman, “Clustering in Wireless Sensor Networks: A Review”, International Journal of Advance Research in Computer science, Vol. 7, May-June 2016, ISSN no. 0976-5697.
[9] Ahmad Abed Alhameed Alkhatib, Gurvinder Singh Baicher, ”Wireless Sensor Network Architecture”, 2012 International Conference on Computer Networks and Communication Systems(CNCS 2012) IPCSIT Vol.35(2012) (2012) IACSIT Press, Singapore.

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