Performance Analysis of Enhanced Energy Aware Sleep Scheduling Clustered based Routing Protocol using NS2

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Abstract: In wireless sensor network (WSN), deployed sensor nodes to detection an event and transmit the data from sensor nodes to the base station (BS). Stability period, energy consumption and network lifetime is a big issue in the WSN. For this purpose, a number of routing algorithms are invented. In this research paper, we are introduced enhanced energy aware sleep scheduling clustered based routing (EEASSCR) protocol is based on clustering approach. When clustering is an approach used to minimize the energy consumption of such network. Hence it reduces the energy consumption, increase stability period of network and increases the network lifetime. Basically, EEASSCR is an enhancement protocol of EASSCR. The comparative analysis of EEASSCR with EASSCR, LEACH and SEP on the basis of delay, packet loss, throughput and residual energy is done and it has found that EEASSCR is better.

Keywords: WSN; EEASSCR; EASSCR; LEACH; SEP; CH; BS

I. INTRODUCTION

A wireless sensor networks (WSN) consists of a huge number of sensor nodes are deployed in the different regions at operate in different modes [1] [5]. The sensor nodes are deployed randomly to monitor physical terms such as sound, temperature, vibration, motion or pollutants at different regions. Improvement in wireless communication, electronics and technological transformation has enabled the expansion of in the field of WSNs due to their different applications such as health, military, automation, home, air pollution, area monitoring, environmental etc. The some components are applicable in WSNs such as sensor node, processor and base station. Sensor nodes are applicable to senses the data and transmit it to the user [3]. These nodes are portable, light in weight and small in size. Basically, sensor nodes collect the data from its distributed area, implement the simple calculations and communicate with other sensor nodes or with the base station (BS). A different technique like as direct communication technique are used to send the data from sensor node to base station but in the minimum transmission energy sensor nodes are nearest to the base station has large probability to transmit the data than sensor nodes which are located distant from the base station (BS) [7]. Main challenges for the WSNs are stability period of network, lifetime of network and energy efficiency of the network because the battery capacities of the sensor nodes are limited and due to rigid deployment of the sensor nodes, it is impossible to change them [4]. So need to suggest another approach is known as clustering. Clustering are also used in WSNs, it is alternative to increase the energy efficiency of network and performance of the network. Basically, it I applicable to minimize the energy consumption of sensor nodes. In clustering, number of sensor nodes are divided into a number of clusters and a set of sensor nodes are named as cluster head (CH) [15]. Cluster head collects the data from the other non-cluster heads nodes, secondly aggregate the data from all the sensor nodes and then transmit it to the base station. Clustering thus uniformly distributed the energy load of the network, reduces the energy consumption and increase the network lifetime of the network [11] [10]. The protocols are defined below;

A. Low Energy Adaptive Clustering Hierarchy (LEACH) Protocol

Low energy adaptive clustering hierarchical (LEACH) protocol is the first energy efficient hierarchical protocol scheme. LEACH protocol is the type of homogeneous protocol. Basically, it is called as pro-active routing protocol.
In this protocol, the entire sensor nodes consist as equal amount of energy, because the LEACH has considered as a homogeneous type of protocol [1]. The most important function of LEACH protocol is arrangement of sensor nodes on incurred signal intensity. In this protocol, sensor nodes are divided into different locations on the basis of sensor nodes location. The base station is situated out of sensing area and a special node is known as a gateway node and this node is placed center position [3]. Some nodes are located nearest to the base station. So, the data transferred from sensor nodes to base station using the direct communication technique and rest nodes are take part in the cluster head (CH) formation i.e. clustering approach [14]. Here a sensor node becomes a cluster head through arbitrarily choosing a number between 1 and 0. The cluster head (CH) that far away from the sink consumed more energy for single hop routing to the base station. But it has some drawbacks like it performs poorly when WSNs are deployed over a large region [16].

B. Stable Election Protocol(SEP)

To the improvement of LEACH protocol for homogeneous network of WSNs a new protocol SEP was proposed that appropriate resource heterogeneity for the better stability period of network. Stable election protocol (SEP) is the heterogeneous type of network [2]. In this protocol, used two type of sensor nodes like as advanced node and normal node. The advanced nodes are authorized higher weights as compared to normal node and hence large probability to be named as cluster head (CH) in each round. In SEP protocol, all sensor nodes are deployed arbitrarily in nature. If majority of sensor nodes are deployed far away from the base station (BS) it consumed more energy [1]. The normal nodes are deployed nearest to the base station and transmit data directly to the base station. But, the advanced nodes are deployed far away from the base station and they consumed more energy for the transmission of data from sensor node to base station, therefore, to remove the limitation of energy in sensor nodes occurring a cluster head (CH) formation. SEP protocol performs better as compared to LEACH protocol in the term of stability period of network [8].

C. Energy Aware Sleep Scheduling clustering based routing (EASSCR) protocol

To improvement of LEACH and SEP protocol in WSNs that an EASSCR protocol is utilizes to increase the stability period of network and increase the lifetime of network. Basically it is used to ensure that increase the residual energy of sensor node in WSNs. EASSCR protocol is a distributed competitive unequal clustering approach, it considered a residual energy and average energy of sensor nodes. Similar to that of different energy efficient protocols like as LEACH, SEP, A-LEACH our proposed schemes are follows cluster head (CH) formation technique [8].

In WSNs due to high quantity of node deployment, same area may get covered by large number of sensor nodes. Therefore, to avoid data redundancy, some nodes may be turned-off. So in this technique, at half of sensor nodes are perform i.e. known as active nodes and some nodes are in rest i.e. called sleep nodes or passive nodes [8].

D. Enhanced Energy Aware Sleep Scheduling clustering based routing (EASSCR) protocol

To the improvement of EASSCR protocol in WSNs that an EEASSCR protocol is utilizes to increase the stability period of network and increase the more lifetime of network. Basically it is used to ensure that increase the residual energy of sensor node in WSNs as compared to EASSCR protocol. EEASSCR protocol follows the enhanced EASSCR algorithm. This algorithm is based upon clustering and cluster head selection approach. In EEASSCR protocol, cluster head will be selected upon the based on normal energy and initial energy of the sensor nodes. It means that the EEASSCR protocol is working upon clustering algorithm. Therefore, the working of enhanced EASSCR algorithm given below;

a) Node deployment & Cluster formation: Previously performing clustering formation, the sensor nodes are randomly deployed in the 50x50 network area. After the deployment of sensor nodes, the nodes are divided into the number of groups are known as a cluster formulation. Otherwise, the grouping combinations of sensor nodes are called as clustering formulation.

b) Selection of cluster head: After the process of cluster formulation, the selection of cluster head will be based upon the energy of sensor nodes. EEASSCR protocol selects a sensor node as a cluster head if the residual energy of that sensor node is more than its initial energy. Otherwise, the node directly transmits data to the base station (BS) to avoid data loss.

\[ \text{E}_{\text{res}} > \text{E}_{\text{ie}} \]

Where \( \text{E}_{\text{res}} \) is known as a residual energy and \( \text{E}_{\text{ie}} \) is known as an initial energy. When the residual energy is more than initial energy than sensor node selects as a cluster head (CH) [13].
c) Data Aggregation & Data Transmission: Succeeding the selection of cluster head (CH), the cluster head aggregate the data from all the sensor nodes and transmit it to the base station (BS). Otherwise, data aggregation is a technique to compressed the data and due to this technique more amount of energy is saved in cluster head sensor node and transmit the data it to the base station [3] [1].

In this paper, we propose and evaluate an enhanced energy aware sleep scheduling clustering based routing (EASSCR) protocol for heterogeneous and homogeneous network. In this approach, a new cluster head (CH) is proposed based on the initial and residual energy of sensor nodes and the distance between them and base station. This protocol is improved version of EASSCR, LEACH and SEP protocol presented in and simulation result shows that our strategy is more efficient as compared to EASSCR, LEACH and SEP protocol.

II. RELATED WORK

Some work related to this strategy is described below:
Kumar D., et al. [2009] implemented Energy efficient heterogeneous clustered (EEHC) protocol. This paper also describes that the performance of the EEHC protocol and it’s compared with LEACH protocol. The simulation results demonstrate that our proposed heterogeneous clustering approach is more effective in prolonging the network lifetime compared with LEACH. EEHC protocol is better than LEACH on the basis of stability period and energy consumption. The conclusion is obtained is that there is need for increase the lifetime of the network [5]. Shiekhpour R., et al. [2011] presented a survey on various routing protocols of WSNs like as DEEC, D-DEEC, H-LEACH, WEP, H-HEED etc. In this paper, the clustering technique are used to minimize the energy consumption of sensor nodes and the performance show that energy efficient clustering based heterogeneous routing protocols are better than energy efficient clustering based homogeneous routing protocols [2]. Kumar V., et al. [2011] provided a survey on different clustering based algorithms in WSNs such as LEACH, H-LEACH, HPR-LEACH, RE-LEACH, MR-LEACH etc. and these algorithms are defined on the based on network lifetime, stability period, accuracy and energy efficiency. The paper presented energy efficient clustering algorithms of WSNs and also presented a description of LEACH and its extensions in WSNs [9]. Bala M., et al. [2012] designed a hybrid energy efficient distributed (HEED) protocol and it compared with multilevel-heterogeneous hybrid energy efficient distributed (MH-HEED) protocol, heterogeneous-hybrid energy efficient distributed (H-HEED) protocol and the deterministic- hybrid energy efficient distributed (D-HEED) protocol. The simulation results show that the period of lifetime of network and energy efficiency are more as compared to MH-HEED, H-HEED and D-HEED protocols. The conclusion obtained the cluster formation of D-HEED [4]. Kumar S., et al. [2013] introduced Energy efficient clustered based routing (EECP) protocol and it compared with low energy adaptive clustering hierarchy (LEACH) protocol and low energy adaptive clustering hierarchy (LEACH) protocol with heterogeneity networks. Simulation results show that the performance of EECP protocol is better than LEACH and LEACH with heterogeneity [10]. Tanwar S., et al. [2015] presented a review on the heterogeneous routing protocols for wireless sensor networks. The paper also presents a comparison of the protocols using various parameters like CH Selection, Energy Efficiency, Security and Application Specific. In this paper, author has categorized various heterogeneous routing protocols for WSNs based upon various parameters. A comparison of various protocols with other existing protocols is provided with respect to various performance evaluation parameters namely – CH selection, energy efficiency, security and application specific. The broad categorization gives insight to various users to one of the protocols from different categories based upon its merits over the others [11]. Pramanick M., et al. [2015] introduced Energy aware sleep scheduling clustered based routing protocol (EASSCR) Protocol. The goals of this scheme are, increase stability period of network and minimize the loss of data and Performance analysis show that EASSCR has significant improvement over existing protocols LEACH protocol, SEP protocol and M-GEAR protocol in terms of lifetime of network and data units gathered at base station (BS) [1]. Thapa R., et al. [2017] implemented an energy aware sleep scheduling clustered based routing (EASSCR) protocol using cluster head (CH) selection algorithm and it compared with low energy adaptive clustering hierarchy (LEACH) and stable election protocol (SEP). Simulation results show that EASSCR protocol perform better as compared to LEACH and SEP on the basis of energy consumption, stability period of network and lifetime of sensor network [8]. Verma D., et al. [2015] worked on Leach protocol using the concept of cluster head in heterogeneous WSN. The result has been obtained as that the lifetime of network per round is constant over packet length. A very rapid advancing wireless sensor networks and latest hierarchical protocol used in this environment leads to give the network stability, throughput and less energy consumption which leads to make the network more reliable and energy stable, this have led to many new protocols specifically designed for sensor networks where energy
conservation is prime aim [12]. Anisi M., et al. [2011] proposed an energy-efficient mechanism for data forwarding so as to increase the network lifetime. Authors compared the proposed approach with LEACH and VLEACH in terms of residual energy, throughput and data correlation. Proposed approach results better as compared to LEACH and VLEACH [3].

### III. SIMULATION SETUP

The network is simulated through the network simulator 2.35 (NS 2.35) and IEEE standard 802.11. The simulation network is used two dimensional view. The base station are used in the center of the network at selected region and cluster head (CH) transmit the data to base station using multi hopping. Cluster head (CH) will be selected at the minimum distance is followed through the cluster. The sink or base station transmits the message to all sensor nodes with cluster head (CH) and desired route to be followed. The some sensor nodes are react and another discard the message [16].

![Figure 1. Network Deployment](image1)

![Figure 2. Data Aggregation and Data Transmission to sink](image2)

The figure 1 shows the network deployment and figure 2 shows the data aggregation as well as data transmission by the use of base station (BS).

The desired specifications of network and its other details are shown in the form of table given below:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simulation Tool</td>
<td>Network Simulator 2.35</td>
</tr>
<tr>
<td>IEEE Standard</td>
<td>IEEE 802.11n</td>
</tr>
<tr>
<td>Protocol</td>
<td>EEASSCR, EASSCR</td>
</tr>
<tr>
<td></td>
<td>LEACH, SEP</td>
</tr>
<tr>
<td>Total Number of Nodes</td>
<td>51</td>
</tr>
<tr>
<td>Total Number of Cluster</td>
<td>4</td>
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<tr>
<td>Head (CH)</td>
<td></td>
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<tr>
<td>Network Size (in meters)</td>
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</tr>
<tr>
<td>Node Range</td>
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</tr>
<tr>
<td>Sink</td>
<td>1</td>
</tr>
</tbody>
</table>

### IV. RESULT & DISCUSSIONS

The sensor nodes are deployed randomly and clustering process is used to minimize the coverage area. Another, x-axis defined number of packets and y-axis are defined simulation time in seconds. Figure 3 shows the result of delay in graphically. The time required through the packets to reach the sink is called as a delay. We compare the EEASSCR protocol with EASSCR, LEACH and SEP in this paper and more delay in another protocol because of dynamic clustering. In EEASSCR protocol, delay has less as compared to EASSCR, LEACH and SEP protocol. The numbers of packets are not reach the base station at the time of transmission is called as a packet loss. Figure 4 shows packet loss is less in EEASSCR protocol as compared to EASSCR protocol because the use of multihopping transmission technique. Otherwise SEP protocol is multi-level heterogeneous network but LEACH protocol is an example of homogeneous network. EASSCR has equally works on heterogeneous and homogeneous networks but it is proposed that works satisfactorily in heterogeneous networks. Figure 5 shows the result of throughput in graphically. The number of packets are received by the base station per unit time is known as a throughput. Simulation result shows that the EEASSCR protocol performs better as compared to EASSCR, LEACH and SEP protocol. Figure 6 shows the result of residual energy in the way of graph. Assume that the residual energy of 51 sensor nodes are 50 joules. The residual energy of EEASSCR protocol is more than EASSCR, LEACH and SEP protocol because in the process of EEASSCR protocol half of the nodes are active i.e. called active nodes.
and rest of the other nodes called sleep nodes or normal nodes. So that most of the sensor nodes are consumed less energy.

Figure 3. End to End Delay

Figure 4. Packet loss

Figure 5. Throughput

Figure 6. Residual energy
IV. CONCLUSION

Several techniques are applicable to implement wireless sensor network for the increase of lifetime of network, but still need improvements to overcome the issues of wireless sensor network (WSN). In this paper, we have evaluated the performance of EEASSCR WSN protocol and compared with EASSCR, LEACH and SEP protocol. Comparative analysis showed performance of EEASSCR protocol is better as compared to EASSCR, LEACH and SEP protocol. EEASSCR protocol performs better in terms of delay, packet loss, throughput and residual energy. Further the performance of EEASSCR is needed to improve for the higher energy efficiency and accuracy in terms of delay and Packet Loss.

REFERENCES


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