Lookup based Energy Efficient Hybrid Approach for Wireless Sensor Network

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Abstract—Energy efficiency is one of the major crucial issues in Wireless Sensor Networks (WSN) as it has significant impact on the lifetime of the network. WSN consists of large number of sensor nodes having a constraint energy capacity so an energy efficient mechanism is important. This paper presents a hybrid protocol based on lookup table approach. The proposed protocol is a combined form of Weight-Based AODV (WBAODV) and Improved Dynamic Source Routing (IDSR) protocols, and is named as Lookup based Hybrid Distance Vector Dynamic Routing (LHDVDR) protocol. The simulation tool used here is NS-2. The simulation results show that the performance of LHDVDR in terms of throughput, average delay and packet delivery fraction is better than the other two protocols.

Index Terms—WSN, AODV, DSR, WBAODV, IDSR, LHDVDR

I. INTRODUCTION

Wireless sensor network is a combination of different technologies like wireless communication, information technology and electronic field. A sensor network is composed of large number of sensor nodes, which are densely deploys either inside the phenomenon or very close to it [1]. Due to node deployment recharging sensor nodes is normally impracticable. Thus energy saving routing protocols in wireless network is necessary for increasing the network life time.

Various hybrid routing protocols have been proposed to meet the application requirements of wireless sensor networks.

Routing protocols can be classified depending on the network structure, protocol operation, and initiator of communication. Fig. 1 shows the categorization of the routing protocols. Routing path can be established in one of the three ways i.e. proactive, reactive or hybrid.

Fig.1 shows the architecture of wireless sensor network. It consists of sensor field, sensor node, sink and task manager. A sensor network is composed of a large number of sensor nodes which are capable of sensing, data processing, and communication.

In traditional network they are created for general purpose but wireless sensor network is concerned for single application at a time as the energy conservation is the main constraint in WSN. As this leads to the introduction of various energy efficient protocols to meet the problems related to conservation of energy and increase the lifetime of network. Wireless sensor networks are environment-driven. While data is generated by humans in traditional networks, the sensor network generate data when environment changes.

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Applications of wireless sensor networks can be categorized into military applications, home applications, medical applications, environmental monitoring etc. Depending on the application, different architectures and design goals/constraints have been considered for sensor networks such as Network dynamics, Node deployment, Energy considerations, node capabilities and data aggregations.

An overview of routing protocols is presented in section II. In section III reactive protocols are discussed and in section IV the proposed scheme is being presented. The results and discussions are presented in section V. Finally, section VI contains conclusions and future scope of the work.

II. LITERATURE SURVEY

Routing protocols in Wireless sensor network have to deal with a number of challenges and design issues [12]. Energy efficiency is the main issue in designing a routing protocol. So in this section a few energy efficient approaches are discussed.

Radius self-adjusting routing protocol was presented for wireless sensor network. Using this protocol the node reduces its max transmission radius only to reach the farthest neighbor before it sends the first packet. Here the on-demand route discovery process is initiated and an energy saving strategy has been designed. In order to slow down the energy consumption speed, the sensor node readjusts the transmission radius when remaining energy reaches the threshold [2].

One of the major issues in wireless sensor networks is developing a routing protocol which has a significant impact on the overall lifetime of the sensor network [10]. VLEACH was proposed with an aim to reduce energy consumption within the wireless network. It was based on clustering approach and simulations results showed that it was effective in prolonging the network lifetime compared to original version of LEACH protocol.

Zone routing protocol ZRP combines the advantage of DSDV and DSR and results in a hybrid scheme, taking advantage of pro-active discovery within a node’s local neighborhood, and using a reactive protocol for communication between these neighborhoods [8].

A comprehensive survey on energy efficient routing protocols was made in wireless sensor networks. It focused on the techniques that these protocols use in order to route messages, taking into consideration the energy they consume and how they achieve tominimize this consumption and extend the lifetime of the network[12].

A hybrid protocol based on Look up Table approach was proposed. Different Routing Protocols were studied and on the basis of their performance and nature a hybrid protocol was implemented. The scheme consisted of the lookup database according to the property and efficiency of the protocol. It combined DSDV and DSR routing protocol as DSDV is suited for small networks and DSR consist of route discovery and route maintenance [11].

III. REACTIVE ROUTING PROTOCOLS

For Messages to be transferred to the sink node, a path has to be established. Depending on the path establishment, wireless sensor network protocols can be classified as reactive, proactive and hybrid protocols [7]. Fig 2 shows the classification of routing protocols. Reactive protocols are demand-driven protocols which establish the path only when required. A number of reactive protocols have been proposed so far. The AODV and DSR protocols also fall under this category.
A. Ad-Hoc on demand distance vector (AODV)

Ad hoc on demand distance vector is a well known wireless ad hoc network protocol. It is based on destination sequenced distance vector. It uses a broadcast route discovery mechanism and it relies on dynamically established routing table entries and intermediate nodes. The function performed by AODV protocol includes local connectivity management, route discovery, route table management and path maintenance. [3].

![Routing protocols in WSNs]

Figure 2. Classification of WSN Routing Protocol

B. Dynamic Source Routing (DSR)

The key distinguishing feature of DSR is the use of source routing which means the sender knows the complete hop by hop route to the destination [7]. It is a simple and efficient routing protocol designed specifically for use in multihop wireless ad-hoc networks of mobile nodes. DSR allows the network to be completely self organizing and self configuring, without the need for any existing network infrastructure. The DSR protocol allows nodes to dynamically discover a source route across multiple network hops to any destination in the ad-hoc network.

IV. Proposed Approach

The proposed Protocol is based on hybrid scheme that uses lookup table approach. This Scheme contains the lookup database for the protocol according to the property and efficiency of the protocol. The current scheme combines the best features of the following discussed protocols.

A. Weight Based AODV (WBAODV)

WBAODV is on demand protocol. It works dynamically to adjust the routing traffic based on the network configuration [3]. Like AODV, the WBAODV protocol includes two stages: routing discovery and routing maintenance.

When a source node has packets to deliver, it initiates the routing discovery stage to find routes to select the destination. In this stage the protocol WBAODV periodically monitors and collects data that reflects the network status. During the maintenance stage, the WBAODV adjusts its routing decision based on current and predicted network load and link stability.

The weight of a route is decided by four factors are the speed of the nodes, the power level of battery, the bandwidth and the hop count [3].

B. Improved DSR (IDSR)

It is an improved form of DSR protocol. It works same as DSR i.e. two stages route discovery and route maintenance but for constrained bandwidth a probabilistic flooding method is introduced in IDSR [4].

The probability for flooding is determined according to the number of neighboring nodes around a relaying node. In route maintenance, for the dynamically changing channels, communication often become unstable or asymmetric and the neighbor nodes usually become unreachable. For path failure management consideration is made that each node knows the distance and impedance matching condition.

Various Approaches are followed and better protocols are being introduced in order to meet the issues and challenges of WSN applications. Current scheme contains the Look up database for the protocol according to the property and efficiency of the protocol.

The following steps are proposed for the look up table working:

1. Send in the data for routing
2. If both are acting same at the same place then use much more
   i) Traffic
ii) Long Distance (route discovery)
iii) Energy consumed
iv) Congestion.

3. Selection of routing protocols will be decided by Lookup Agent. Based on the feature of routing protocol, agent will select the appropriate routing protocol for efficient data transmission and will save the energy.

V. SIMULATION

In this section, simulation environment and performance metrics used in the analysis of LHDVDR, WBAODV and IDSR protocols is described.

A. Simulation Scenario

For simulations we have used Network Simulator 2. The detailed simulation information is depicted in table 1.

<table>
<thead>
<tr>
<th>TABLE I. SIMULATION PARAMETERS</th>
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<tbody>
<tr>
<td>Parameter</td>
</tr>
<tr>
<td>Channel Type</td>
</tr>
<tr>
<td>Network Interface Type</td>
</tr>
<tr>
<td>Mac Type</td>
</tr>
<tr>
<td>Routing Protocols</td>
</tr>
<tr>
<td>Interface Queue Type</td>
</tr>
<tr>
<td>Antenna Model</td>
</tr>
<tr>
<td>Queue Length</td>
</tr>
<tr>
<td>Number of Nodes in Topography</td>
</tr>
<tr>
<td>X and Y Dimensions of Topography</td>
</tr>
<tr>
<td>Time of Simulation End</td>
</tr>
</tbody>
</table>

B. Metrics

The performance metrics considered for analysis of these protocols are:
Throughput: Throughput is a measure of amount of data delivered by a source node at the destination per unit time.

End-to-End Delay: The difference between the time when packet is sent by the resource and when it is received by the receiver.

Packet Delivery Fraction: The ratio of data packets delivered to the destinations to those generated by the CBR sources is known as packet delivery fraction.

V. RESULTS AND DISCUSSIONS

In order to evaluate the performance of the proposed hybrid Protocol (LHDVDR) and to compare it with WBAODV and IDSR, the parameters discussed in the above section were considered. Following are the results.

A. End-to-End Delay

The Fig.4 shows the comparative end to end delay analysis for LHDVDR, WBAODV and IDSR protocol on varying the offered load. It clearly shows that LHDVDR performs well as compared to the other two protocols having lowest end-to-end delay as compared to the other two protocols.

![Figure 4. End-to-End Delay for LHDVDR, WBAODV & IDSR](image)

B. Throughput

Throughput refers to how much data can be transferred from one location to another in a given amount of time. The Fig. 5 shows the better performance of LHDVDR as compared to IDSR and WBAODV having highest throughput.

C. Packet Delivery Fraction

Fig 6. shows the simulation comparison of the three protocols. In the beginning of the simulation the packet delivery fraction is high for wbaodv as compared to LHDVDR and IDSR, but as the pause time increases pdf for LHDVDR becomes high and that of WBAODV lower down.

![LHDVDR WBAODV IDSR](image)

The average values of the considered parameters for each protocol has been also evaluated. These average values are summarized in the comparison table of the three protocols with respect to the parameters.

VI. CONCLUSIONS

In this Paper, various routing protocols were studied. Proposed hybrid protocol LHDVDR and the other two protocols WBAODV and IDSR were implemented in network simulator based on some important
performance metrics. The metrics considered during simulation were end-to-end delay, throughput and packet delivery fraction.

Figure 5. Throughput for LHDVDR, WBAODV & IDSR

Figure 6. PDF for LHDVDR, IDSR and WBAODV

<table>
<thead>
<tr>
<th></th>
<th>LHDVDR</th>
<th>WBAODV</th>
<th>IDSR</th>
</tr>
</thead>
<tbody>
<tr>
<td>THROUGHPUT</td>
<td>485.35</td>
<td>211.26</td>
<td>164.71</td>
</tr>
<tr>
<td>PDF</td>
<td>16.72</td>
<td>11.62</td>
<td>12.24</td>
</tr>
<tr>
<td>END TO END DELAY</td>
<td>26.61</td>
<td>33.11</td>
<td>34.09</td>
</tr>
</tbody>
</table>

According to the approach used, it leads in the selection of the best protocol performance in the created one. From the above results, it shows that the Hybrid protocol Lookup based Hybrid Distance Vector Dynamic
Routing (LHDVDR) shows better results in terms of throughput, end-to-end delay, and packet delivery fraction. So, the proposed hybrid protocol outperforms the other two protocols—Weight Based AODV (WBAODV) and Improved DSR (IDSR). As per look up based table approach we have used two protocols. In future multicast routing protocols can be implemented as a hybrid scheme and parameters will be tested for energy efficiency as well.

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REFERENCES