ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

DESIGN AND VALIDATION OF EEDR ROUTING PROTOCOL PERFORMANCE IN WIRELESS SENSOR NETWORKS

Pramod M S[*1] & Shivashankar[2]
[*1&2]Department of Electronics & Communication Engineering, Sri Venkateshwara College of Engineering, Bengaluru

DOI: 10.5281/zenodo.1414084

ABSTRACT

In this paper, the design and validation of new routing approach called Energy Efficient Distributed Receiver (EEDR) is proposed. The receiver-based routing protocol relies on the receiver node to discover paths between the sender node and the receiver node. It reduces the transmission of control packets and hence reduces the energy consumption in the network. Since the exchange of control packets are reduced, the time consumption in data transfer is also reduced and this makes the improvement in the network life time and overall network reliability. The main performance criteria in this proposed work is reduction in the energy consumption and reducing the routing overhead. The routes are discovered on the basis of channel quality and the impact of transmitted power, noise, path loss and signal bandwidth for the establishment of the route is taken into consideration.

1. INRTODUCTION

Wireless Sensor Networks (WSNs) poses formidable design challenges in energy constrained operation, communication range, memory and processing power constraints, bandwidth constrained links, Dynamic network topologies and Network traffic patterns [1-3]. These new-found types of networks are largely dictated by application requirements and characterized by severe resource constraints in terms of available energy, computational and communication capabilities [4]. Routing is one of the significant design considerations in WSNs, more especially under severe energy constraints; with the exchange of routing control packets increasing power-consumption from the small, non-rechargeable and hard to replace batteries [5].

WSN communications is still a developing concept with wide open areas of research. WSNs are being used for a variety of services. The main challenges of WSN are network bandwidth reduction, collision occurrence and performance deterioration [6]. A mixed mode routing scheme is a technology which combines address based routing mode and data centric routing mode. An additional field is added to the control packet known as target field which adds information about the range to which node must broadcast which decreases large amount of control packets that are exchanged.

In this paper, we propose the design and validation of Energy Efficient Distributed Receiver (EEDR) algorithm for mobile sensors in the Network. The proposed mechanism uses information related to channel information, the transmission range of sensor nodes, Channel Quality Indicator (CQI) and Minimum Hop.

2. RELATED WORK

There is a need to find an approach which low energy consumption and low latency. The work in [7] considers the issue of streamlining the organization of topology to improve the system lifetime in WSNs and utilizing the graph filters. Since this issue is perplexing furthermore and combinatorial, the effective polynomial time heuristic calculations are enlivened from the aftereffects of Genetic Algorithms (GA). This type of decision making increases the Lifetime of the Network.

In paper [8] there is a description of Mobile Ad-Hoc Networks (MANET) that the nodes will be able to move and synchronize with their networks. It also provides the simulation analysis of Destination-Sequenced Distance-Vector Routing (DSDV), Ad hoc On-Demand Distance Vector (AODV) and Dynamic Source Routing

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

(DSR) using Network Simulator (NS2). MANET can be classified into 3 kinds of routing protocols namely Table Driven, Source Initiated and Hybrid. DSDV is a proactive routing protocol. The Proactive routing protocol discovers the routes in advance. This increases Routing Overhead and reduces the Throughput. AODV is a routing protocol which is source initiating. AODV is a reactive routing protocol and discovers the routes only when it is not available in the route cache. The AODV sends a RREQ to its neighbors and then neighbors will send to their neighbors and process is repeated until the destination node is reached. DSR is a proactive protocol which is similar to AODV protocol. DSR stores the complete route towards destination whereas AODV stores only next node.

In paper [9] proactive routing algorithms have been described. DSDV routing algorithm is simulated and then the performance analysis of DSDV is performed on Constant Bit Rate for many loads.In the paper [10] the implementation of AODV routing algorithm has been described. The AODV exchanges a series of messages like HELLO, Route Request (RREQ), Route Reply (RREP), sends a DATA. if any error occurs it sends RRER packet. The description of architecture how to implement AODV on a Linux machine is also described in detail.

WSNs are being used for a variety of services [11]. Day by Day number of services is increasing and huge amount of user population can be used. The main challenges WSN is facing today are network bandwidth reduction, collision occurrence and performance deterioration. A mixed mode routing scheme is a technology which combines address based routing mode and data centric routing mode. An additional field is added to the control packet known as target field which adds information about the range to which node must broadcast which decreases large amount of control packets that are exchanged.

Cross-layer optimized geographic node-disjoint multipath routing algorithm [12] has two phases. In the first phase Physical layer transmission adjust the transmission range based on the remaining energy of the nodes. During the second phase sleep scheduling is executed which improves the network lifetime by making the nodes to sleep at regular intervals.

3. METHODOLOGY

3.1 Node Deployment

Node Deployment Algorithm is responsible for formation of network by randomizing the placement of the nodes within the limits $\{x_{min}, x_{max}, y_{min}, y_{max}\}$. x_{min} is the minimum value of x end point,x_{max} is the maximum value of x end point. y_{min} is the minimum value for the y end point and y_{max} is the maximum value of y end point. Node Deployment places the nodes in the network and also generates a matrix known as Node Deployment Matrix which is of order$N$*3. Where N is the number of nodes in the network. The first column will be Node ID, Second column is the x position for the node and Third Column is the y position for the node.

3.2 EEDR Routing Metrics

EEDR routing protocol based on the receiver node performs the broadcasting of the CRN packets. The next hop of the node will be decided among the intermediate nodes towards the sender node. We assume that the EEDR routing protocol only needs the senders address and the receivers address to decide on the next hop of the route.

3.2.1 End to End Delay

End to End Delay is the time taken for the data to go from the source node to destination node.

$$End\ to\ end\ delay = t_{stop} - t_{start} \quad (1)$$

Where,
t_{start} = time at which data is sent
t_{stop}= time at which data is received

3.2.2 Energy Consumption

The total energy consumption is given as follows

$$E_c = \sum_{i=1}^{l} E_c(i) \quad (2)$$

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

Where, L = Number of links
$E_c(i)$= Energy consumed across i^{th} link

The energy consumed is calculated as:

$$E_{tx} = E_{elec} * k + E_{amp} * k * d^{\delta} \tag{3}$$

$$E_{rx} = E_{elec} * k \tag{4}$$

$$Energy\ Consumed = E_{tx} + E_{rx} \tag{5}$$

Where,
E_{elec} = Energy consumed for driving the transmitter or receiver circuitry.
E_{tx} = Energy required for transmission of packet.
E_{rx} = Energy required for reception of packet.
E_{amp}= Energy required for packet generation.
k = bit length of the message.
d = distance between the nodes
δ = Attenuation factor $0.1 \leq \delta \leq 1$

3.2.3 Residual Energy
Whenever a node participate in routing then the battery energy gets updated using the following condition

$$Updated\ Energy = Current\ energy - Energy\ Consumed \tag{6}$$

$$R_e = \sum_{i=1}^{n} R_{e_i} \tag{7}$$

Where,
R_e = Residual energy of the network
R_{e_i} = Residual energy at i^{th} node

3.2.4 Number of Alive Nodes
This is defined as the count of set of nodes whose battery level is greater than or equal to *B/4* Where *B* is initial Battery Power. Only active nodes will involve in the route discovery, route maintenance and data transmission.

3.2.5 Routing Overhead
The routing overhead is defined as the ratio of total number of control packets to total number of data packets.

$$Routing\ Overhead\ \frac{Number\ of\ control\ packets}{Number\ of\ data\ packets} \tag{8}$$

4. MULTIPLE ROUTE DISCOVERY IN EEDR

4.1 EEDR multiple route discovery
The steps involved in multiple route discovery in EEDR Algorithm are as follows:

1) Source Node , Destination Node, Transmission Range and *TTL*
2) Find the Neighbor Nodes
3) Find the length of neighbor nodes
4) Start from the first node till all the neighbor nodes
5) Perform Individual Route Discovery using EEDR between Source Node and Destination Node.
6) Cache the route
7) Repeat process until all routes are found.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

Fig.1 shows the flowchart of multiple route discovery in EEDR. It starts with the deployment of nodes and multiple routes are discovered between the sender and receiver.

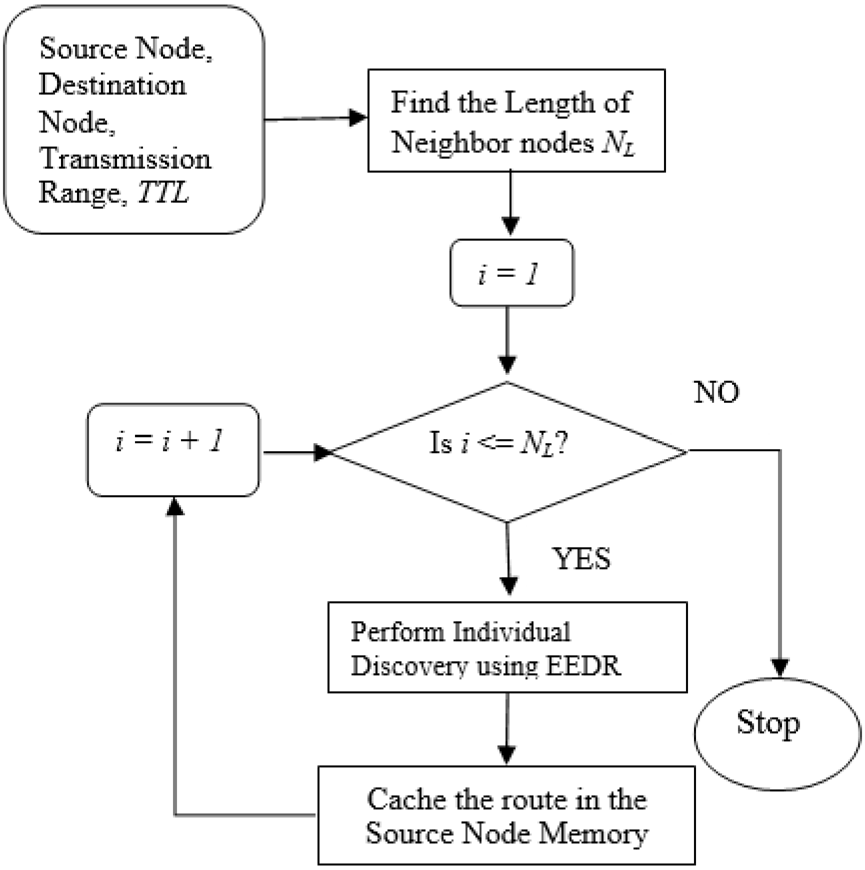

Fig.1: Multiple Route Discovery

4.2 Individual EEDR Algorithm

Individual EEDR route discovery algorithm can be described in the Fig.2. The fig shows source node, destination node, transmission range and *TTL* acts as an input. The routing table is generated for all the nodes in the network. The first step is to find the set of neighbor nodes. If the neighbor nodes have the destination node then the process is stopped. The second step is to compute the *CQI* values for all the neighbor nodes. The third step is to find the maximum *CQI* value and the corresponding node. The fourth step is to compute value of Time-To-Live (*TTL*) period. If *TTL* value is non-zero then process is repeated. If *TTL* is zero then shortest path algorithm is triggered.

The Shortest path implementation is described as follows

1. Source Node, Destination Node & Transmission Range acts as an input.
2. The neighbor nodes are computed w.r.t Source Node.
3. If the neighbor nodes has the destination node then stop the process.
4. If the Destination node is not present then jump to Step5.
5. Compute the distance of each of the neighbor w.r.t destination
6. Find the node which corresponds to minimum distance.
7. Repeat the process until destination is reached.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

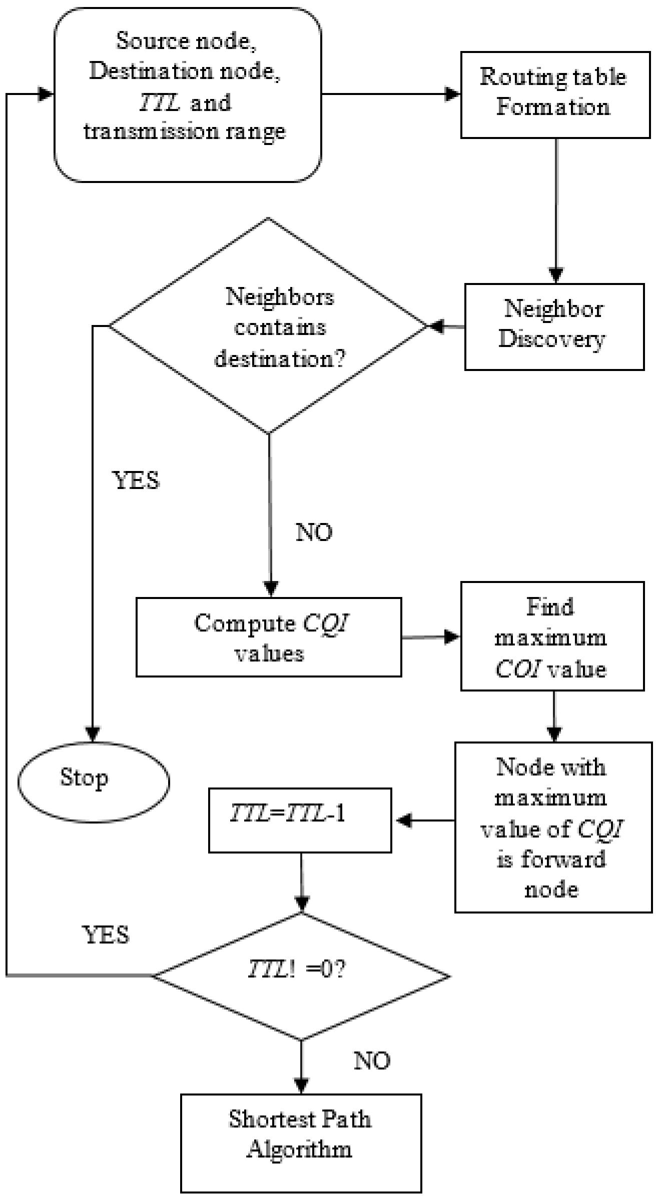

Fig.2: Individual Route Discovery

Fig.3 shows the flowchart of shortest path implementation. The neighbor nodes are discovered and checked for destination. The distance of every intermediate node with respect to destination is calculated and the minimum distance is found.

The following are the steps for Best Route Discovery EEDR

1) Multiple Routes acts as an input
2) Compute the *CQI* across Multiple Routes
3) Find the maximum value of *CQI*
4) Route corresponding to maximum value of *CQI* is the Best Route

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

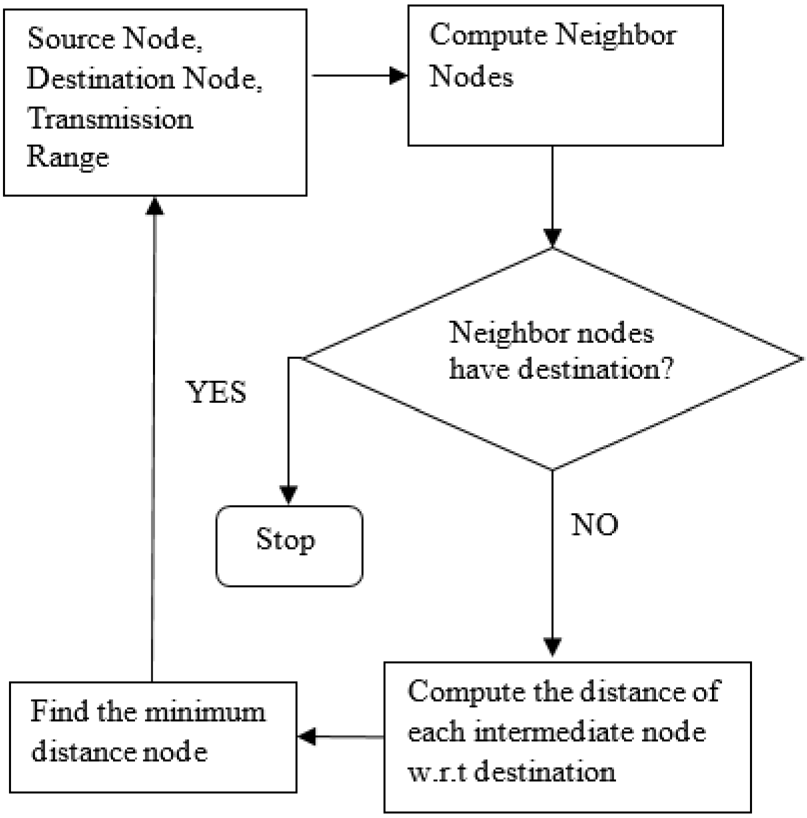

Fig.3: Shortest path implementation

5. RESULTS

This section discuss the validation results of the proposed EEDR routing in comparison with the existing AODV and DSDV routing protocols.

TABLE 1 shows the simulation parameters chosen for execution of the work.

Table 1: Simulation parameters

Parameter Name	Value
Number of Nodes	50
Initial Energy of nodes	3000mW
Topology area	1000m x 1000m
Transmission Range	1-100m
Energy required for transmission	15mJ
Attenuation Factor	0.5
Sender Node	2
Receiver Node	25
Time to leave	4

Fig.4(a) shows the multiple routes discovered in EEDR routing. The best route chosen among all the routes based on the maximum *CQI* and is as depicted in Fig.4(b).

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

Routes Information EEDR

Route No	Route
1	2------> 1------> 5------> 9------> 13------> 17------> 21------> 25------>
2	2------> 2------> 6------> 10------> 14------> 18------> 22------> 25------>
3	2------> 4------> 8------> 12------> 16------> 20------> 24------> 25------>
4	2------> 5------> 7------> 11------> 15------> 19------> 23------> 25------>
5	2------> 6------> 3------> 7------> 11------> 15------> 19------> 23------> 25------>

Fig.4(a): EEDR multiple Routes

Best Route Information -EEDR

Best Route	Best CQI
2------> 5------> 7------> 11------> 15------> 19------> 23------> 25------>	40062.48

Fig.4(b): Bets route discovered

The Performance parameters of EEDR are as below

Performance EEDR

Time Taken (ms)	Total Hops	Energy Consumed	No Of Alive Nodes	No Of Dead Nodes	Lifetime Ratio	Remaining Energy	Routing Overhead	Throughput
1613.0	41	845.2988591338164	50	0	1.5	487237.4406766631	0.082	0.6199628022318661

Fig.5: Performance analysis.

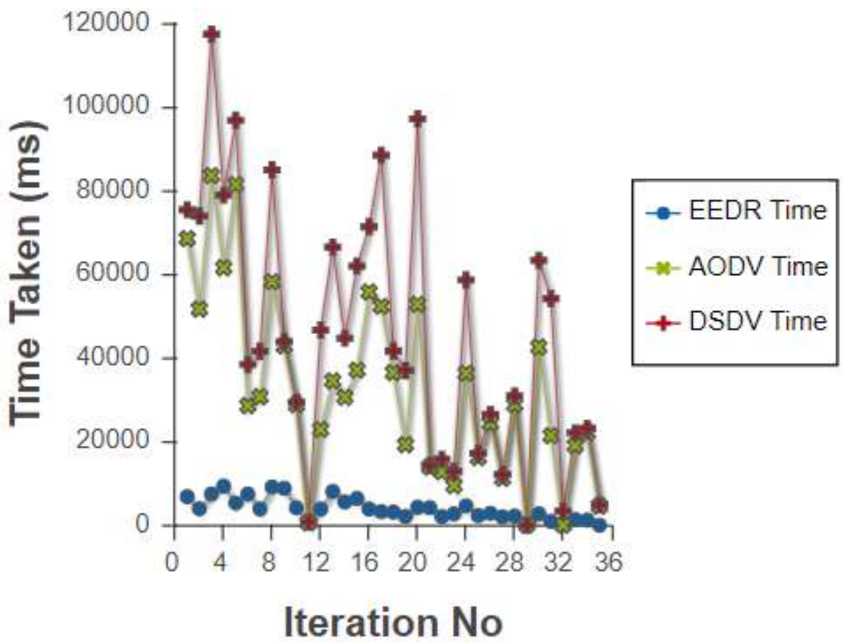

Fig.6: Time taken v/s no. of iterations

Fig.6 shows the graph of end-to-end delay. The EEDR routing has the lowest delay compared to existing AODV and DSDV protocols.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

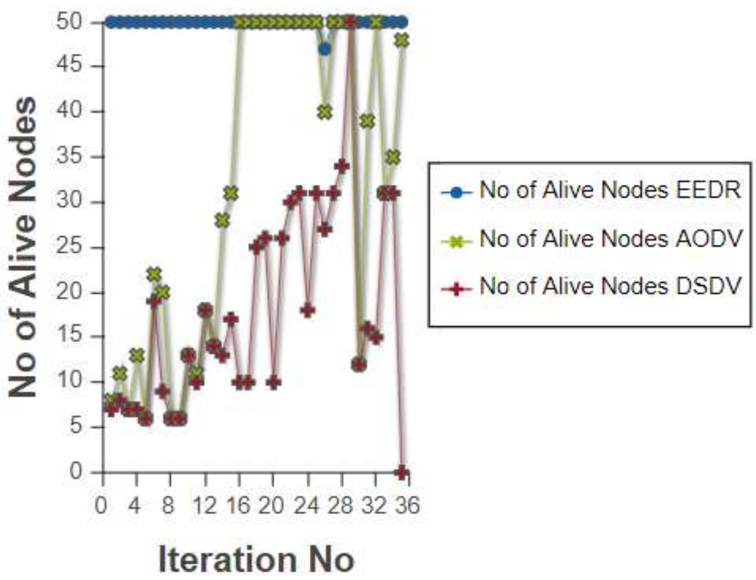

Fig.7: Number of Alive Nodes v/s no. of iterations

Fig.7 shows the number of alive nodes comparison. The EEDR has highest number of alive nodes compared to AODV and DSDV routing protocols.

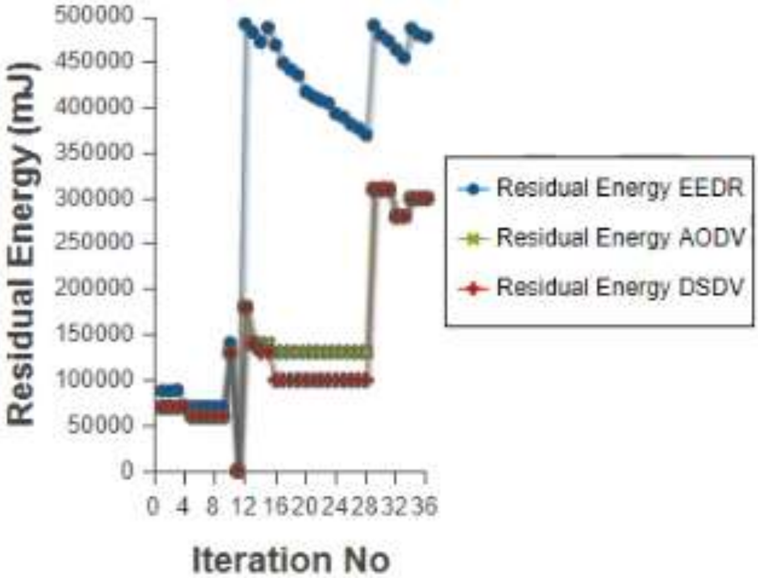

Fig.8: Residual energy v/s no. of iterations

Fig.8 shows the residual energy comparison. The EEDR has highest residual energy compared to AODV and DSDV routing protocols. Fig.9 shows the routing overhead comparison. The EEDR has lowest routing overhead compared to AODV and DSDV routing protocols.

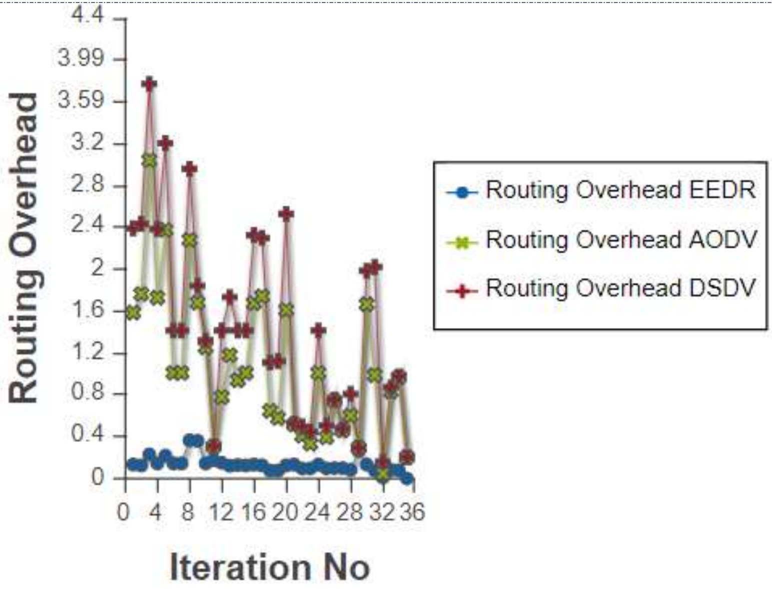

Fig.9: Routing overhead v/s no. of iterations

6. CONCLUSION

In this work, a new protocol called EEDR routing protocol is implemented and validated. The route establishment starts from the receiver side. The route establishment and maintenance is explained and the performance comparison of EEDR protocol is carried with the reactive and proactive protocol. AODV of reactive and DSDV of proactive routing protocols are considered for the performance analysis. The outcome of the proposed work is reduction in consumption of energy, reduced delay, reduced and routing overhead. The number of alive nodes are more in the proposed EEDR routing than the existing AODV and DSDV routing protocols.

REFERENCES

[1]. Hafiz Husnain Raza Sherazi, Luigi Alfredo Grieco, Gennaro Boggia, "A comprehensive review on energy harvesting MAC protocols in WSNs: Challenges and tradeoffs", Elsevier-Ad Hoc Networks, Vol. 71, pp. 117-134, 2018

[2]. Kgotlaetsile Mathews Modieginyane , Babedi Betty Letswamotse , Reza Malekian, Adnan M. Abu-Mahfouz, "Software defined wireless sensor networks application opportunities for efficient network management: A survey", Elsevier-Computers and Electrical Engineering, Vol.66, pp. 274-287, 2018

[3]. Nandkumar Kulkarni, Neeli Rashmi Prasad and Ramjee Prasad, "Q-MOHRA:QoS Assured Multi-Objective Hybrid Routing Algorithm for Heterogeneous WSN", Springer-Wireless Personal Communications, Vol.100, no.2, pp. 255-266, 2018

[4]. FadiAl-Turjman, "QoS—aware data delivery framework for safety-inspired multimedia in integrated vehicular-IoT", Elsevier- Computer Communications, Vol. 121, pp. 33-43, 2018

[5]. David Airehrour, Jairo A. Gutierrez and Sayan Kumar Ray, "SecTrust-RPL: A secure trust-aware RPL routing protocol for Internet of Things", Elsevier-Future Generation Computer Systems, 2018

[6]. Bharat Bhushan and Gadadhar Sahoo, "Recent Advances in Attacks, Technical Challenges, Vulnerabilities and Their Countermeasures in Wireless Sensor Networks", Springer- Wireless Personal Communications, Vol. 98, Issue 2, pp. 2037–2077, 2018

[7]. Leila Ben Saad, Thilina Weerasinghe and Baltasar Beferull-Lozano, "Topology Design to Increase Network Lifetime in WSN for Graph Filtering in Consensus Processes", IEEE 25th European Signal Processing Conference (EUSIPCO), pp. 351—355, 2017

[8]. Abdullah A. Al-khatib and Rosilah Hassan, "Performance Evaluation of AODV, DSDV, and DSR Routing Protocols in MANET Using NS-2 Simulator", Springer- International Conference of Reliable Information and Communication Technology, pp. 276—284, 2017

[9]. Miralem Mehic, Oliver Maurhart, Stefan Rass and Miroslav Voznak, "Implementation of quantum key distribution network simulation module in the network simulator NS-3", Springer-Quantum Information Processing,Vol. 16, no.10, p.253, 2017.

[10]. Nirbhay Kumar Chaubey, "Security Enhancement and Minimized Delay of Neighbour Defence Technique For AODV (NDTAODV) Routing Protocol by Varying Network Size in MANETS", International Journal of Computer Science and Mobile Applications, Vol.5, Issue 10, pg. 204-212, October- 2017
[11]. Vennila Santhanam and D.B. Shanmugam, "Integrating Wireless Sensor Networks with Cloud Computing and Emerging it Platforms Using Middleware Services", International Research Journal of Engineering and Technology, Volume: 05 Issue: 08, Aug 2018
[12]. Xi Chen, Yixuan Xu and Anfeng Liu, "Cross Layer Design for Optimizing Transmission Reliability, Energy Efficiency, and Lifetime in Body Sensor Networks", Sensors- Multidisciplinary Digital Publishing Institute, Vol.17, no.4, p. 900, 2017

CITE AN ARTICLE

Pramod, M. S., & Shivashankar. (2018). DESIGN AND VALIDATION OF EEDR ROUTING PROTOCOL PERFORMANCE IN WIRELESS SENSOR NETWORKS. *INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY, 7*(9), 194-203.