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# Energy Consumption and Packet Loss Analysis of LEACH Routing Protocol on WSN over DTN

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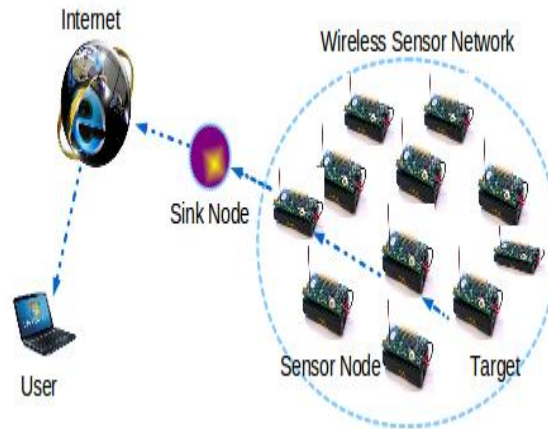
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**ABSTRACT:** Wireless sensor network is a group of nodes that are connected to each other by wireless connection. These type of network work on the dynamic topology of the network because positions of nodes in the wireless network are changing continuously. The nodes in WSN are basically made up of small electronics device which are used for sensing, computing and transmitting the data. The nodes are run on the battery power during communication process. The battery consumption in WSN is very high due to high computation operations on it. In the recent years WSN grows at very high at the research area is also increased in this field to provide effective computation. By considering the network structure routing is categorized into two parts that are flat and hierarchical routing. In this proposed work cluster are made by WCA-GA (Grey Wolf optimization) on the basis of distance and energy parameters. The cluster head is also selected on the basis of WCA-GA and EXISTING-DTN in three different metrics. At the end the performance evaluation of the proposed work is compared with the existing approach Leach on the parameters of Throughput, Dead node, Alive nodes, energy.

**KEYWORDS:** Grey Wolf Optimization, Flower Pollination Algorithm, Infrastructure as a Service, Virtual machines.

## I. INTRODUCTION

The distinct advancement done in the field of wireless technology possibly developed the use of wireless sensor networks (WSN) consisting of small devices which are used for collecting the information with proper cooperation planning with each of its part. These small type of devices are generally known as the nodes and it consists of memory used for storing the data, CPU for data processing, transceiver enabling the communication signals between the sender and the receiver, and the battery for energy fulfilling requirements. The sizing of each and every sensor node varies according to the applications in use. For example, in surveillance or military-based applications it might be assumed very small (microscopically) and the cost is dependent on its parameters such as processing speed, battery, and memory size. Wireless Sensor Networks (WSN) as referred to [1, Fig.1.1] are the application based networks which consists of a number of sensor nodes. It represents an arrangement of many sensor gadgets which speak with wireless networks with the assistance of restricted vitality expending steering conventions.



**Figure.1.1 Wireless Sensor Network**

WSN are thick wireless networks of little, cheap, low-control, disseminated self-ruling sensors which amass and proliferate natural information to encourage checking and controlling of physical conditions from remote areas with better exactness. For the most part, it is accepted that every sensor in a system has certain limitations as for its vitality source, power, and memory and figuring capacities. It contains a door that gives wireless network back to the wired world and dispersed nodes. It can likewise be characterized as a system of gadgets that can impart the data accumulated from an observed field through wireless connections. The information is sent through different nodes with an entryway and the information is conveyed to different networks like wireless Ethernet. These networks are utilized to control physical or ecological conditions like sound, weight, temperature and so forth. WSN nodes have constrained battery limit. As the use of WSN is increasing rapidly and simultaneously this technology is facing various major challenges of energy constraints depending upon the limited lifetime of batteries as each of its node relies on energy demand for performing the basic operational activities which has become the major reason behind the failure in wireless sensor networks. One node interruption may result in shutting down the overall operation of the system. The nodal operation relies on active mode, idle, and sleeping modes. In case of active modes, energy is consumed while transmitting or receiving the data. In case of idle mode, the node consumes the energy same as consumed in active type node whereas in case of sleeping mode, the node gets shut down in order to save the energy. To build the life expectancy of WSN the usage of vitality in a productive way is a most normal issue. As the utilization of WSN are expanding at a very fast pace and using numerous varieties of sensors with limited batteries for target following, physical condition observing and so on. These applications require fast correspondence between sensor nodes. The WSN technology uses the following steps to keep the safe for its longer usage.

**1. Flat Based Routing:** Such kind of routing technique is used in identical network with randomized parameters guidance. All the network nodes are of same type and the multi hop route is used to optimize the network route. In most of the intra- cluster mobile network, these kind of routing approach is been used to carry out the network communication. This routing approach works on the destination adaptive and data adaptive communication carried out over the network. The network also has the multi case communication to minimize the communication effort. To carry out the multi cast communication aggregative communication approach is adaptive in these networks. Such kind of routing technique also requires minimizing the number of intermediate nodes as well as minimizing the communication effort of each involving node over the network. Such kind of communication route read the next neighbor under different physical and communication parameters and choose the node with effective throughput and minimum expected loss and delay. The work is about to minimize the flooding by capturing the routing information as well as minimize the redundancy in communication [6]. The work is also effective to carry out the broadcasting of the network as well as effective hop selection over the network. The process based on multi-hop flat routing protocol led to the formation of another form of routing known as data centric routing. Here, in case of data centric based protocol, the sink send certain queries to a specified selected region and waits for the data or information from the sensor nodes. The first data-centric protocol used is



named as SPIN. In order to remove the redundancy of data, the SPIN performs data negotiation between the sensor nodes. After the discovery of SPIN many other data-centric protocols were developed as explained briefly in the section.

**(a) SPIN (Sensor Protocols for Information via Negotiation):** The planning done behind the SPIN methodology was to perform data naming using descriptors or meta-data of very high level.

Swapping of meta-data is done among the sensing nodes before the process of transmission via data-advertising strategy that forms the basic key feature of the SPIN protocols. When the node receives the newly formed data it unfolds the data to its neighbors and the neighbors that are interested extract the data by sending the data request to the sensor node. The SPIN negotiation property helps in solving the major redundancy issues. There are basically three types of messages for the data exchange process in SPIN technology:

These are: Firstly, the ADV type message which permits sensor to perform the task of advertising a specific type meta-data. Secondly, the DATA type message that carries the original (actual) data and thirdly, REQ based message which performs the requesting data operation. In this SPIN protocol, the topological transformations are usually of localized form as each and every node needs to have or to know its single-hop type neighbors.

**(b) Directed Diffusion (DD):** This was developed after the SPIN protocol. The main objective of Directed Diffusion to diffuse the data through the sensing nodes with the help of utilization of data naming scheme. It requires the utilization of pairs of attributes based values for the data and queries the sensors on urgent demand basis with the use of the pairs discussed. The query based procedure is set up on interest basis using listed forms of attribute-value pairs like geographical area, duration, objects name, interval, etc. This type of interest is further broadcasted by sink neighbors. The sensing nodes acquire flexibility of inward data aggregation and each of the node performs the catching operation for using it later. Further, the interest based catches are compared with interest based values. The entry of the interest consists of several gradient fields [7]. This gradient can be neighbor reply link from where the interest was received. Hence by utilization of the gradient and the interests, several paths forms between the sources and the sinks. The DDs are highly energy efficient as they occur on demand basis and there is no such need for keeping the network topology (globally).

**(c) Rumor Routing (RR):** It represents a compromising condition between the notifications of flooding events and the queries of flooding. The major plan of this type of protocol is to set up the paths leading to each and every event. Instead of flooding throughout the networks, a query gets generated and sent further randomly till it discovers the event based path. As the event based path gets discovered, it easily routes to the event directly and if in case the path is not discovered, the re-submission of query is tried. So, RR represents a very good class of query based delivery to the events within large networks.

## II. RELATED WORK

**Hong, Chao, et al. [21]** proposed hybrid beaconless geographic routing. In this approach data packets are divided into two type of packet that are normal packets and delay sensitive packets. It uses two kind of handshake mechanism for delay sensitive packets that are request to send and clear to send. Priority method is used for the channel assignment. The analysis of the proposed approach shows that delay sensitive packets have lower latency and higher packet delivery ratio and low energy consumption.

**Doudou, Messaoud, et al. [22]** Cascading wake-up MAC protocol is proposed low power wireless sensor network. This work mainly focused on energy/delay, optimization and switches between two modes on the basis of traffic type and delay. First mode is high duty cycle and second mode is low duty cycle these modes are used to adjust the wake-up nodes according to load. The proposed MAC protocol is compared with existing protocol and it performs better in energy saving and data delay reduction.

**Zhuo, Shuguo, et al. [23]** introduced Queue MAC a hybrid protocol which supports the CSMA and TDMA in variable traffic. When the load is light on the WSN then it uses contention based CSMA and transfer data with low delay and scattered transmission. When the traffic is high on WSN then it uses contention free TDMA mechanism and allocates the transmission slots. The proposed method reduced the packet buffering and packet delay by combining TDMA and CSMA. This method works effectively on single and multichannel modes.



**Jacob et al [24]** to reduce the energy consumption on the wireless sensor network PHY-MAC cross layer design is proposed by the author in this article. Sleep time vary according to the information comes from the physical layer. To solve this issue Sensor-MAC protocol is used which uses sleep-wake up cycles and enhance the performance of the system.

**McCarthy et al. [25]** proposed an Energy Conscious Opportunistic Routing Protocol (ECORP). This protocol allows energy conservation without changing the latency of the important packets. In this work energy harvest using solar panels and reduces the network traffic. This protocol reduced the network failure and enhances the lifetime of the network.

**Ruhrup, Stefan, et al. [26]** forwarder planarization (BFP) scheme determines correct edges of a local planar sub-graph without hearing from all neighbors. This paper also shows the impact of sub-graph on message complexity. Worst case message complexity is also measures in this paper. The simulation results of this paper also show that the average case message complexity by using CNG and GG. A theoretical framework is used for delay function.

**Wu, Shibo et al. [27]** presented the GPER geographical power efficient routing (GPER) for the wireless sensor network. In this routing process, each node is able to make local decision that how far to transmit the data. This protocol works in very scalable and power efficient way. Each node first establishes a sub-destination within its maximum radio range. The node, however, may decide to relay the packet to this sub-destination through an intermediary node, if this preserves power. The simulation result of this paper shows that it saves the energy and provides more efficient results.

**Frey et al. [28]** explained the design issues in the routing protocols of wireless sensor network. Author presents a routing technique based on geographic routing. Author surveyed on the different techniques of routing. In this author presents the beaconless routing algorithm. Author also discussed the effect of routing on the physical layer.

**Kalosha, Hanna, et al. [29]** described the Reactive face routing. The Beaconless Forwarder Planarization (BFP) scheme finds correct edges of a local planar subgraph at the forwarder node without hearing from all neighbors. Face routing then continues properly. Angular Relaying determines directly the next hop of a face traversal. Both schemes are based on the Select and Protest principle. In this method neighbor respond according to the delay function and do no violate the condition of sub-planner graph. It also explains the impact on message complexity. The simulation result shows that message complexity is average in CNG and GG.

**Zheng, Ming-Cai [30]** proposed minimum hop routing link reliability protocol for wireless sensor network. This protocol is mainly used to enhance the reliability in WSN. This protocol set the limits of the nodes to the neighboring node during data transmission. It also extends the period of the transmission to enhance the reliability. In this process communication overhead in not increased due to level space controlling

### III. THE PROPOSED METHOD

#### Water Cycle Algorithm (WCA)

The latest bio-inspired algorithm is the water cycle optimization algorithm. This algorithm's main concept is simulating the behavior of grey wolf living in a pack. They have a serious hierarchy of social dominance. Alpha is known as the level leaders and is responsible for decision making in the pack. The wolf pack persistence is based on the decision of alpha. Beta is known as the second level subordinate wolves. The beta operation is for help in making the decision for alpha or other activities.

Delta is known as the third level subordinate wolves. This category member consists of elders, scouts, hunters, caretakers, and sentinels. For region boundary observation and in any danger case, scouts are liable for the warning. The protection and pack's safety guarantee is given by sentinels. The expertise wolves are the elders, denoted as alpha or beta. Alphas and betas are helped by hunters while prey hunting and caring for the ill, weak, and wounded wolves by caretakers and providing food for a pack. Omega is the lowest level. All dominant wolves with omega wolves have to comply.

**Methodology Steps**

**Step1 :** Deploy the wireless Sensor network.

**Step2 :** Apply the leach routing process.

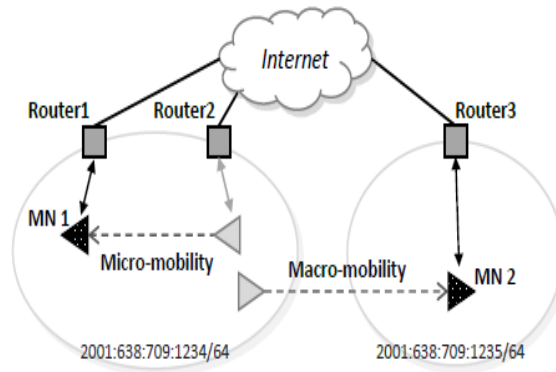
**Step3 :** Simulate the blackhole attack on the wireless Sensor network and parallel optimize by WCA algorithm.

**Step4 :** {  
 Initialize the water cycle optimization  
 • Update the fitness function.  
 • Check the objective function  
 • Check it optimize or not it optimized then analysis the time and dead node otherwise check the counter is greater than 0 or not. If the counter value is less than not converge and ignore the node during routing. Else again initialize the value at WCA.  
 }

**4.4 EXISTING-DTN**

The current trend encourages connecting the WSN to outside networks in order to allow remote data collection and control, which involves the use of the EXISTING-DTN protocol. From the viewpoint of network, there are two types of mobility: node mobility and network mobility. The node mobility is when a node (robot, vehicle, animal, etc.) changes its attachment point. While the network mobility occurs when a router, with all devices attached to it, changes its attachment point and all of these nodes appear as a single entity. This case of mobility can be found in many applications, such as military applications.

From the viewpoint of mobility, there are also two types of mobility, micro and macro mobility (Figure.3): (i) the micro-mobility is when nodes move within the same field (e.g. nodes move within the same network or to another network that uses the same EXISTING-DTN prefix). Within this area, a Mobile Node (MN) can change its access point without changing the EXISTING-DTN prefix. (ii) In contrast, the Macro-mobility is when nodes move between different areas.



**Figure 4.2 EXISTING-DTN Based Wireless sensors Network**

**IV. RESULT ANALYSIS**

**4.1 Result Analysis**

This chapter describes the detailed result or the proposed work by using tables and graphs of the results. The performance evaluation of the proposed WCA\_GA\_DTN Leach is compared with EXISTING-DTN Leach and with Leach also. The comparison based on the number of rounds and the nodes in the cloud. The comparison is based of the following parameters: -



- Live Nodes
- Dead Nodes
- Throughput
- Average residual Energy

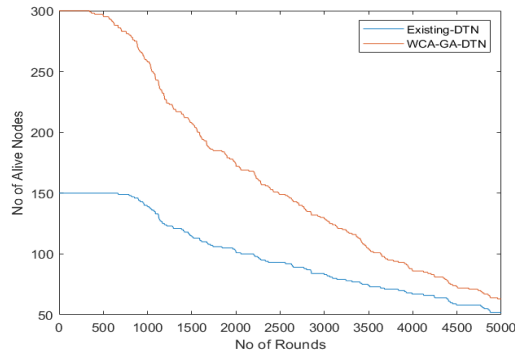


Figure 5.1 Number of live nodes in WCA\_GA\_DTN Leach and EXISTING-DTN Leach

- The above given Figure 5.1 represents the live nodes in the number of rounds on the two algorithms WCA\_GA\_DTN Leach and EXISTING-DTN Leach. The Blue line on the graph represents the WCA\_GA\_DTN Leach and red line represents the EXISTING-DTN leach nodes. The round starts from the 0 to 1000 and the maximum number of live node is present in round 200 and changes according to the number of nodes changes

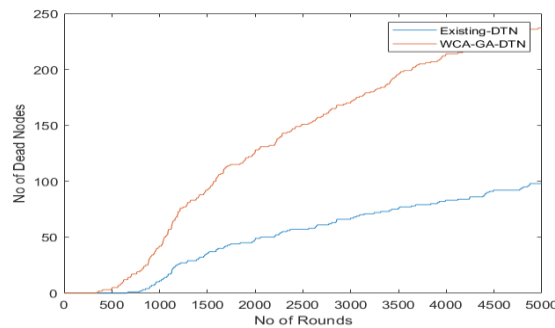
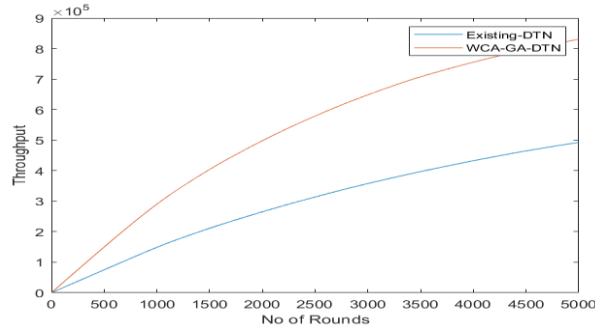


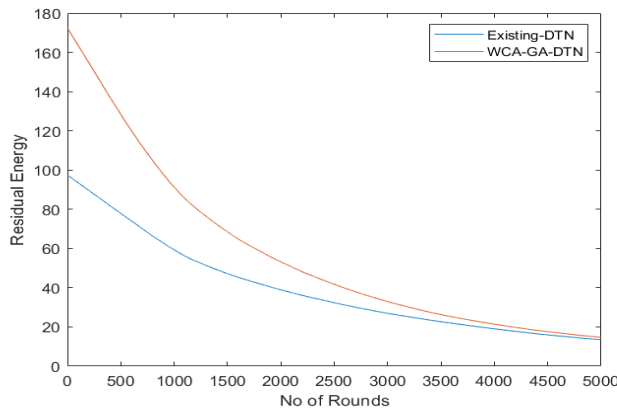
Figure 5.2 Number of dead Nodes in WCA\_GA\_DTN Leach and EXISTING-DTN Leach

The above given Figure 5.2 represents the dead nodes in the number of rounds on the two algorithms WCA\_GA\_DTN Leach and EXISTING-DTN Leach. The Blue line on the graph represents the WCA\_GA\_DTN Leach and red line represents the EXISTING-DTN leach nodes. The round starts from the 0 to 1000 and the minimum number of dead node is present in round 150 and changes according to the number of nodes changes. The graph curve concluded that the number of dead nodes in WCA\_GA\_DTN leach is less than EXISTING-DTN.



**Figure 5.3 Throughput on WCA\_GA\_DTN Leach and EXISTING-DTN Leach**

The above given Figure 5.3 represents the throughput in the number of rounds on the two algorithms WCA\_GA\_DTN Leach and EXISTING-DTN Leach. The Blue line on the graph represents the WCA\_GA\_DTN Leach and red line represents the EXISTING-DTN leach nodes. The throughput of the grey wolf optimization algorithm with Leach is better than the existing EXISTING-DTN.



**Figure 5.4 Average Residual Energy WCA\_GA\_DTN Leach and EXISTING-DTN Leach**

The above given Figure 5.4 represents the average residual energy in the number of rounds on the two algorithms WCA\_GA\_DTN Leach and EXISTING-DTN Leach. The Blue line on the graph represents the WCA\_GA\_DTN Leach and red line represents the EXISTING-DTN leach nodes. The average residual energy of the grey wolf optimization algorithm with Leach is better than the existing EXISTING-DTN.

#### IV. CONCLUSION

Wireless sensor networks have gained a lot of attention in the last few years and used by the peoples in various applications and also in the military services. In WSN it is very challenging process to design a robust and scalable routing protocol which performs well at the time of data congestion on network. In the proposed work particle swarm optimization algorithm is used to provide the optimal result in the nodes of WSN. WCA\_GA\_DTN work on the biological behavior of the swarms a provides effective solution. In this work WCA\_GA\_DTN is used for selection of cluster heads according to their size. It works on the alive nodes, dead nodes and the energy consumption by the nodes. The results depict the WCA\_GA\_DTN performs better than the existing approach EXISTING-DTN LEACH and Leach in every scenario.





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