OPEN ACCESS
International Journal of Engineering and Advanced Technology (IJEAT)
ISSN: 2249-8958 (Online), Volume-8 Issue-5, June 2019

# Interference Reduction Aware Optimal Route Path Establishment In Wireless Sensor Network Environment

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***Abstract:*** ***Reliable data retransmission without collision is the most concerned research issues in the real world environment with increased interference effects. This is focused and achieved in our previous research method by introducing the method namely Location and QoS Guaranteed Routing Technique (LQoS-RT). In this research method, optimal and reliable routing is performed by constructing the route path with the concern of location details. However this research method failed to focus on the interference effect which affects the reliable data transmission. And also computation overhead of the previous research method is high by analyzing each technique for the interference measurement. This is focused and resolved in the proposed work by introducing the Interference Reduction aware Optimal Routing Scheme (IRORS). Here initially clustering is performed to group the nodes that lie within same transmission range. The cluster head for each cluster is selected with the concern of interference whereas in the previous work cluster head selection is done based location information alone. The node with the low interference probability is selected as cluster head thus the data communication decision can be made without any data loss due to interference. Here the optimal cluster head selection with less probability of interference is selection by applying hybrid firefly particle swarm optimization algorithm. And then optimal routing is performed by adapting the modified AODV routing protocol. In order to make sure the optimal and reliable routing without interference coefficient of restitution value is calculated periodically. If the interference probability is high then rerouting is performed. Likewise the optimal and reliable routing without interference is guaranteed. The performance assessment of the research work is conducted in the NS2 simulation environment from which it is proved that the proposed research method ensures the better performance than the existing work.***

***Index Terms:*** ***Reliable data transmission, Coefficient restitution measure, Interference reduction, Route path construction, Optimization.***

## I. INTRODUCTION

Military trades or military signs incorporate all parts of correspondences, or transport of information, by military. Military correspondences length from pre-history to the present. The soonest military exchanges were passed on by individuals by strolling. A while later, correspondences progressed to visual and perceivable signs, and subsequently advanced into the electronic age [1]. The ability to get and use information is of essential hugeness on the battle zone. It can normally spell the complexity between triumph and then again demolition. The Battle at Midway, in World War 2 was won since Americans could catch Japanese correspondences and use the information further supporting their preference. This is a prime instance of the noteworthiness and inadequacy of correspondences. Correspondence empowers you to arrange your troops yet in doing in that capacity the foe can tune in into your exchanges and devise a counter system. In multicast, a singular message is passed on to a social affair of objectives in a framework. This issue has been inspected for both wired and remote frameworks. A survey of multicast traditions for exceptionally named frameworks can be found in [2]. An important imperative of research around there, to date, is that most by a wide margin of works disregard hindrance, which is a colossal factor in remote multihop frameworks. The few works that do consider impedance use off kilter models. In this work, we do the key investigate examination of through and through multicast coordinating structures for remote multihop frameworks that speaks to impedance using careful block models. We plan new impedance careful multicast coordinating structures and exhibit that their execution fundamentally outperforms that of existing multicast counts that don't speak to hindrance. Multicast directing systems can be requested into three guideline orders: tree-based, work based, and structure-less. Tree-based traditions [3], [4], [5], [6] use different kinds of trees as principal guiding structure to course multicast messages to all objectives. Tree structures give fundamental and down to earth controlling establishments to the detriment of solidarity inside seeing compactness and association disillusionments. Work based traditions [7], [8], [9] use work structures to give energy by having various courses between the source and objectives to the detriment of work structure bolster. Structure-less multicast traditions don't unequivocally make a coordinating structure anyway rely upon various strategies, for instance, sort out coding [10], [11] and geographic controlling [12], [13]. In this basic examination of impedance careful multicast, we focus on tree-based traditions on account of their ease and cost sufficiency. Growing the examinations and thoughts developed in this way to work based traditions is a fascinating point for future research. The general association of the exploration work is given as pursues: In the area 2, different related research works that has been led beforehand as far as accomplishing impedance mindful steering is talked about. In segment 3, nitty gritty discourse of the proposed research strategy is given with appropriate model and outlines.

**Manuscript published on 30 June 2019.**
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In area 4, recreation condition is examined infinity gritty and the proposed research approach is thought about against the different parameters. At long last in area 5, generally speaking examination of the work is finished up dependent on their outcomes.

## II. RELATED WORKS

Most tree-set up together traditions have been based as for briefest way trees or Steiner trees. The goal of briefest way trees is to confine the partition between the source and each objective, while the target of Steiner trees (for instance [14], [15]) is to restrict the aggregate of the divisions in the multicast tree. Two or three investigations differentiating these predominant tree structures have been done. Ruiz and Gomez-Skarmeta [16] mulled over briefest way trees and Steiner trees. The makers fought that Steiner tree isn't fitting for remote frameworks and prescribed that the issue should be re-nitty gritty to restrain the cost similar to the amount of sending center points. They proposed an insatiable heuristic figuring, considered MNT, and showed that the proposed computation can reduce the amount of sending center points. Nguyen [17] came back to the examination and evaluated the execution of most concise way trees, Steiner trees, and the MNT figuring with respect to divide extent. The maker exhibited that most concise way trees offer the best execution to the extent package transport extent. In any case, neither of these examinations spoke to check in their appraisals. Other work that thought about multicast scaling law and structure are [18], [19], [20]. The makers inspected the asymptotic multicast limit of multi jump remote frameworks. In [20], an investigate structure for multicast trees that achieves limit in the demand sense was proposed. While the work represented hindrance, they used the tradition show for impedance, which isn't as correct as the physical impedance model, and they were concerned basically with asymptotic scaling results, instead of best execution on constrained frameworks. Different examinations consider the multicast issue with different goals, for instance, essentialness [21], [22], [23], cost of building and keeping up multicast trees [24].

## III. INFERENCE COLLUSION AWARE OPTIMAL ROUTE PATH ESTABLISHMENT

In the proposed research method initially clustering is performed to group the nodes that lie within same transmission range. The cluster head for each cluster is selected with the concern of interference whereas in the previous work cluster head selection is done based location information alone. The node with the low interference probability is selected as cluster head thus the data communication decision can be made without any data loss due to interference. Here the optimal cluster head selection with less probability of interference is selection by applying hybrid firefly particle swarm optimization algorithm. And then optimal routing is performed by adapting the modified AODV routing protocol. In order to make sure the optimal and reliable routing without interference coefficient of restitution value is calculated periodically. If the interference probability is high then rerouting is performed. Likewise the optimal and reliable routing without interference is guaranteed.

### A. Probability of Interference Measurement

Consider the sender node will create $L_{bulk}$ data for each data transmission. This bulk data will be divided into number of data packets with size L bit data. This segmented packet will be forwarded to the receiver node for data communication. Once the data packet is received by receiver node it will send back the ack packets to the sender nodes. With the failed reception of ack packets, the sender node will retransmit the corresponding data packets to the receiver again. This transmission rate can be increased or decreased based on channel quality condition. Here the time taken to transmit the data packets from the sender node m is denoted as follows:

$$T_{pkt,m}(L) = \frac{L_{shr} + L_{phr}}{R_{base}} + \frac{L_{mhr} + L}{R_m}$$

Where L ➔ bit size
Shr ➔ synchronization header
Phr ➔ physical layer packet header
Mhr ➔ medium access control layer packet header

It is known that the packet loss would occur when the corresponding packets collude with the interference signal. Thus the probability of data transmission failure can be denoted as like given below:

$$\bar{p}_m(L,\gamma) = 1 - \left(1 - p_{m,c}(L)\right)(1 - p_{m,s}(L,\gamma))$$

Where $p_{m,c}$ ➔ chance of transmission failure due to packet collision
$P_{m,s}$ ➔ chance of transmission failure due to low SNR value

Here the probability of transmission failure due to packet collision is measured in terms of amount of channel occupied by the interference signal. The amount of channel occupied by the interference signals can be evaluated by adapting the semi markov model. Generally the channel of wireless sensor network would consists of two states namely busy and idle. The time consume by both these states will be calculated by utilizing the probability density function (PDF) and it is denoted as $f_{Tbusy}$ (t) and $f_{Tidle}$ (t). The calculation procedure for the channel occupied by the interference signals is represented as given below:

$$\rho = \frac{\tau_{busy}}{\tau_{busy} + \tau_{idle}}$$

Where $\tau_{busy}$ ➔ busy duration time
$\tau_{idle}$ ➔ idle time
From this equation probability of collision due to interference signal can be represented as given below:

$$p_{m,c} = \rho p_{m,c|busy} + (1 - \rho) p_{m,c|idle}$$

By using the above equation the interference measurement of each node in the network will be measured.

### B. Optimal Cluster Head selection based on Probability of Interference

In this work optimal cluster head selection is performed by introducing the hybrid firefly and particle swarm optimization algorithm.


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The fitness function that is considered for the optimal cluster head selection is interference value of the nodes. The node with the less interference will be elected as the optimal cluster head. In firefly algorithm each firefly will move towards the location where it is present with more brightness. Likewise in this work node with more resources will be attracted by the firefly and it will start move towards that node to select as cluster head. Thus here historical information about the corresponding nodes does not affect the cluster head search behavior. This method will be more useful in searching the optimal cluster head within local region. However this will lead to the premature convergence issues where there is a possibility of selecting wrong node as cluster head without studying every nodes present in the environment. As oppose to it, PSO algorithm looks for the historical information about the nodes present in the network to select the more suitable solution in which particle will be guide towards. Thus the merits of both FA and PSO algorithm is utilized in this work to select the most optimal cluster head which is more suitable for the reliable communication. In this hybrid work both PSO and FA will be combined together in process to select the more suitable cluster head. The processing flow of cluster head selection process using Hybrid Firefly and PSO algorithm is shown in the following figure.

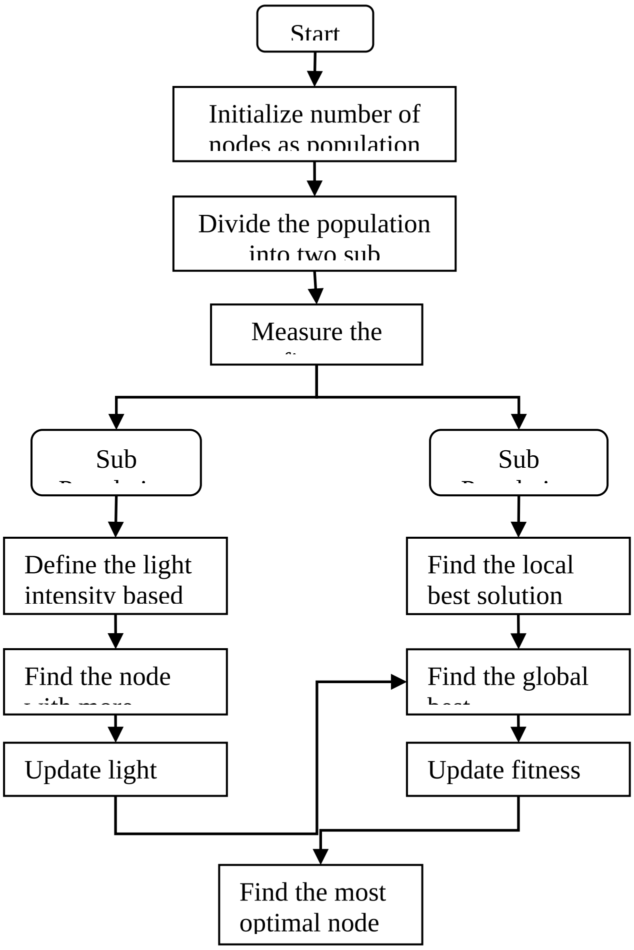


Figure 1: Optimal cluster head selection process

In figure 1, optimal cluster head selection process is shown. From this figure, we can learn that the optimal cluster head selection can be chosen by hybrid firefly particle swarm optimization method. This method ensures that optimal cluster selection with reduced interference effect. After cluster head selection data to be transmitted will be gathered by the cluster head. This cluster head will transfer the data that are gathered from the sensor nodes to the server node. Here the shortest route path selection is done to transfer the data from the cluster head to the receiver node. This is done by using modified AODV routing protocol.

### C. Routing using modified AODV Protocol

In this research work, modified AODV routing protocol is utilized to establish the reliable and stable route path between the cluster head and the receiver node. The main contribution of this modified AODV routing protocol is to ensure the stable route path for the reliable data transmission. The stability of the route path is measured by considering the duration taken to send and receive the hello packets between the sender node and the receiver node. To measure the delay occurred while transmitting and receiving the hello packets, it is broadcasted to neighbor nodes initially. In the modified AODV protocol header additional field is added namely sending time which is not present in the conventional AODV protocol. This new field will measure and store the sending time of hello packets. The new header field of modified AODV routing protocol is given as follows:

<destination address, destination sequence id, hop count, network lifetime, sending time>

The delay time $delaytime_i$ of hello packets sent from the ith node will be calculated in i+1th node by finding the different between the sending time noted in ith node and the receiving time noted in i+1th node. The equation for calculating the delay time is given below:

$$Delaytime_i = received\ time_i - Sending\ time_i$$

This delay time will be aggregated together in further nodes before it reaches the receiver node. The accumulation process is done as like given in below equation.

$$accumulatedtime_i = \frac{1}{n}\sum_{j=0}^{n-1} delaytime_{ij}$$

From this measured delay time and accumulated time routing stability can be calculated by using the following equation

$$RS_i = \frac{1}{n}\sum_{j=0}^{n-1}(delaytime_{ij} - accumulatedtime_i)^2$$

Where RS ➔ routing stability

Here the lesser value of routing stability defines the selected route path is more stable and reliable.

#### *i. Coefficient of restitution measure evaluation for payload decision*

This measure adjusts the ricocheting conduct of balls where ball won't return to its unique position following it is bounced. This nature of balls is studied in the material science where it is explained that the nature of balls creates spring instead of circle. The power will be enumerated from the ball when it touches the floor based on its weight.


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Then this ball will bounce based on the power it gains and the equal gravitational power. This is proved in the Hookes law. The stable velocity of ball will be turned into active velocity when it is dropped which will make the ball bounce so fastly. This will be continued until the ball get backs into its nor velocity. It takes note of the wonder of "vitality misfortune", portrayed by the COR, the proportion of the speed of the ball after skip to the speed of the ball before bob. A flawlessly hard floor is a stationery floor, unequipped for moving itself. The "stationery conduct" is noted, further. The definitions underneath are noteworthy in the specific situation.

$$\text{Coefficient of Restitution} = \frac{\text{Rebound Speed}}{\text{Incident Speed}}$$

$$\frac{KE_{rebound}}{KE_{incidence}} = \frac{V_{rebound}^2}{V_{incidence}^2} = \text{Coefficient of Restitution}^2$$

The system is recognized like a gravitational field, the bundle is seen like a ball, moving from source to the segment, sending a bundle and getting statement can be seen as a skipping ball. The enhancement of the package is picked by the gravitational power field. WMN, focuses are stationary, undifferentiated from the greatly hard floor. The loss of tallness could be suggested grouped way lengths a message may investigate, which is an immediate consequence of the loss of criticalness cleared up as of now. Dynamic planning can be translated as hugeness exchange between focus focuses, for example an imaginative relationship among focus focuses with a definitive target that messages are transmitted. An adequate degree of vitality exchange is cleared up by motor hugeness, the importance of which is uncommon. Allow us to consider two articles: Object 1 and Object 2, and they are pummeling into each other, for this circumstance, the COR is demonstrated by

$$COR = \frac{(X_2 - X_1)}{(Y_1 - Y_2)}$$

Where:
X1 is the last speed of Object 1 after effect
X2 is the last speed of Object 2 after effect
Y1 is the underlying velocity of Object 1 preceding effect
Y2 is the underlying velocity of Object 2 preceding effect.

The COR is considered in assessing the execution of the proposed framework. In the proposed system, each inside point in the structure is doled out with gravitational potential (v), and the alliance (transmission) between the focuses in its region is affected by power. Enable us to expect that the bundle p in focus v is sent to the neighbor focus to achieve the passage g. The going with ricochet neighbor is perceived through the potential field separate between focus point v and assorted neighbors. Expect that w is the neighbor of v, here the power is depicted as

$$F(v, w) = V(v) - V(w)$$

The coefficient of compensation surveys the flexibility of mishaps. A magnificently versatile mishap has a COR estimation of 1 and dynamic vitality is especially kept up and multi skip transmissions may happen. A perfectly inelastic impact has a COR estimation of 0. The join of thing with zero COR, quits bouncing at all and it constitutes no transmission of messages.

At the point when the hub is prepared with bundles to be sent, it initially sends RTS to check if the neighboring hub isn't blocked; in the event that the neighbor is clogged, at that point the sender sits tight for some measure of time. At the point when the sender gets CTS, it starts sending the packages to the neighboring center and thusly believes that the attestation will find out the RTT regard. The RTT respect relies on different factors, for example, the rate at which information is exchanged from the source, the medium utilized for the transmission (for example a remote, optical fiber or copper), the parcel between the source and neighboring focus focuses, the closeness of clack in the circuit, the measure of different asking for pending at the transitional focuses, and the speed at which the generally engaging focus point limits. RTT estimation can be used in coordinating counts for figuring the perfect courses.

For each hop, sampleRTT is constrained by the multifaceted nature between the bundle sent time and ACK got time. The sampleRTT may move from bundle to bundle because of dynamic nature of the channel. So as to locate the authentic RTT, the regular estimation of sampleRTT is settled and the AverageRTT is assessed as

$$\text{Difference}(\delta) = \text{sampleRTT} - \text{AverageRTT}$$

$$\text{AverageRTT} = \text{AverageRTT} + \delta$$

Where δ is somewhere in the range of 0 and 1.

Since the remote topology changes intensely, every center should have the ability to pick up capability with the courses quickly. In case any of the centers are latent, the tradition maintains a strategic distance from them from the way. Thusly, the acknowledged messages are utilized by the focuses to show action and slowness to its neighbors. The focuses which are dynamic react rapidly to the new course ask.

## IV. EXPERIMENTAL RESULTS

The experimental results were conducted in NS2 simulator, were the performance of the proposed research methodologies are evaluated. The system topology of a 100m X 100m of haphazardly disseminated heterogeneous hubs with their underlying energies fluctuating between 0.5J to 2.25J is utilized and BS is situated in the focal point of the system framework. So as to be reasonable, the vitality of the framework on a by and large for each convention is guaranteed to be the equivalent; an all out vitality of 102.5J has been utilized. Likewise, the ideal parameters of these conventions are utilized for yielding their comparing best execution.

Here proposed research method namely IRORS and Location and QoS Guaranteed Routing Technique (LQoS-RT) is compared with the existing research decision-gathering scheme (DGS).

### A. Energy Consumption

Energy consumption of the proposed research method should be lesser than the existing research methods for the better performance. Energy consumption comparison values are shown.


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Table 1: Energy Consumption

| Number of nodes | Energy Consumption | | |
|---|---|---|---|
| | DGS | LQoS-RT | IRORS |
| 20 | 100 | 92 | 85 |
| 40 | 140 | 132 | 89 |
| 60 | 170 | 163 | 97 |
| 80 | 200 | 182 | 125 |
| 100 | 250 | 232 | 145 |

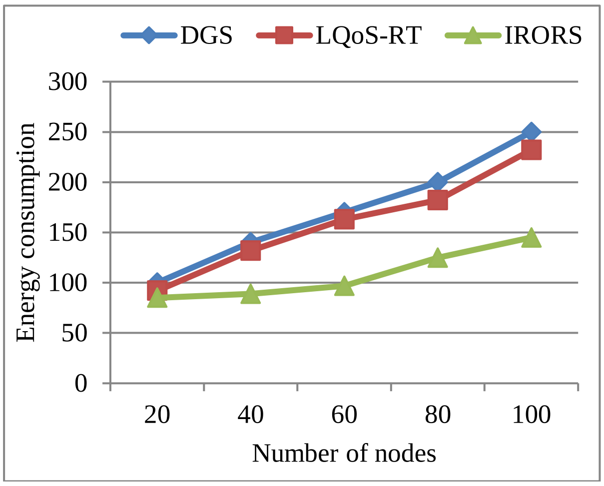


**Figure 2: Energy consumption comparison**

Figure 2 represents the connection between the Energy utilization on correspondences and the quantity of hubs. It tends to be said that the proposed IRORS approach devours less vitality when contrasted and the current DGS approach and past work LQoS-RT. This is because of the group head choice calculation the bunch heads will be chosen from the sensor hubs dependent on the computation made utilizing certain components in each hub. In view of the separation between the hubs, versatility of the hubs, remaining vitality and transmission scope of the area hubs the heaviness of the every hub will be determined in productive way. Alternate calculations are need in computing the leftover vitality between the hubs while transmitting the bundles. The execution of Energy utilization by hubs is seen to be as yet lesser for further expanding hubs as well.

## B. Delivery Ratio (DR)

Delivery ratio is characterized as the all out number of parcels that can be transmitted amid some specific timeframe.

Table 2: Delivery ratio

| Number of nodes | Delivery ratio | | |
|---|---|---|---|
| | DGS | LQoS-RT | IRORS |
| 20 | 0.79 | 0.802 | 0.91 |
| 40 | 0.798 | 0.814 | 0.93 |
| 60 | 0.816 | 0.821 | 0.949 |
| 80 | 0.824 | 0.834 | 0.97 |
| 100 | 0.83 | 0.84 | 0.99 |

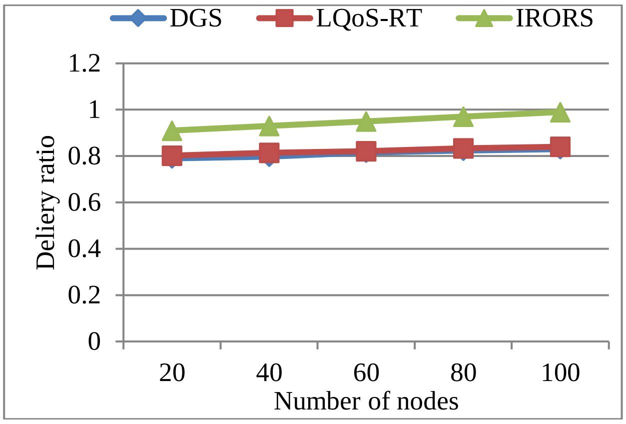


Figure 3: Delivery Ratio comparison

The delivery ratio is depicted in the Figure 3; it is basically the proportion of the quantity of conveyed and transmitted message to the goal hub. It is generally depicts the condition of message sent to the goal hub. It tends to be said that the proposed IRORS approach have a higher proportion of transmitting the parcels when contrasted and the current DGS and past LQoS-RT.

## C. Throughput (TP)

Throughput is characterized as the all out number of bundles that can be transmitted for the specific timeframe.

Table 3: Throughput

| Number of nodes | Throughput | | |
|---|---|---|---|
| | DGS | LQoS-RT | IRORS |
| 20 | 0.54 | 0.69 | 0.75 |
| 40 | 0.65 | 0.75 | 0.79 |
| 60 | 0.68 | 0.81 | 0.87 |
| 80 | 0.74 | 0.84 | 0.93 |
| 100 | 0.77 | 0.91 | 0.97 |

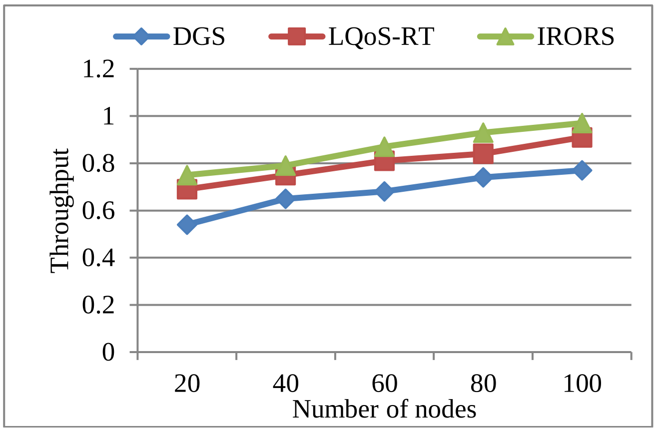


Figure 4: Throughput comparison

Figure 4 demonstrates the correlation consequence of throughput from the proposed IRORS, and past LQoS-RT, existing DGS technique. It is noticed that the proposed IRORS achieves higher throughput when contrasted and the various proposed and existing methodologies. The execution of throughput by hubs is seen to be as yet higher for further expanding hubs as well.



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### D. End-to-End Delay (EED)

End to end delay is characterized as the all out time taken to finish the effective information transmission.

Table 4: End to end delay

| Number of nodes | End to end delay | | |
|---|---|---|---|
| | DGS | LQoS-RT | IRORS |
| 20 | 0.49 | 0.45 | 0.41 |
| 40 | 0.47 | 0.41 | 0.38 |
| 60 | 0.43 | 0.38 | 0.31 |
| 80 | 0.39 | 0.32 | 0.24 |
| 100 | 0.36 | 0.28 | 0.21 |

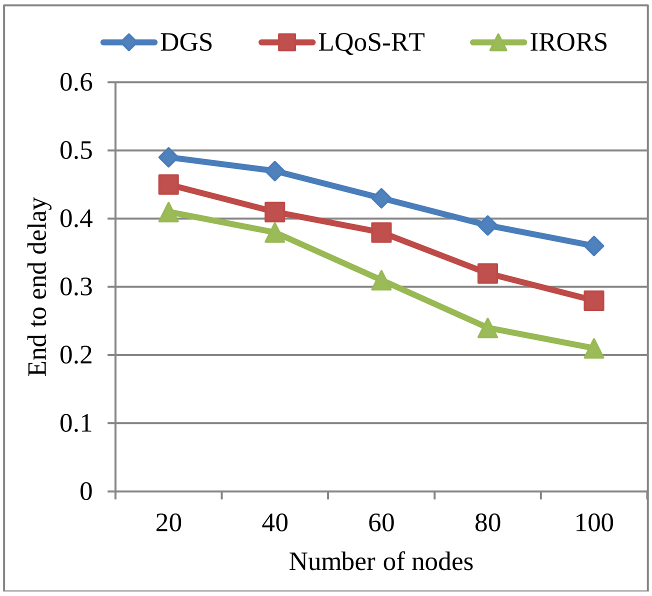


**Figure 5: End to end comparison**

Figure 5 looks at the start to finish delay between proposed IRORS with the past LQoS-RT existing DGS strategy. In the event that the span of expanded, the IRORS utilizes a functioning vitality utilization system to identify likely connection breaks between the source and goal hubs and rapidly apply an elective way discovering component for message exchange. In addition, when the no. of hubs is expanded, the proposed strategy built up a decrease in deferral by than in existing techniques.

## V. CONCLUSION

In the proposed research method initially clustering is performed to group the nodes that lie within same transmission range. The cluster head for each cluster is selected with the concern of interference whereas in the previous work cluster head selection is done based location information alone. The node with the low interference probability is selected as cluster head thus the data communication decision can be made without any data loss due to interference. Here the optimal cluster head selection with less probability of interference is selection by applying hybrid firefly particle swarm optimization algorithm. And then optimal routing is performed by adapting the modified AODV routing protocol. In order to make sure the optimal and reliable routing without interference coefficient of restitution value is calculated periodically. If the interference probability is high then rerouting is performed. Likewise the optimal and reliable routing without interference is guaranteed. The general assessment of the examination strategy is led in the NS2 recreation condition from which it is demonstrated that the proposed research procedure prompts give the ideal result than the current research technique.

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