Enlightening Enactment of Cooperative Communication in Heterogeneous Mobile Ad-Hoc Networks Surroundings

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Abstract
Cutting edge wireless networks must suit the accessible data rate in the quickly developing requests of rising system with the necessity to boost the capacity of networks. Enabling the better depending procedure is probably the best ways to deal with improve the limit with beneficial utilization of advantages. Propelled by the perception of a few relaying approaches, the uncertain nature of wireless system must be taken care of betterly with wise choices on relay determination. The proposed conventions are planned in four sections in this paper. In initial segment, a recipe to settle on savvy decision of relay at each location based on impressive QoS parameters is proposed. The second part is about to improve the proposed recipe to decrease the conclusion to end delay. The third part works dependent on doling out need among the parameters to finish up the benefits and bad marks among the distinctive parameters. The fourth part demonstrates an integration of gaming choice in the proposed derivation for the improvement of throughput and packet delivery ratio. The exact examination of the proposed methodologies demonstrated that our reproduction results have yielded noteworthy throughput than the traditional component.

Keywords*: Wireless network, Cooperative communication, Relaying strategy, Random selection, Multi hop environment*

1. Introduction

The fifth era wireless systems target fulfilling the objectives set by administrative specialists in regards to the network of a wide range of gadgets. In this way, cutting edge heterogeneous networks (HetNet) ought to permit keen items to interface and impart in Internet-of-Things (IoT). Smart cities, body area network, vehicle-to-vehicle communications and smart energy grids are expected to become reality through the IoT. As a result of connected devices everywhere, there will be an ever increasing demand for capacity. In contrast to wired systems, the nature of transmitting joins in versatile ad hoc arrange is dependent upon arbitrary variances. This adversely affects the performance of

heterogeneous mobile ad hoc network which results in poor throughput. Therefore, increasing throughput using cooperative communication is further essential which leads to meet higher capacity of demands .The mobile communication has a significant growth during the last decades both in number of mobile users and the data traffic demands. According to cisco's report, data traffic increases sevenfold between 2016 and 2021. A single smartphone can generate an average traffic close to 6.8 GB per month. European flagship 5G project mobile and wireless communications enablers for twenty-twenty information society (METIS) suggest the future communication system should meet the requirements by new radio concepts. Cooperative communication provides spatial diversity through MIMO systems that replace single antenna due to hardware constraints and supporting multiple antennas in wireless environment is most difficult. Although, considerable developments have been made towards counteracting potential methods in wireless ad hoc networks, the techniques for improving capacity still remain inadequate. The constraints of relay selection, objective, proposed intelligent decision based Relay Selection (IDRS) architecture, Procedure, Results and conclusion are discussed in this research article.

2. Cooperative Communication in Heterogeneous Mobile Ad Hoc Network

Connectivity is the key to the success of several applications such as home networking and multimedia, telematics for intelligent transportation, environment sensing, inventory management, industrial automation, rapid network deployment for disaster response, patient health monitoring and medical care, tactical warfare and social networking. . Cooperative communication can be used to improve the weaker link problem and solve connectivity problem for heterogeneous mobile ad hoc networks. The tremendous progress of wireless communication over the past few decades due to the large demand for mobile access often requires more than one antenna to provide better connectivity. Cooperative communication, a key enabling technology has the potential of providing spatial diversity and mitigating the effects of channel fading without multiple antennas at both transmitters and receivers side. Cooperation is always possible when there exists the number of communicating terminals exceed two. Transmitting independent copies of the signal generates diversity and it can effectively combat the deleterious effects of fading. In particular, spatial diversity is generated by transmitting signals from different locations, thus allowing independent faded versions of the signal at the receiver. Cooperative communication efficiently utilizes the elements in heterogeneous network which significantly improves the performance of communication in terms of spectrum efficiency and spectral diversity.

3. Heterogeneous Mobile Ad Hoc Network in Surveillance

The rapidly increasing heterogeneous devices are allowing government agencies, the private sector and military organizations to deploy surveillance for performance monitoring, billing verification, failure prediction, traffic engineering, call quality monitoring, collect and support diagnostic, troubleshooting, security and fraud prevention activities. Typically, this requires multiple antennas at both sender side and receiver side for better communication but it is impractical to be cost effective if multiple antennas are built. Specifically, due to size, cost or hardware limitations, a wireless node may not be able to support multiple transmitting antennas. Examples include handsets (size) or the nodes in a wireless ad hoc network (size, power). Therefore, relay selection is generally considered as one of the intelligent choice to enhance the capacity using available resources [Sousa et al.].

4. Relay Selection in Cooperative Communication

Cooperative communication is a promising approach to combat wireless impairments such as interference control, topology control, power control, security issues etc. The above mentioned impairments need to be focused without the need of multiple antennas for an effective communication. Relay selection in cooperative communication environment has gained a lot of attention to improve the spatial diversity with the mitigation of channel impairments. Since, cooperative communication is based on relaying approach, by default, relay selection plays an important role to make an vibrant affects not only on the sender's and receiver's performance but also the on the entire system performance [Sousa et al]. Relaying approach brings multiple inputs multiple output (MIMO) environment through the installation of single antenna itself. When source node transmits data to destination node d, the relay node R also receives data simultaneously. Therefore, the destination receives multiple copies of data and fading paths from two nodes are statistically independent to generate transmission diversity. Figure 1 depicts the best relay selection strategy in which node 2 is selected as best relay between the Source (S) and Destination (D) out of many optional nodes intelligently.

The relay selection methods are classified as single relay selection and multiple relay selection methods. Most of the proposed relay selection schemes are based on the realistic assumptions that availability of perfect Channel State Information (CSI). In practical, the transmission channel varies over time and a time gap exists between selection of relay and transmission of data [Marye et al]. Therefore channel state information used for relay selection is not consistent and in other words, using CSI for selecting relay is an outdated version[Zhang et al] .The

Performance of entire cooperative communication for the next generation wireless networks depends on careful relay selection.

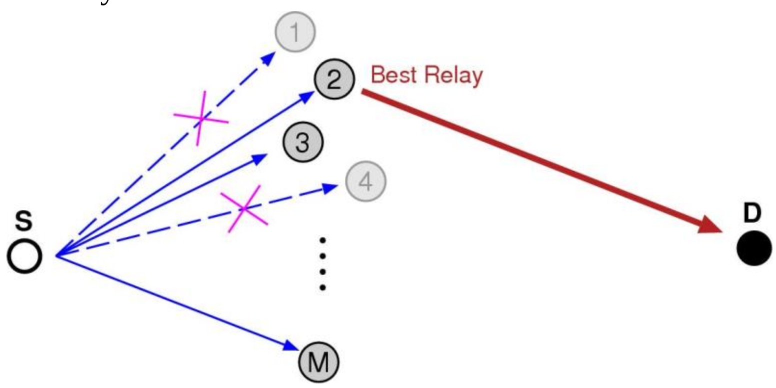

Figure 1. Relay Selection

5. Relay Selection Approaches

The concept of relay channel model consists of a source, destination and relay [Quer et al]. It facilitates the information to be transferred from source to destination by providing fundamental relaying techniques such as Decode and Forward (DF) and Compress-and-Forward (CF). From the literature survey, the relay selection categorized into six categories based on the kind of selection technique used is listed below[Wang et al]:

Random Relay Selection: The simplest routing scheme is random relaying scheme for selecting the cooperation partner between source and destination. This method selects relay randomly without respect to any capacity parameters from potential relays for forwarding. In random relay selection, all the available nodes have the chance of being selected and does not require any feedback about battery state [Gu et al]. The major advantage of random selection scheme is very low complexity, low selection time and low signaling overhead. But this scheme might not be very efficient in terms of gain. For frequency selective channels, this random relay selection can achieve the same diversity as best relay selection. But for frequency flat fading channels, using random selection, no diversity gain can be obtained.

Classification based Relay Selection: To forward the packets in cooperative communication, each candidate runs classification algorithm to decide whether it should participate as a relay or not. Classification is identified based on training set observations. Better training data set decides the performance of relay selection but determining a suitable classifier is an impractical one. Classification based method to select appropriate relays for video streaming over wireless mesh networks has been proposed .In this method, each candidate relay runs a Support Vector Machine (SVM) to decide whether it should participate in forwarding packets or not. The SVM considers the features which are sensitive to video quality and it is trained to maximize user perceived quality. The evaluation results show that the classification based

approach outperforms the baseline scheme. But the performance of interest to train the SVM is user perceived video quality, rather than the classification accuracy over all nodes in a network and metrics are invariant across different scenarios [Naeem et al].

Scheduling based Relay Selection: Scheduling based approach is used to improve the overall system capacity while selecting best relay under fairness constraint among both users and relay station. In general, scheduling is done for load balancing [Wang et al]. So, relay selection based on scheduling focuses the buffer capacity of relay. An opportunistic scheduling algorithm is presented which combines distributed relay selection with centralized scheduling to reduce feedback overhead of the channel state information. The proposed algorithm can efficiently exploits multi user diversity and cooperative diversity in wireless networks.

Greedy based Relay Selection: Greedy algorithms are important mathematical techniques that obtain a local optimal solution to complex problems with low cost in a step by step manner. In the greedy process, decisions at each step are made to provide the largest benefit based on improving the local state. It is simple and easy to implement with less computing resources but the exhaustive search will result in an exponential computational complexity. Greedy algorithms may fail to achieve global optimal choice as they do not execute all procedures exhaustively. Greedy algorithms have been widely applied in sparse approximation, internet routing and arithmetic coding [Wang Y at al]. There are two major greedy approaches: Orthogonal Matching Pursuit (OMP) and Basis Pursuit (BP) are used to approximate an arbitrary input signal with the near optimal linear combination of various elements from a redundant dictionary

Fuzzy based Relay Selection: Fuzzy based relay selection algorithm selects relay based on considering fuzzy parameters such as bandwidth, residual energy, social norm, relaying strategy, Signal-to-Noise (SNR) ratio, distance between nodes etc.[Narendrakumar et al]. Fuzzy logic is a many valued logic and so there is no guarantee that selected relay is an optimal. The number of fuzzy parameters and its characteristics also affect the fuzzy solution. This approach is complicated if so many QoS parameters are considered, but with limited number of parameters, there will be a decidability issue [Brante et al].

Game theory based Relay Selection: Game theory, a mathematical model which is applied to set up cluster of nodes as game players with fully distributed node participation. The method also guarantees for the proper relay selection without any overhead for the node management[Sangeetha, et al]It is a kind of tool used to solve multi objective problems in wireless communications. In theoretical point of view, a game has three components namely players, actions for player and utility functions. Each player interacts with other players

through available set of actions which results in utility function. Even though game theory extensively involved in cooperative communication environment, selection of utility function, computation of steady state condition and efficiency are still being an open issue. Therefore, gaming approach is not a complete solution for all complex problems. As a result of classification analysis, merits and demerits of relay selection approaches are shown in Table 1.

Table 1. Relay Selection Approaches

METHOD	MERITS	DEMERITS
Random selection	Not require any state information	No guaranteed throughput
Classification based selection	Better dataset selects best relay	Suitable classifier selection
Scheduling based selection	The performance of relay selection heavily depends upon scheduling algorithm	Has to consider many QoS parameters to prioritize the relay nodes which leads to overhead
Fuzzy based selection	Suitable selection of QoS parameters can select an optimal relay	No of fuzzy parameters affect the solution
Greedy based Selection	Simple and requires less computing resources	Local optimum miss the best solution
Game theory selection	Suitable for several phenomena like bargaining, coalition formation	Assumption about payoffs will not provide an optimal solution.

6. Constraints of Relay Selection

Relaying approach improves the capacity in one end and reduces channel impairments with the use of multiple channels on the other hand [Sangeetha et al]. To guarantee coverage diversity, relay selection forms virtual antenna array for the transmission from source to destination . Relay selection algorithms categorized in two forms namely single relay selection method and multiple relay selection method. In single relay selection method, only one relay is to be selected to forward the multiple relaying candidates request with limited processing capability and unable to satisfy QoS requirements. But in multiple relay selection method more than one relay are selected from the group of candidate relays with the purpose to improve multiplexing gain and increase in complexity of signal detection [Boddu et al]. When source transmits data to destination (d), the relay (r) also receives data simultaneously and therefore, the destination receives multiple copies of data from the source. Existing approaches leverage to increase the system capacity can be grouped into three categories as follows:

i) To Increase higher frequencies;

ii) To improve link efficiency by using multiple antenna transmissions;

iii) To increase the Density of network by deploying more base stations and reducing cell size.

7. Objectives

To enhance the capacity in highly populated areas, deploying smaller cells in heterogeneous network is a common solution. Because small sized cells can manage high quality links that increases spatial reuse. However, due to this extreme densification will the network deployment will also get improved at reasonable operational cost. Hence, to improve the performance of next generation wireless networks in a better way, efficient relay selection might be another approach. The key challenges in existing relay selection are

i) Maximize the achievable throughput

ii) Reduce costly signaling overhead

iii) Minimize communication mode switching.

This research is mainly to show interesting insights in solving the key challenges with the impact of different proposed relay selection approaches.

The main objectives of this proposed works are

- To design a formula for an intelligent choice of relay at every location based on considerable QoS parameters.
- To enhance the proposed formula for reducing the end to end delay.

8. Proposed IDRS System Architecture

Our discussions focused on network scenario with a single relay network in distributed environment which can create possibility of transmitting data for multiple source nodes. Two network objectives to be achieved are throughput and packet delivery ratio. We begin by considering system model as in Figure 2, where there are several relay nodes Ri where i= {1,2..., N} indicates no of nodes, that can be reachable in coverage between the single source and destination pairs Ps,d. From the figure R1 and R3 are possible relay nodes in the coverage of source (s) and R1 is a selected relay through which packet is transmitted to destination (d).

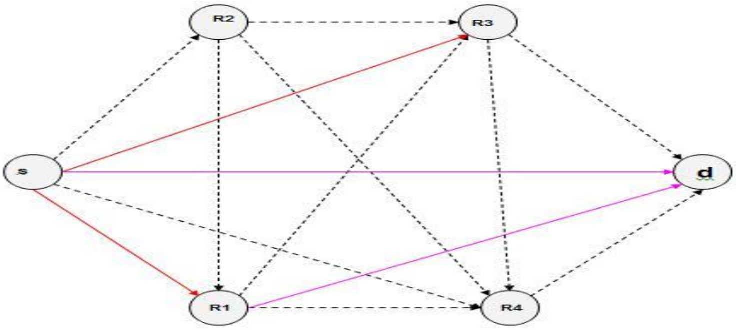

Figure 2 . System Model

It is assumed that nodes are connected via mesh topology and transmission of data occurs in non-overlapping frequency band. Therefore, while broadcasting, the nodes do not interfere with each other and by assuming that noise level without loss of generality is same in all links.

8.1 Network Configuration

Data (Da) received from source s to destination d can be given as

s Da d=s Da ri+ ri Da rj + rj Da d (1)

s Da ri = Da +ϱ, (2)

ri Da rj =s Da ri + ϱ (3)

rj Da d= ri Da rj+ ϱ, where $i \leq j$ (4)

Substituting (2) and (3) in (4), we can rewrite the signal as

s Da d=(((Da + ϱ)+ ϱ)+ ϱ)+....

In Equation (4), received signal at destination combines noise at every link but consecutively constant noise (ϱ) is added with every transmission which can be reduced with noise filter. In our work, noise factor is ignored.

8.2 Network Formation and Inquiry Procedure

Data gathering: To initiate communication, source start receiving the QoS parameters of relays in the coverage area simply through transmitting handshake message (hm) periodically [Xinwei et al]. During the transmission between source and destination, handshake messages hm identifies the parameters distance(α),bandwidth(β) and signal-to-noise ratio(γ) of relay nodes ie) source receives α ,β and γ from ri.

8.2.1 Quality of Service parameters

i) Distance: It is the metric to specify the distance between two nodes where packets are transmitted in between. Shortest distance is preferred for the transmission to save the energy [Xiaozhen et al]. If the QoS parameter α is estimated as a low, then the node is set with the highest preference to select as the best relay [Yuan Liang et al].

ii) Bandwidth: Bandwidth is a metric to define the rate of data transfer. Usually, high bandwidth is necessary to achieve the best transmission [Masoumeh Sadeghi et al]. If the QoS parameter β is estimated as a high, then the candidate is given with the highest preference.

iii) Signal-to-Noise Ratio: Signal-to-noise ratio is an important criterion for the relay selection. In the process of relay selection normally, larger values for SNR ratio is preferred . The selection of number of quality of service parameters also affects the performance results [Renyong et al]. More number of input parameters also degrades the performance of the network. Figure 3 depicts the data gathering process in which source gathers the quality of service parameter values from neighbor nodes within the range.

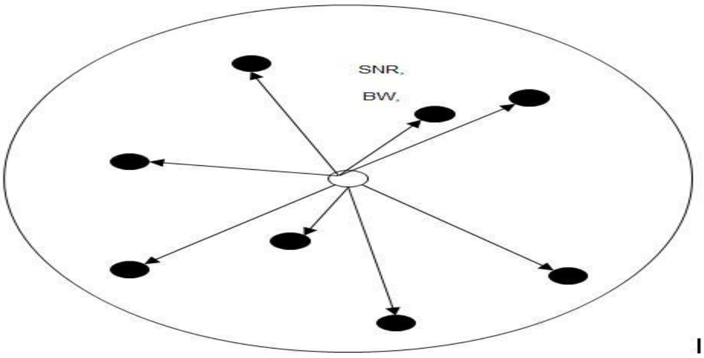

Figure 3. Gathering QoS parameters

8.3 Intelligent Decision Based Relay Selection (IDRS) Procedure

The source node sk, k ∈ [1, N], acts as source, transmits data which is simultaneously received by destination d and through several relay nodes rl, l ∈ [1,N]. Hence, the QoS parameters distance (α), bandwidth (β) and signal-to-noise ratio (γ) of rl are received to the source[Hemant Sharma et al].

Threshold calculation: The threshold t is calculated for all the QoS parameters as mentioned in the following equation.

$$\alpha t = \sum_{i=1}^{n} \alpha i / n$$

Where αt is defined as threshold value for the parameter distance. Similarly, for bandwidth (βt) and signal-to-noise ratio (γt) are calculated. Average value of QoS parameter is fixed as threshold and the linguistic variables High (h) and Low (l) for the input and output are as follows

- αi {Low ,High}
- βi {Low, High}
- γi {Low, High} where i ={1,2,..N}.

To rate the parameters α, β and γ, we use h and l to represent the high and low value for defining the range to write intelligent decision rule.Assignment of linguistic values to QoS parameters

Distance (αd)

if αdi <αd(t) then
ri(αd)=l
else
then
ri (αd) = h (5)

Bandwidth (βb)

if βbi <βb(t) then
ri(βb)=l
else
then
ri (βb) = h (6)

Signal-to-noise ratio (γs)

if γsi <γs(t) then
ri(γs)=l
else
then
ri (γs) = h (7)

The linguistic values are assigned to QoS parameters for categorizing eligible and non-eligible relay nodes [Farooq et al].

Eligible relay criteria: Eligible nodes (Φ) and non-eligible nodes (φ) from the set of relay nodes can be selected using

if αd=l Λ βb =h Λ γs =h
Φ = ri
else if
αd=l Λ βb =h ∨ γs =h || αd=h Λ βb =h Λ γs =h
Φ = ri
else
φ = ri (8)

The procedure for best relay selection through the random experiment is shown in Table 2.

Table 2 . IDRS-Typical Experiment

Relays	**Distance**	**Bandwidth**	**SNR**	**Output**
20	-	-	-	Source Node
9	*L*	*H*	*h*	E(Selected Node)
10	*H*	*L*	*h*	Ne
23	*H*	*H*	*l*	Ne
19	*H*	*H*	*h*	E
40	*L*	*h*	*l*	E
21	*L*	*l*	*h*	E
11	*h*	*l*	*l*	Ne
2	*l*	*l*	*l*	Ne

According to eligible relay criteria, for the above random experiment, the listed eligible and non-eligible relay nodes are

Φ = { 9, 19,40,21 } (9)
φ = { 10, 23, 11 , 2} (10)

In set Φ n ode 9 is selected, since all the QoS parameters satisfy the preferred value. In case, more than one eligible node is satisfying all the preferred value and one among will be randomly selected as a best relay.

9. Results and Discussions

This section presents the results of the IDRS approach and the performance evaluation of the implemented system. The results are shown for both 100 and 200 nodes for the range of both 150 and 300 m. Table 3.4 shows the comparison results of existing approaches with proposed

IDRS for throughput comparison. For better results, the observation is made for 10 ms. The values in the tables are obtained from trace files.

Table 3. Observation of Throughput for Varying Number of Nodes for Range 150m

Throughput (ms)								
No of nodes	**Range 150 m**							
	Time(ms)	**1**	**2.5**	**4**	**5.5**	**7**	**8.5**	**10**
100	**Random**	25.2	65.2	104.6	108	108	108	108
	Fuzzy	26.6	66.6	105.2	145.2	166.6	166.6	166.6
	GT	27.2	67.2	107.2	146.6	169.2	169.2	169.2
	IDRS	31.2	71.2	108.4	148	170.6	170.6	170.6
200	**Random**	12.6	32.6	52.3	54	54	54	54
	Fuzzy	13.3	33.3	52.6	72.6	83.3	83.3	83.3
	GT	13.6	33.6	53.6	73.3	84.6	84.6	84.6
	IDRS	15.6	35.6	54.2	74	85.3	85.3	85.3

From the Table 3, it is clearly understood that the throughput gradually increases depends on the time and throughput changes rapidly when the number of nodes in the network increases. It means that by increasing the users' number for increasing the amount of data pushed in to the network led more packet collision and consequently network throughput decreases. In figure 4 and figure 5, the throughput observation is shown for first 10ms with 100 nodes and 200 nodes respectively.

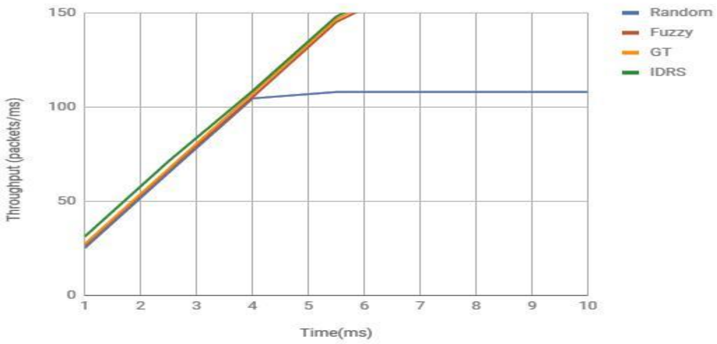

Figure 4: Observation for throughput for 10 ms for 100 nodes, Range 150 m

Table 4, shows the comparative results of existing approaches with proposed IDRS for the throughput parameter in the range 300 m.

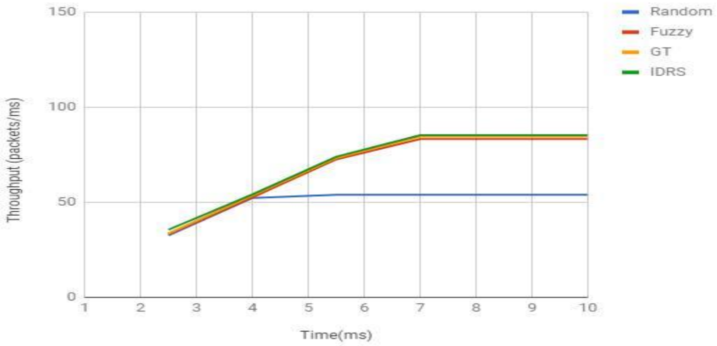

Figure 5. Observation for Throughput for 10 ms for 200 Nodes ,Range 150 m

In figure 6 and 7, the throughput observation is shown for first 10 ms for range 300m with 100 nodes and 200 nodes respectively.

Table 4 . Observation of Throughput for Varying Number of Nodes for Range 300 m

Throughput (ms)								
No of nodes	**Range 300 m**							
	Time(ms)	**1**	**2.5**	**4**	**5.5**	**7**	**8.5**	**10**
100	**Random**	9.2	49.2	88.6	92	92	92	92
	Fuzzy	10.6	50.6	89.2	129.2	150.6	150.6	150.6
	GT	11.2	51.2	91.2	130.6	153.2	153.2	153.2
	IDRS	15.2	55.2	92.4	132	154.6	154.6	154.6
200	**Random**	4.6	24.6	44.3	46	46	46	46
	Fuzzy	5.3	25.3	44.6	64.6	75.3	75.3	75.3
	GT	5.6	25.6	45.6	65.3	76.6	76.6	76.6
	IDRS	7.6	27.6	46.2	66	77.3	77.3	77.3

Table 5 shows the comparative results of existing approaches with proposed IDRS for the packet delivery ratio parameter. The packet delivery ratio is the ratio of packets which have been successfully received to the total sent. For better results, the observation made for 10 ms and the results are shown in number of packets. From Table 5, it is clearly identified that the packet delivery ratio gradually increases depends on time and the proposed approach transmits more number of packets than the conventional systems. In addition.it is learned that even the increasing number of nodes does not affect the performance of proposed approach than existing approaches

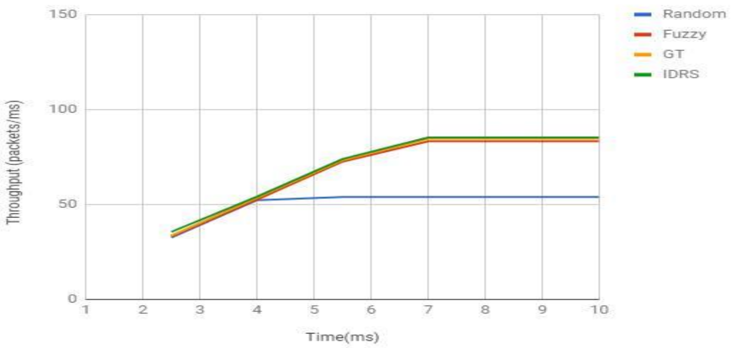

Figure 6. Observation for Throughput for 10 ms for 100 Nodes, Range 300 m

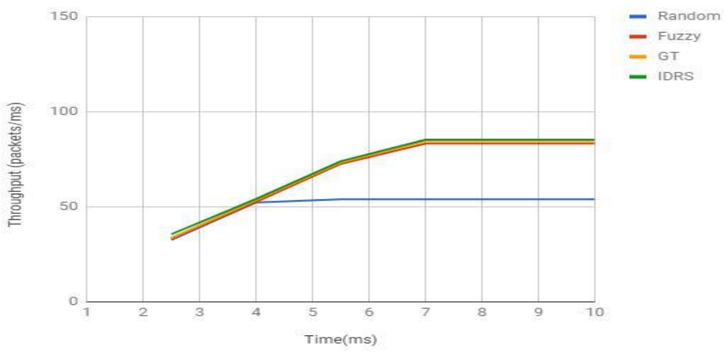

Figure 7. Observation for Throughput for 10 ms for 200 Nodes, Range 300 m

Table 5. Observation of Packet Delivery Ratio for Varying Number of Nodes for Range 150 m

Packet Delivery Ratio (ms)								
No of nodes	**Range 150 m**							
	Time(ms)	**1**	**2.5**	**4**	**5.5**	**7**	**8.5**	**10**
100	**Random**	16	46	75	81	81	81	81
	Fuzzy	13	43	73	103	121	121	121
	GT	14	44	74	105	136	163	163
	IDRS	18	48	78	108	140	167	167
200	**Random**	8	23	38	41	41	41	41
	Fuzzy	7	22	37	52	61	61	61
	GT	7	22	37	53	68	82	82
	IDRS	9	24	39	54	70	84	84

In Figure 8 and Figure 9, the packet delivery observation is shown for first 10 ms for range 150 m with 100 nodes and 200 nodes respectively.

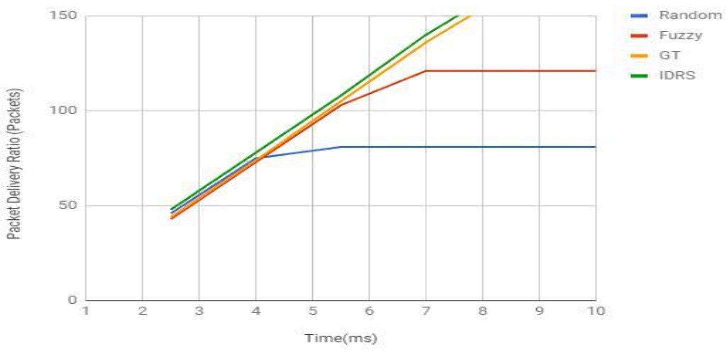

Figure 8. Observation for Packet Delivery Ratio for 10 ms for 100 Nodes, Range 150m

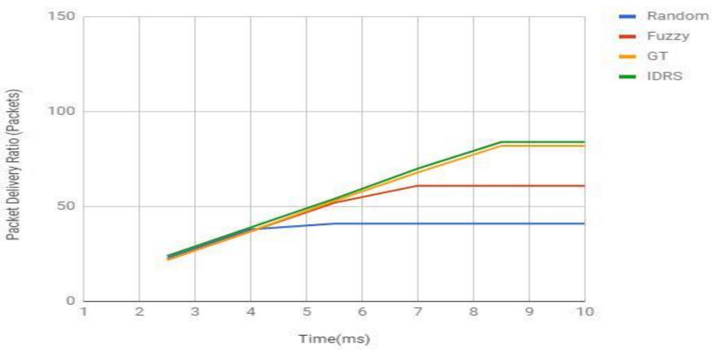

Figure 9. Observation for packet delivery ratio for 10 ms for 200 nodes, Range 150m

Table 6 shows the comparative results of existing approaches with proposed IDRS for the packet delivery ratio parameter with range 300 m. From table 5 and table 6, it is observed that as we start increasing the coverage from 150 m to 300 m, the performance of network is seen decreasing with respect to packets delivery. In both observations of throughput and packet delivery ratio, the performance of proposed IDRS performs better than all other existing approaches.

Table 6. Observation of Packet Delivery Ratio for Varying Number of Nodes for Range 300 m

Packet Delivery Ratio (ms)								
No of nodes	**Range 300 m**							
	Time(ms)	**1**	**2.5**	**4**	**5.5**	**7**	**8.5**	**10**
100	**Random**	6	36	65	71	71	71	71
	Fuzzy	3	33	63	93	111	111	111
	GT	4	34	64	95	126	153	153
	IDRS	8	38	68	98	130	157	157
200	**Random**	4	23	41	44	44	44	44
	Fuzzy	2	21	39	58	69	69	69
	GT	3	21	40	59	79	96	96
	IDRS	5	24	43	61	81	98	98

In Figure 10 and Figure 11, the packet delivery observation is shown for first 10 ms for range 300m with 100 nodes and 200 nodes respectively.

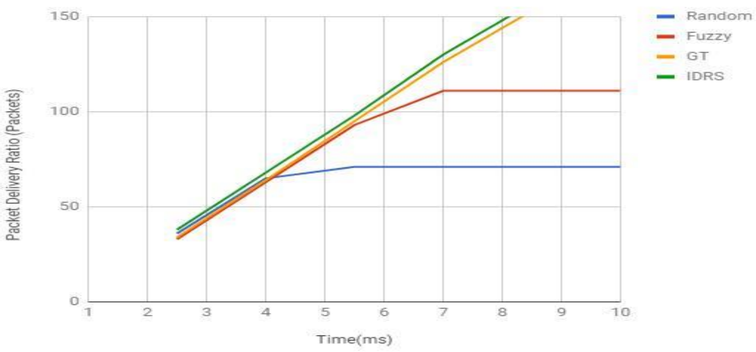

Figure 10. Observation for Packet Delivery Ratio for 10 ms for 100 Nodes, Range 300m

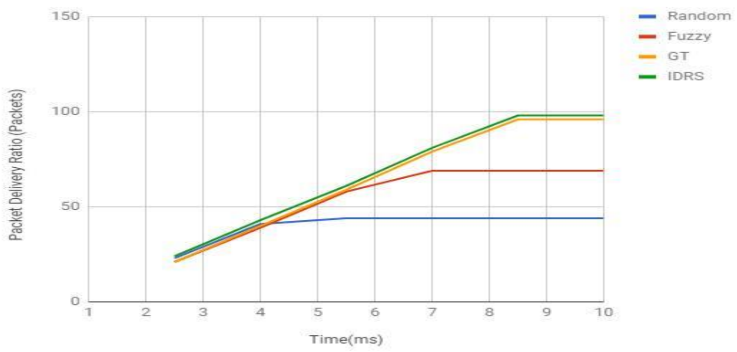

Figure 11. Observation for Packet Delivery Ratio for 10 ms for 200 Nodes, Range 300m

Table 7 shows the end to end delay which stands the time taken for a packet to be transmitted across a network from source to destination. More or less, end to end delay for both proposed approach and existing fuzzy approach are similar. Even though, the end to end delay for random selection is lower than all other methods without yielding the throughput guarantee. Figure 12 and figure 13 illustrates the performance of network in terms of delay by varying number of nodes. With the increase in coverage, end to end delay also increases. Due to the threshold calculation, the parameter communication overhead is high in the proposed method. Hence, it is understood that if the threshold calculation is done implicitly for this implementation, these time durations will be dramatically shortened.

Table 7. Observation of End to End Delay for varying Number of Nodes for Range 150m

End to End Delay (ms)								
No of nodes	**Range 150 m**							
	Time(ms)	**1**	**2.5**	**4**	**5.5**	**7**	**8.5**	**10**
100	**Random**	0.48	1.23	1.98	2.00	2.00	2.00	2.00
	Fuzzy	0.48	1.23	1.98	2.73	3.18	3.18	3.18
	GT	0.48	1.23	1.98	2.73	3.48	4.15	4.15
	IDRS	0.48	1.23	1.98	2.73	3.18	3.18	3.18
200	**Random**	0.95	2.45	3.95	4.00	4.00	4.00	4.00
	Fuzzy	0.96	2.46	3.96	5.46	6.36	6.36	6.36
	GT	0.95	2.45	3.95	5.45	6.95	8.30	8.30
	IDRS	0.96	2.46	3.96	5.46	6.36	6.36	6.36

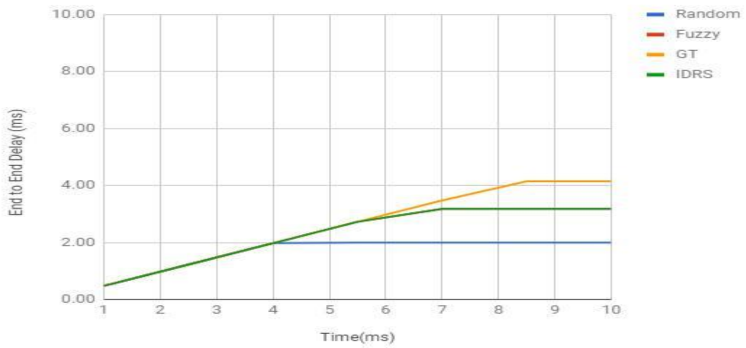

Figure 12. Observation for End to End Delay for 10 ms for 100 Nodes, Range 150m

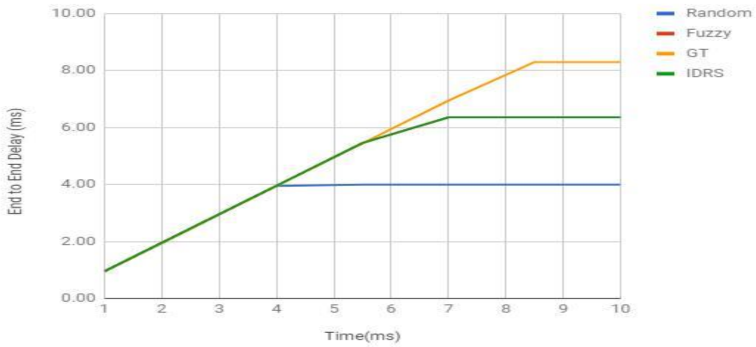

Figure 13. Observation for End to End Delay for 10 ms for 200 Nodes, Range 150m

10. Conclusion

The constraints of relay selection, objective of proposed relay selection approaches, the proposed relay selection procedure, configuration, algorithm and its extended design are discussed in this Paper. The relay based approach has been found useful in making communication of network for surveillance with a number of nodes for 300 meters of communication range based on the Experimental simulation output. It has been also detected that this proven network is fairly robust against the changes in nodes configuration. Since, mesh topology is used for the network formation here; all the nodes in the proposed network have some relationship with each other for improving network reliability even in an environment with poor radio link quality because of the relationship between nodes. The comparative analysis results show that the proposed system outperforms the previous approaches in terms of throughput and packet delivery ratio. As a conclusive remark, the proposed intelligent decision based relay selection consistently performs well with respect to the number of nodes and coverage of data transmission. However, the performance of relay selection approach is less efficient for the surveillance network, when it has more number of nodes due to range limitation.In the future work ,the communication range can be increased on par with the relay nodes inclusion.

Acknowledgement:

The authors wish to thank The Dean and Head of Computer Science, King Khalid University, Kingdom of Saudi Arabia for the support.

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