NETWORK LIFETIME AND ENERGY EFFICIENT MAXIMIZATION FOR HYBRID WIRELESS NETWORK

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Abstract - *Wireless Sensor Network contains a tremendous number of minor gadgets called sensor nodes that are spread in a physical domain for gathering required data. With the incorporation of data detecting, calculation, and wireless correspondence, the sensor nodes can detect physical status, handle the sensed data, and report them to the sink node or Base Station (BS). In this project, we focus on the issue of certificate authority to isolate malware attacker and increase the network lifetime. Mostly, HWNs have high packet loss due to congestion and network disconnectivity. This can be removed by implementing proper routing strategy. Thereby, it has established efficient path in which high amount of packets can be transferred between two mobile clients. Even though, it provides bulk data transmission, it is unable to protect the data from malicious attacks. Since HWNs follow multi hop routing mechanism, thereby, there is a chance to recover the data. The available routing protocol is effectively applicable only to existing networks such as WSNs, MANETs, VANETs and metropolitan MANETs but not for HWNs till now. Therefore, the present study seeks to explore both security and efficient load aware routing protocols. Such protocols have extended network connectivity to wide coverage and also limited malicious attacks by adapting trust based security system. The congestion is completely removed from HWNs. Flexible and protective communication links are achieved by using the efficient load aware routing protocol.*

Key Words: Clustering, energy balance, network lifetime, node deployment, wireless sensor network.

1. INTRODUCTION

Today, Wireless Network technology plays a tremendous role to sustain sufficient data transfer at the time of emergency and safety applications. The infrastructure based ad-hoc network provides proper gateway between the mobile users and other terrestrial networks (e.g., IEEE 802.11-based Wi-Fi networks) for data communication. Such network is normally referred as Hybrid Wireless Networks (HWNs) which take advantage of flexible network connectivity to wider coverage range [1]. But, it is difficult to operate and coordinate among many Base Stations (BS)/Access Points (AP) which are irregularly set throughout the networks. As a result, the performance efficiency of such network has suffered very much due to loss of characteristic parameters and thereby, it leads to affect the overall Quality of Services (QoS) of the network [2]. Hence, it has brought out a hot research topic to develop new strategy of routing protocols which provide a promise solutionto HWNs in the aspect of QoS. That is, it has improved the bulk data transmission and minimized the traffic congestion between source nodes and destination nodesof HWNs significantly.

1.1 Motivation

Mostly, HWNs have high packet loss due to congestion and network disconnectivity. This can be removed by implementing proper routing strategy. Thereby, it has established efficient path in which high amount of packets can be transferred between two mobile clients. Even though, it provides bulk data transmission, it is unable to protect the data from malicious attacks. Since HWNs follow multi hop routing mechanism, thereby, there is a chance to recover the data. The available routing protocol is effectively applicable only to existing networks such as WSNs, MANETs, VANETs and metropolitan MANETs but not for HWNs till now. Therefore, the present study seeks to explore both security and efficient load aware routing protocols. Such protocols have extended network connectivity to wide coverage and also limited malicious attacks by adapting trust based security system. The congestion is completely removed from HWNs. Flexible and protective communication links are achieved by using the efficient load aware routing protocol.

1.2 Objective

The focus of this research work is to enhance QoS performance efficiency of HWNs by adapting efficient load and security aware routing protocols:

To develop a Fuzzy based Mobility and Energy Aware QOS Routing protocol (FMEAQRP) andto improve the QOS of the HWNs. The best nodes and the shortest path in the network will be identified by proposing a unified algorithm namely "Multi Objective Evolutionary algorithm based on decomposition combined with Dijkstra" (MOEAD/D). These algorithms help for fast packet delivery as well as for finding the shortest path.

2. PROPOSED METHODOLOGY

2.1 Fuzzy Based Mobility and Energy Aware Qos Routing Protocol (FMEAQRP)

The packet scheduling is an essential process required to transfer data from source to destination node in the wireless network. Therefore, it is difficult to access its base station. Anyhow, this problem can be rectified by implementing HWNs. However, it faces some issues like network disconnectivity, energy inefficiency whenever varying load and changing node position occur respectively. In order to overcome this issue the fuzzy based mobility and energy aware QoS routing protocol is proposed in this study. According to this, ranking scheme is prepared by evaluating the network parameters such as load, space utility, residual energy, link expiry time and signal strength at receiver side. The ranking is allotted to each individual node from the estimated network parameters valued namely high, medium and low. The node is assigned with high ranking, if the particular node satisfies 4 out of 5 parameters under consideration. Similarly, node with medium and low ranking is assigned according to the satisfaction of network parameter (3/5) and (2/5) respectively. The rules are estimated on the basis of network parameters such as load, space utility, residual energy, link expiry time and signal strength at receiver side. In FMEAQRP, the varying load is categorized into four groups which are given as: (i) Hard Deadline with large packet size, (ii) Hard Deadline with small packet size, (iii) Soft Deadline with large packet size and (iv) Soft Deadline with small packet size. Therefore, Scheduling Probability (SP) is revised and it provides proper selection of forwarding node depends on the category of the packet. The forwarding node strategy of proposed FMEAQRPis tabulated as follows:

Fuzzy decision rules are made by fuzzifying the input parameters and the scheduling probability is assessed based on the outcome of the rule. The fuzzy rules are defined as order based interference which is given as follows:

Step 1: The crisp input is converted into appropriate linguistic parametric variable and each one can be mapped with its corresponding fuzzy set rules. This process is referred as Fuzzification.

Step 2: The antecedents of the fuzzy rules accept the fuzzifier inputs which are taken and then applied to the subsequent carried out by Triangular and Trapezoidal membership functions. This process is referred as Rule evaluation.

Step 3: The fuzzy rule is defined from fuzzy parametric variable (i.e. input and output linguistic terms).The outputs of all rules are aggregated in this step.

Step 4: Again convert linguistic parametric variable into probability crisp input. It is called as Defuzzification. That is, input is obtainedas the aggregate output fuzzy set and corresponding output is offered as a single crisp number.

Table -1: Assignment of Forwarding Nodes

S. No	Deadline	Packet Size	Forwarding Node Assignment
1.	Hard	Large	High scheduling probability
2.	Hard	Small	Medium Scheduling probability
3.	Soft	Large	Low Scheduling probability
4.	Soft	Small	Medium Scheduling probability

The performance of the FMEAQRP is evaluated through network parameters such as packet delivery ratio, packet drop ratio, packet delay and throughput. The high throughput ratio is maintained effectively even under varying load and node position. However, it fails to protect the data from malicious attacks. This will be overcome by adapting secured packet data transmission.

2.2 Security Aware Routing Protocol for Hybrid Wireless Networks (SARP-HWNs)

There is a presence of malicious attack during bulk data transmission. This has happened, because of the large number of hybrid nodes and possible routing paths. It is very difficult to coordinate and select best routing from available number of possible routing paths. Due to different scenario, scheduling property of the FMEAQRP changes accordingly. So, there is a chance to get link failure and more traffic congestion takes place in the selected routing path. This will lead to malicious attack created in the HWNs. It can be resolved by proposed SARP-HWNs routing protocol Intuitionistic Fuzzy TOPSIS (IFT) inference model. It is an efficient model to detect the trusty individual nodes by means of packet delivery ratio, residual energy of sender/receiver; multi-hop overhead and throughput which are computed by using the different node/route attributes. This estimated parametric value is given as input to the IFT interference model in which Multi Criteria Decision Matrix (MCDM) is generated.

$$D = \begin{array}{c} \\ S_1 \\ S_2 \\ \vdots \\ \vdots \\ S_m \end{array} \begin{array}{c} \begin{array}{cccccc} A_1 & A_2 & \cdots & \cdots & A_n \end{array} \\ \begin{bmatrix} i_{11} & i_{12} & \cdots & \cdots & i_{in} \\ i_{21} & i_{22} & \cdots & \cdots & i_{2n} \\ \vdots & \vdots & \ddots & & \vdots \\ \vdots & \vdots & & \ddots & \vdots \\ i_{m1} & i_{m2} & \cdots & \cdots & i_{mn} \end{bmatrix} \end{array}$$

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3. RESULT AND DISCUSSION

In this section, result outcomes and QoS performance of the proposed algorithm for HWNs are discussed. The result and discussion has been given in the following orders.

1: Fuzzy based Mobility and Energy Aware QOS Routing protocol (FMEAQRP) is implemented to improve the Quality of Service (QoS) for HWNs. To achieve this,

i. The proper ranking methodology is assigned to each node based upon the distance between neighbor's nodes. Based on this, low, medium and high ranking scheme is given to each node.
ii. Then, the scheduling property is applied to identify the best routers which establishe deffective data transmission after minimize the traffic congestion among data packets.

2: The network lifetime, energy efficiency and secured data transmission are enhanced along with improvement of Quality of Service (QoS) based on Security Aware Routing Protocol for Hybrid Wireless Networks (SARP-HWNs).

i. It has high capability of preventing malicious attacks and it takes quick recovery time to establish new routing path once connectivity failure known.
ii. It Contains Multi criteria decision making (MCDM) algorithm model which provides 'm' number of best possible solutions given out for 'n' number of predefined attributes.

3.1 Performance Evaluation of FMEAQRP algorithms

The experimental set up consists of different packet size (250, 500, 750and 1000bytes) and unique zone size of 1200m X 1200 m^3 area for 50 sec. The simulation part is carried out by NS2 simulator. The FMEAQRP protocol tested and analyzed with help of network parameters such as Constant Bit Rate (CBR) and end to end packet delay, packet drop and throughput ratio.Figure1(a-d) shows the graphical representation of the FMEAQRP protocol outcomes with respect to different mobile node speed which is givenas 1, 2, 3, 4, 5 and 10m/s respectively.

In Figure 1(a) shows the comparative analyses of the mobile speed (1-5m/s) with respect to delay for FMEAQRP and QOD protocols respectively. When compared with QOD, FMEAQRP has 30% less delay. This is because of hard date packets through the high sending nodes. The delivery ratio and packet drop of FMEAQRP and QOD protocols are evaluated and compared by varying the mobile speed which is clearly given in Figure1 (b) and (c).When compared with QOD, FMEAQRP has 39% higher delivery ratio and 19% lesser packet drop. This is because of nodes are selected on the basis of interface quality in FMEAQRP. In Figure1 (d) shows the consequence of throughput acquired for FMEAQRP and QOD protocols on changing the mobile speed. Because of node separations, the throughput is diminished by the increment node speed in the outcome. Besides, in comparison to QOD, the FMEAQRP has 25% higher throughput when nodes are increased. Figure 2(a) shows the plot between delay vs varying packet size from 250-1000 Bytes for both FMEAQRP and QOD protocols respectively.

Figure 1: **Demonstrate the metric execution for FMEAQRP and QOD Protocolby varyingmobile node speed.**

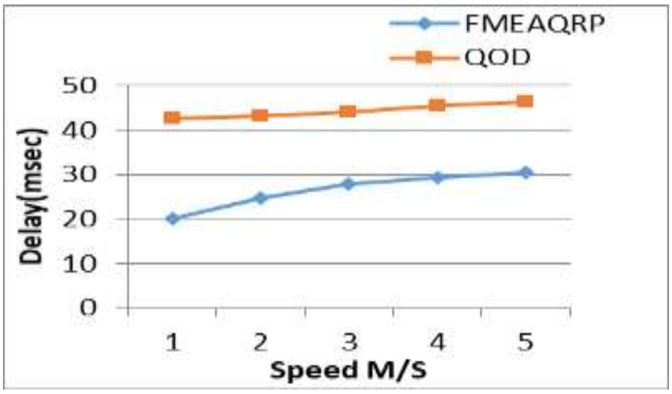

Chart (a): Speed Vs Delay

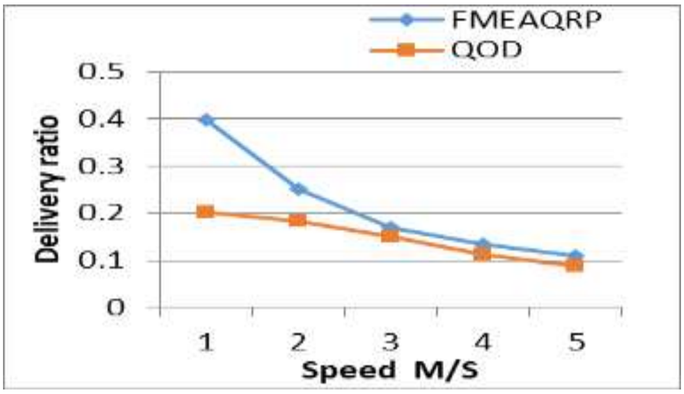

Chart (b): Speed Vs Deliver ratio

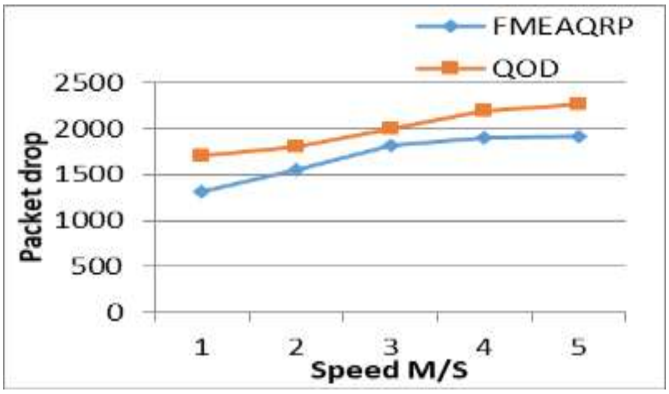

Chart (c): Speed Vs Packet drop

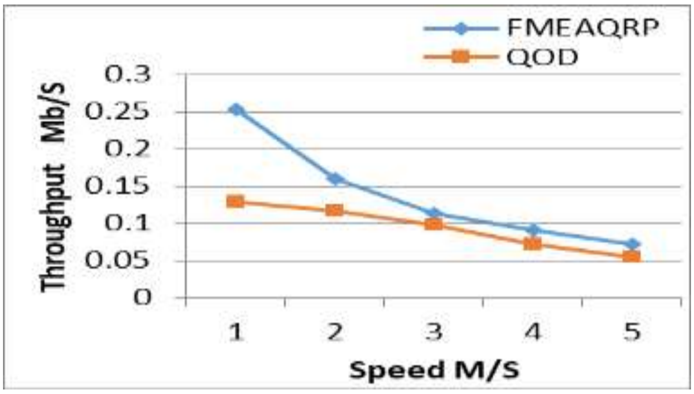

Chart (d): Speed Vs Throughput

Figure 2: Show the metrics performance for FMEAQRP and QOD protocol byvarying Packet size.

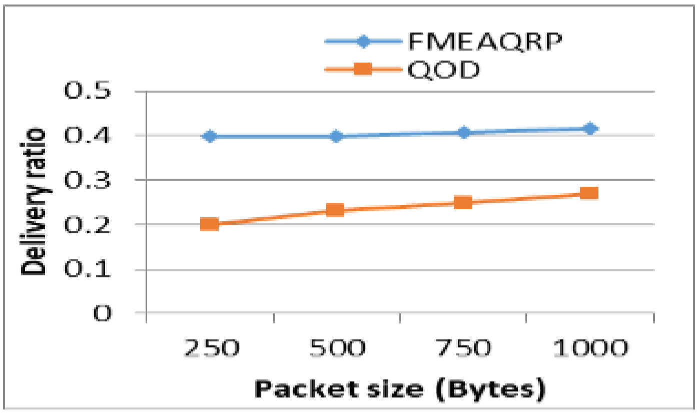

Chart (a): Packet size Vs Delay

It is observed that the delay occurred whenever the packet size of node increases. When compared with QOD, FMEAQRP provides 25% less delay. In Figure 2 (b) and (c) the significance of delivery ratio and packet drop is noted by changing the packet size for FMEAQRP and QOD protocols respectively. It shows that the quantity of packets transmitted is less, the packet drops decrease and the delivery ratio increases. When compared to QOD, FMEAQRP has 41% higher delivery ratio and 13% lesser packet drop as sending nodes with better connection quality. The result of throughput obtained for FMEAQRP and QOD protocols by increasing the packet size given in Figure 2(d). The figure describes the Increment packet size in the outcome by incrementing the throughput. When compared to QOD, FMEAQRP has 28% higher throughput with better connection quality.

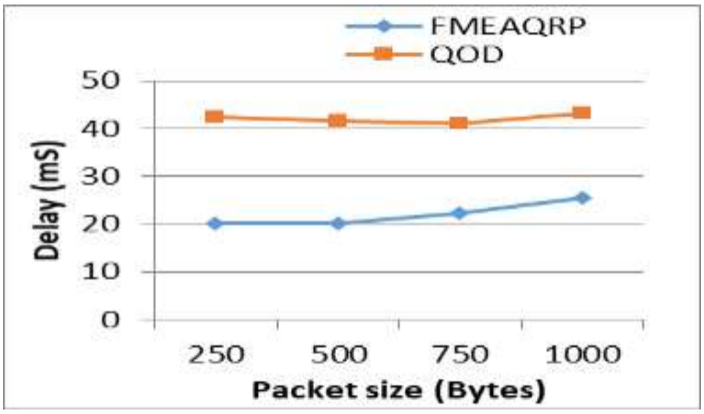

Chart (b): Packet size Vs Deliver ratio

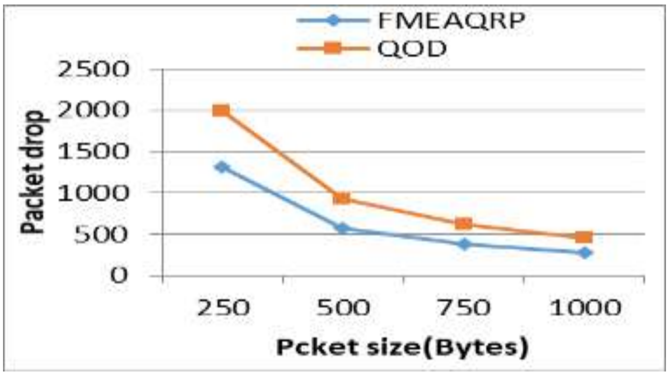

Chart (c): Packet size Vs Packet drop

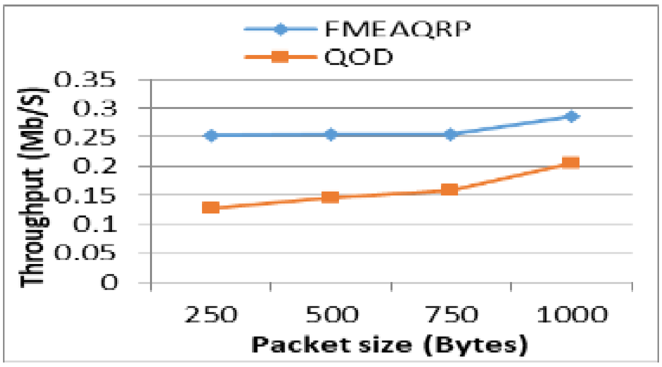

Chart (d): Packet size Vs Throughput

3.2 Performance Evaluation of SARP-HWNs algorithms

The network lifetime, energy efficiency and secured data transmission are enhanced along with improvement of Quality of Service (QoS) based on SARP-HWNs algorithm. It uses Multi criteria decision making (MCDM) algorithm model which provides 'm' number of best possible solution given out for 'n' number of predefined attributes. Hence, it provides maximum network lifetime. The performance of proposed SARP-HWN is analyzed by using three parameters (packet loss ratio, network lifetime and end-to-end delay). The simulation setup consist of the following criterion such as varying speed of node by constant multiply of 10 m/s and network size (1000×1000).Figure 3(a) shows the plot of packet loss ratio with respect to number of nodes and its varying speed. It is clearly observed that the packet loss ratio decreases as the number of nodes and its speed change respectively. Hence, it is concluded that the packet loss ratio of the SARP-HWNs is better than POLITIC routing protocol due to minimum packet loss ratio. Figure 3(b) shows the plot of end to end delay with respect to number of nodes and its varying speed. It is clearly observed that the packet delay is reduced when number of nodes and its speed change rapidly. Therefore, it is concluded that the end to end delay of the SARP-HWNs is achieved through reasonable good quality service in the aspects of packet delay as compared with POLITIC routing protocol. Figure 3(c) shows the plot of routing cost with respect to number of nodes and its varying speed. It is clearly observed that the routing cost is minimized due to optimum set of best paths which are identified with help of Multi criteria decision making (MCDM) algorithm model which provides 'm' number of best possible solution given out for 'n' number of predefined attributes. Hence, it leads to have minimum routing cost. Due to this, the routing cost of the SARP-HWNs provides high performance efficiency when compared with POLITIC routing protocol.

Figure 3: Comparative analysis of SARP-HWN with POLITIC routing protocol

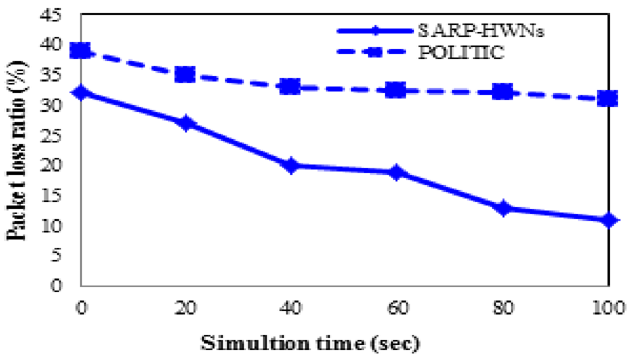

Chart (a): Packet loss

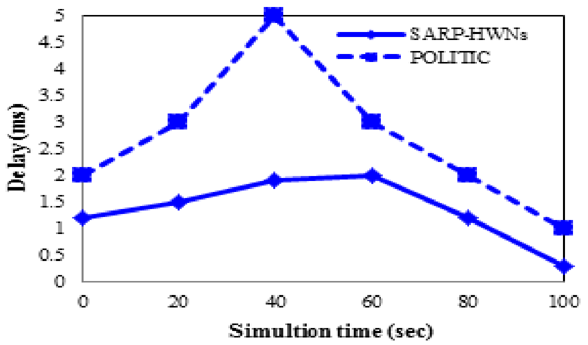

Chart (b): End to end delivery

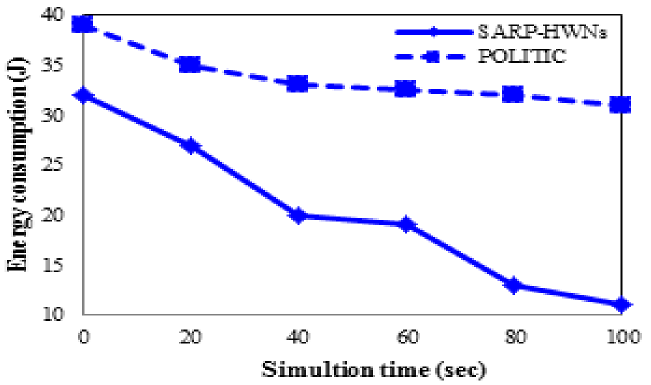

Chart (c): Routing cost

Figure 3(d) shows the plot of throughput ratio with respect to number of nodes and its varying speed. It is clearly observed that the number of packets/frames increases, as the number of nodes and its speed change respectively. Hence, it is concluded that the throughput ratio of the SARP-HWNs is larger than POLITIC routing protocol due to availability of multiple set of best possible routing paths. Figure 3(e) shows the plot of jitter with respect to number of nodes and its varying speed. It is clearly inferred that the delay difference of the two successive packet transmissions is improved when the number of nodes and its speed change respectively., it leads to have optimum energy consumption that takes place at every individual node in the network. It is clearly given in Figure 3(f) which shows the plot of energy consumption with respect to simulation time.

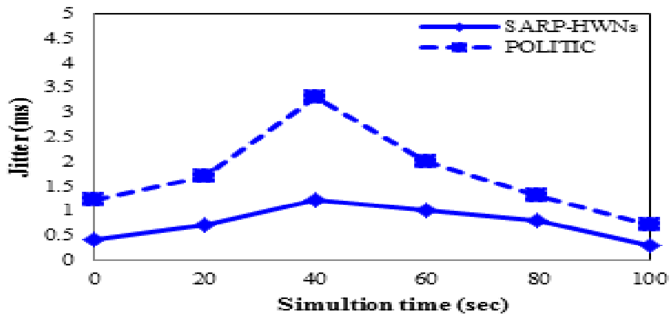

Chart (d): Throughput

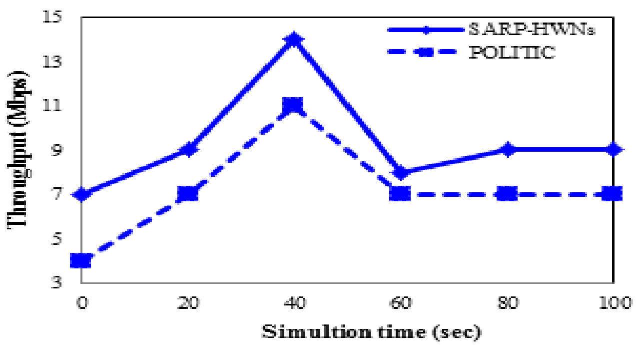

Chart (e): Jitter

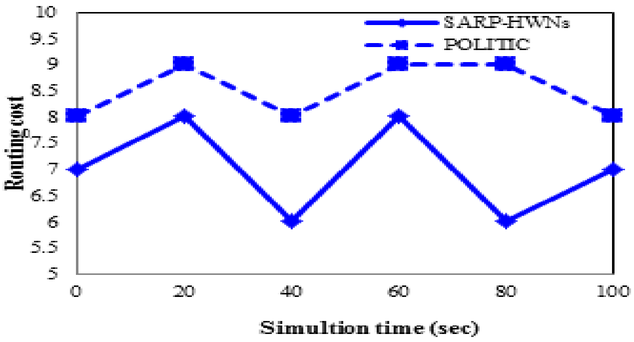

Chart (f): Energy consumption

4. CONCLUSION

In this research work, attempt has been made to acquire a new strategy of routing protocols which provides a promising solution to HWNs in the aspect of QoS. First, the fuzzy based mobility and energy aware QoS routing protocol is proposed to enhance the packet scheduling strategy by which proper data transfer is obtained between mobile nodes. Thereby, high throughput ratio is achieved even under variable load and node position respectively. However, link failure and traffic congestion induced malicious attack in the HWNs. It can be resolved by proposed SARP-HWNs routing protocol, Intuitionistic Fuzzy Topsis (IFT) inference model. It includes both Multi Criteria Decision Matrix (MCDM) and Gravitational Search Algorithm (GSA). The MCDM identify best routing paths after evaluated trust values from node/routing attributes. At each time instant, GSA selects one efficient best routing path from possible set of routing paths for packet data transmission. Again, the large number of nodes available in the efficient best routing path suffer energy conservation problem. It forms weighted normalized decision metric by taking three extra criteria such as Level of enrollment (total number of active best nodes), Level of non-participation (total number of passive best node) and Intuitionistic file (fitness weighted value). It provides minimum number of nodes which induce minimum 20% improvement in Delivery Ratio and 20% reduction in delay and efficient shortest routing path. On the whole, the performance evaluation parameter of QoS of HWNs is improved as compared to other load aware routing protocols. In future, the hybrid wireless networks will be implemented for multi-disciplinary applications, where proposed protocols are analyzed under the real time scenarios by adapting different testing techniques.

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