iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 **Issue:** VI **Month of publication:** June 2018

DOI: http://doi.org/10.22214/ijraset.2018.6020

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue VI, June 2018- Available at www.ijraset.com

A Novel Marko Vain Random Walk approach for Ad Hoc Multi-Hop Networks

Syoban Ajumal[1], Eswaramoorthy V[2], Yathavaraj V[3]
[1, 2, 3]*Department of Computer Science and Engineering, Maharaja Engineering College*

Abstract*: *In ad hoc multi-hop wireless network proposed novel Marko vain random walk approach to improve the performance in terms of end-to-end throughput, where each link is affected by interference coming from other multi-hop paths nearby. The approach captures the mutual impact of each path on all others. It can be applied to both, contention-based and scheduled, medium access control (MAC) protocols. Sources have data to send to destination nodes through n relays. A random walk on a directed graph consists of a sequence of vertices generated from a start vertex by selecting an edge, traversing the edge to a new vertex, and repeating the process. We will see that if the graph is strongly connected, then the fraction of time the walk spends at the various vertices of the graph converges to a stationary probability distribution. The Node assumed like Markovian random-walk movement strategies moving over a graph (or network), while each sensor node, the impact on the end-to-end throughput and data arrival rates are increased over different sensor nodes. In particular, from the analysis, obtain the optimal movement strategy among a class of Markovian strategies so as to minimize the data loss rate over all sensor nodes, Unlike most previous approaches, the mathematical tool proposed appears to be scalable, allowing easy extension to any number of hops. The proposed approach outperforms good compared with existing approaches in terms of accuracy with very similar end to end delay and energy consumption.

Keywords: Ad hoc Networks, Medium Access Control, End to End delay, Energy, Throughput.

I. INTRODUCTION

Wireless communication refers to the use of untethered communication (e.g., infrared, acoustic, or radio frequency signals) for sending and receiving data between devices equipped with wireless interfaces. Since its introduction, wireless communication has been a revolution for communication and networking technologies with the great advantages that it provides in comparison to its wired counterparts. With no wires needed for end-to-end communication, wireless communication provides flexible deployment and use, cost reduction, mobility, network scaling, and convenience for both users and service providers. The efficacy of data aggregation in sensor networks is a function of the degree of spatial correlation in the sensed phenomenon[1]. In the ad-hoc mode, with limited transmission range, for a node to be able to communicate with another node out of its transmission range, it should depend on other intermediate nodes for packets to reach the intended destination. These intermediate nodes act as relays for the packet. This communication paradigm is known as “multi-hop” communication where a node can act as a source, a destination, or a relay. A network comprised of nodes that use wireless multi-hopping for data transmission is known as a “wireless multi-hop network.” A wireless multi-hop network suffers from all the previously mentioned drawbacks of wireless communication. Such drawbacks should be taken into consideration in designing an application or a protocol for a wireless multi-hop network and they are common for all the wireless multi-hop network paradigms. As well, as a common characteristic for all wireless multi-hop networks, these networks are ad-hoc networks. This means that nodes in a network have no central control and they are responsible for cooperating with one another for handling network organization and management. Thus, wireless multi-hop networks are known to be self-organizing and self-configuring networks. With the multi-hopping feature, wireless multi-hop networks have some unique characteristics and challenges in each layer of the protocol stack as well. For instance, signal interference and attenuation are major problems that need to be handled by the physical layer. Wireless nodes also suffer from the hidden and exposed terminal problems which should be handled by the deployed MAC protocol[3]. The network layer faces great challenges with the most crucial one the task of establishing the communication path with its multi-hopping requirements, and this is the responsibility of the routing sub-layer. In single Hop network of ALOHA and CSMA algorithms is evaluated in terms of outage probability based on the Signal-to-Interference-and-Noise Ratio (SINR); however, the Authors consider only the closest interferer in the computation of the interfering power, providing a lower bound to the performance achievable. In Multi hop network ALOHA in a multi-hop context where the probability of successful transmission is evaluated, considering a simple model where interference only propagates two hops away [7]. In a widely accepted model for ALOHA in a network with spatial reuse was introduced. In the problem of starvation and

©IJRASET: All Rights are Reserved

throughput imbalances in multi-hop CSMA based wireless networks. CSMA with Collision Avoidance (CSMA/CA) protocols in multi-hop wireless networks. A multi-hop network using the IEEE 802.15.4 MAC protocol. The models a CSMA based multi-hop network affected by the interference caused by nodes on the same path. A multi-hop transmission in a Poisson field of nodes, where nodes use an ALOHA-like protocol. However this model does not consider retransmissions and random back off. An Improved Lion optimization algorithm (ILOA)-centered lifetime prediction algorithm for route healing in MANET predicts the lifetime of link and node within the to be had bandwidth headquartered on the parameters like relative mobility of nodes and power drain fee[4].

II. METHODOLOGY

In this paper novel Marko vain random walk approach proposed to improve the performance in terms of end-to-end throughput, where each link is affected by interference coming from other multi-hop paths nearby. The approach captures the mutual impact of each path on all others. It can be applied to both, contention-based and scheduled, medium access control (MAC) protocols. Sources have data to send to destination nodes through n relays. The Node assumed like Markovian random-walk movement strategies moving over a graph (or network), while each sensor node, the impact on the end-to-end throughput and data arrival rates are increased over different sensor nodes. A random walk on a directed graph consists of a sequence of vertices generated from a start vertex by selecting an edge, traversing the edge to a new vertex, and repeating the process. The graph is strongly connected, and then the fraction of time the walk spends at the various vertices of the graph converges to a stationary probability distribution. The model accounts for a realistic packet capture model and precisely describes the behavior of the MAC protocol used by nodes to access the channel. The spatial distribution of nodes in the network is taken into account through stochastic geometry[2]. By merging and integrating the latter tool to a Markovian random walk analysis of the MAC protocol considered, get a mathematical framework which is very useful and flexible. The model allows the computation of the end-to-end throughput and delay and captures the behavior of the performance when changing different system parameters and accounting for both, inter- and intra-path interference.

A. Creation of System Model

Network consisting of a set of N nodes, where node i, i = 1, 2, . . .; N. Suppose that there is a set of F unicast sessions in the network, with their source and destination nodes being randomly selected among all the nodes. The route of each session can be computed by some routing protocol. Assume that scheduling is done in a time frame consisting of T time slots. In such a network, our goal is to find an optimal scheduling solution in each time slot so that the minimum achievable (end-to-end) throughput among all the sessions can be maximized.

Assume that nodes are time synchronized (at the level of packet): the time axis is divided into slots of duration Tslot [s]. The packet transmission time is (slightly) smaller or equal to Tslot depending on whether the ideal or imperfect acknowledgement. Source nodes generate a new packet with probability p during a given slot when in idle state, transmitting it immediately during the next slot; after the reception by the first relay is acknowledged, or the maximum number of unsuccessful transmissions have been performed, they move back to idle state where another packet could be generated with probability p.

So, multiple packets might be simultaneously present in the path. For instance, with p = 1 (saturation traffic) and no retransmissions, a packet is generated every two slots. Assume that the average number of slots needed to reach the first relay in the path or being dropped because of reaching the maximum number of retransmissions, according to the MAC protocol used, is ξ; the average number of time slots a source remains in a state where packets cannot be generated is equal to ξ.

B. Reference MAC Protocol

Reference MAC protocol to be analyzed, to propose new protocols or study complex ones. Nevertheless, the choice makes accounts for i) probabilistic generation of data packets, ii) random backoffs, iii) acknowledgement mechanisms, iv) retransmissions. Each node, upon successful reception of a packet, will access the channel in the next slot to forward the packet further. Consider both the case where acknowledgements (ACK) are sent backward, and not. In case of ACK mode, and of packet loss,

a backoff procedure is used to try accessing the channel later, up to a maximum number of attempts. In particular, if a node does not receive the ACK at the end of the data transmission, it will generate a delay, randomly and uniformly distributed between 0 and W – 1 time slots (being W an integer parameter), at the end of which it will retransmit the packet. Assume the backoff counter decreases at each slot and we do not account for backoff freezing, being out of the scope of this work. If rmax retransmissions are reached unsuccessfully, the packet is lost.

©IJRASET: All Rights are Reserved

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue VI, June 2018- Available at www.ijraset.com

C. Markov Chain based MAC Protocol

To compute the end-to-end throughput, need to determine p(n) TX, which depends on the success probability pS, and pS as a function of p(j) TX, Vj. can be applied to the two scenarios to compute the success probability, with x = d. On the other hand, the model is then compared to simulation results To compute pS, which depends on the statistics of interference in the network, a stochastic geometry approach can be useful [5]. In the case of the first scenario, to simplify the mathematical analysis, we assume relays are located in the optimal positions. In these results, having nodes in the path at a constant distance d, as in the case of the second scenario so, the same mathematical framework. In order to derive the transmission probabilities of the different nodes and first need to model the nodes behavior via a Markov Chain, where the different states of the j-th node in the path are represented. The fact whether the j-th node has a packet to transmit or not, is accounted for statistically, through the probability that it has received a packet from the (j − 1)-th node. In particular, the j-th (j = 0, . . . , n + 1) node in each slot can be in one of the following states: 1) Idle, that is, there are no packets in the queue and it is not waiting for data (only the source node could be in this state); 2) Frozen, that is, no action is taken till when the packet reaches the destination or it is dropped (only the source node could be in this state); 3) Reception, that is, the node is waiting for possible data or acknowledgements to be received; 4) Transmission, that is, the node is transmitting the data packet or the ACK; 5) Backoff, which is the backoff state where the node delays the packet transmission. Denote as T (j) i the i-th transmission made by node j to deliver a given packet and as B(j) i,k the backoff state of node j waiting for transmitting the packet for the (i + 1)-th time and having a backoff counter currently equal to k. Moreover, to distinguish between data and ACK transmission, when needed, we also use a subscript d or a for the state T (j) i , such as for the reception state.

D. Iterative Algorithm for Deriving probability

Ideal acknowledgement the ACK is successfully transmitted by the intended receiver within (at the end of) the same slot used for the data packet transmission. Therefore, in one slot have both, data and ACK (the time slot is assumed to be slightly larger than the data packet transmission time, to leave room for the short ACK sent backward). Since, as a consequence, do not need to account for ACKs in the states, we will not use subscripts d or a for the state T (j) i .

The transmission process of each node as the recurrence of consecutive cycles each composed of idle state and consecutive transmission events separated by backoff states. Assuming independence among transmission cycles, from renewal conclude that the probability that a node (source or relay) is in a given state (idle, transmission and backoff) can be computed on the ratio between the average number of slots spent in that state (idle, transmission and backoff) in a renewal cycle and the average number of slots spent by the node (source of relay) during the whole cycle. In order to identify the renewal cycle and its average duration in number of slots, in report the Node-Level MC describing the behavior of a generic source when using up to rmax retransmissions. Note that in the case of the benchmark traffic the diagram should be slightly modified: after a successful transmission or after having reached the maximum number of retransmissions, the source will move to the frozen state until the previous packet has been received by the final destination, or it has eventually been dropped. At the end of the frozen state the source will come back to idle with probability one As expected, pTX is a function of pS. Imperfect acknowledgement the cases in which ACK packets have the same length of data packets. In this case both, data and ACKs, are occupying one slot each, and possible collisions of ACKs are accounted for. Subscripts d or a are used in the states to distinguish between data and ACK: T (j) di refers to the i-th transmission of a data packet from node j and T (j) ai indicates node j is transmitting an ACK to node j − 1 which had sent the data i times.We also denote as Rd the reception state when the node is waiting for a data from the previous hop in the path, and as R(j) ai the state where node j, after its i-th transmission, is waiting for an ACK from node j + 1.

E. Markovian random-Walk Movement Based MAC Protocol Implementation

A random walk on a directed graph consists of a sequence of vertices generated from a start vertex by selecting an edge, traversing the edge to a new vertex, and repeating the process. We will see that if the graph is strongly connected, then the fraction of time the walk spends at the various vertices of the graph converges to a stationary probability distribution. Since the graph is directed, there might be vertices with no out edges and hence nowhere for the walk to go. Vertices in a strongly connected component with no in edges from the remainder of the graph can never be reached unless the component contains the start vertex. Once a walk leaves a strongly connected component it can never return. Most of our discussion of random walks will involve strongly connected graphs. Start a random walk at a vertex x0 and think of the starting probability distribution as putting a mass of one on x0 and zero on every other vertex. More generally, one could start with any probability distribution p, where p is a row vector with nonnegative components summing to one, with px being the probability of starting at vertex x. The probability of being at vertex x at time t + 1

©IJRASET: All Rights are Reserved

is the sum over each adjacent vertex y of being at y at time t and taking the transition from y to x. Let p (t) be a row vector with a component for each vertex specifying the probability mass of the vertex at time t and let p (t+1) be the row vector of probabilities at time t + 1. In matrix notation p (t)P = p (t+1) where the ijth entry of the matrix P is the probability of the walk at vertex i selecting the edge to vertex j. A fundamental property of a random walk is that in the limit, the long-term average probability of being at a particular vertex is independent of the start vertex, or an initial probability distribution over vertices, provided only that the underlying graph is strongly connected. The limiting probabilities are called the stationary probabilities. Consider two cases: i) ideal acknowledgement, where ACK packets are much smaller than data packets and they are assumed to be always correctly received and ii) imperfect acknowledgement, where ACKs are of the same size of data packets and possible collisions are accounted for. For the sake of clarity, dedicate two sections to the two cases identified above, deriving for each of them, the transmission probabilities, the success probability

III.EXPERIMENTAL SETUP AND RESULTS

NS-2 simulation has been used to simulate the model, generate wireless topologies. The randomly place a set of nodes in a 1000 unit X 1000 unit grid, and vary the connectivity for the topology, by appropriately choosing a uniform transmission radii for all the nodes. The proposed Markovian random-walk movement strategies approach outperforms the existing algorithms in terms of packet delivery and delay significantly as shown in Fig.1 and Fig.2, because more valuable information is fully used. This can be explained that some extra energy is used in the process of Markovian random-walk movement strategies moving over a graph.

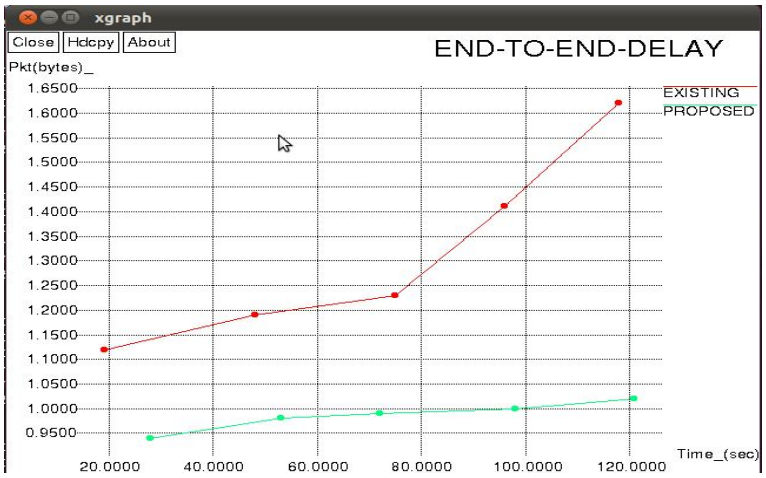


Fig.1 Performance graph of End to End Delay

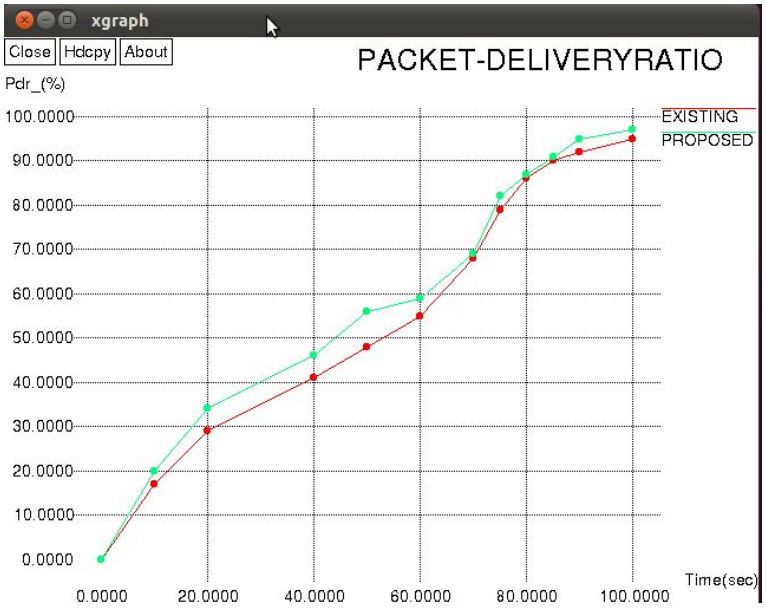


Fig.2 Performance graph of Packet delivery Ratio

©IJRASET: All Rights are Reserved

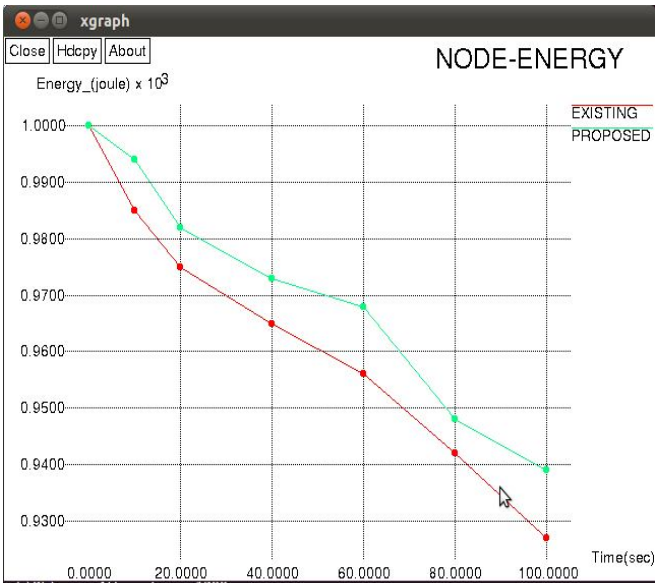


Fig.3 Performance graph of Node Energy

For the networks that used to monitor the environment with high requirements of accuracy, proposed approach is good choices for the user. However, the proposed approach outperforms good compared with existing approaches in terms of accuracy with very similar end to end delay and energy consumption as shown in Fig.2 and Fig.3.

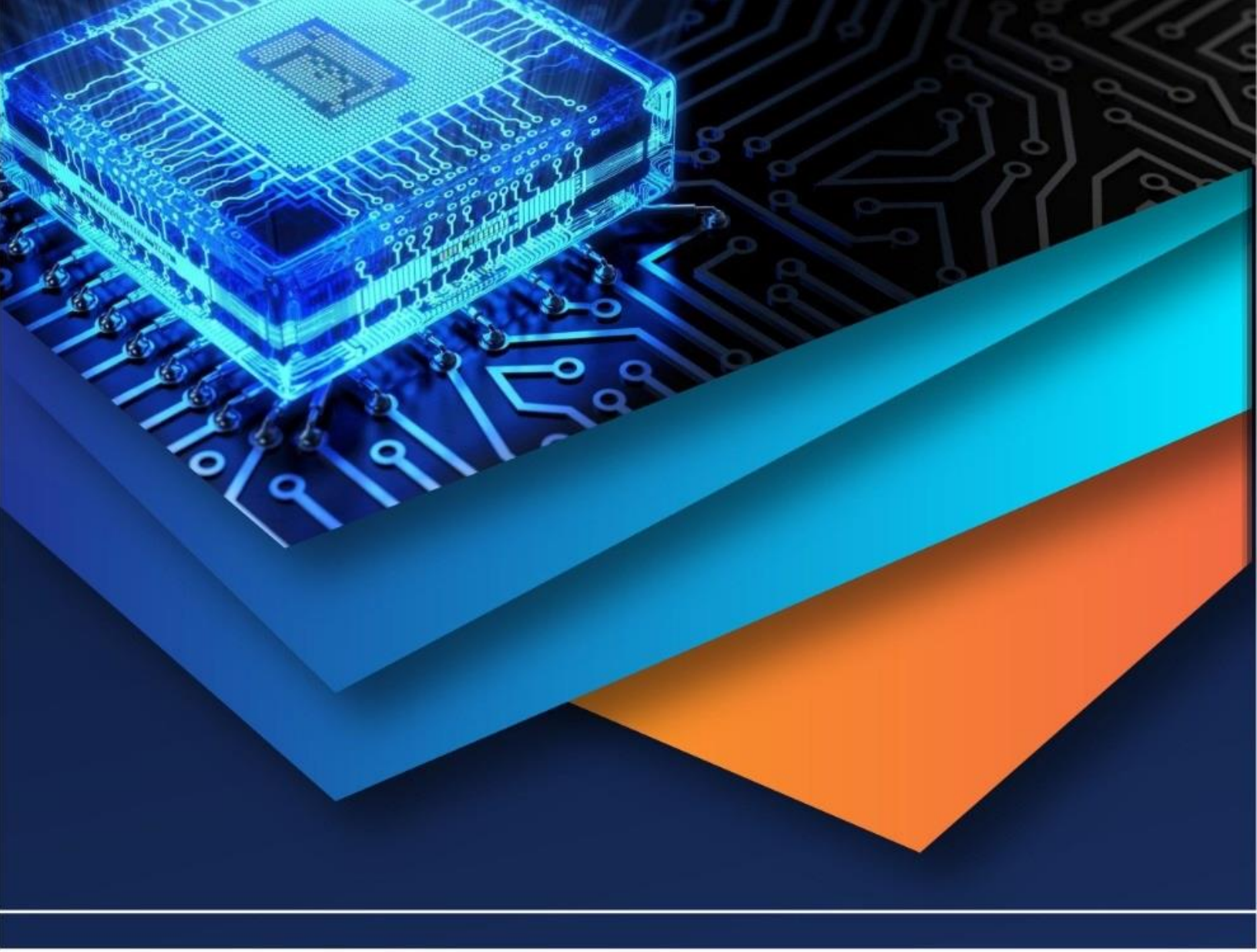
IV. CONCLUSION

In this paper novel Marko vain random walk approach to improve the performance in terms of end-to-end throughput, where each link is affected by interference coming from other multi-hop paths nearby. The approach captures the mutual impact of each path on all others. It can be applied to both, contention-based and scheduled, medium access control (MAC) protocols. , Finally, the model provides the throughput-delay tradeoff. Unlike most previous approaches, the mathematical tool proposed appears to be scalable, allowing easy extension to any number of hops. The proposed approach outperforms good compared with existing approaches in terms of accuracy with very similar end to end delay and energy consumption.

REFERENCES

[1] S. Pattem, B. Krishnamachari, and R. Govindan, “The impact of spatial correlation on routing with compression in wireless sensor networks,” ACM Trans. Sens. Netw., vol. 4, no. 4, pp. 1–31, 2008
[2] E. Hamida and G. Chelius, “Strategies for Data Dissemination to Mobile Sinks in Wireless Sensor Networks,” IEEE Wireless Comm., vol. 15, no. 6, pp. 31-37, Dec. 2008.
[3] G. Bianchi, “Performance analysis of the IEEE 802.11 distributed coordination function,” IEEE J. Sel. Areas Commun., vol. 18, no. 3, pp. 535–547, Mar. 2000.
[4] V.Eswaramoorthy, P. Sengottuvelan and N.Kuppuswamy, “Fuzzy Logic based Improved Lion Optimization Algorithm Centered Routing Protocol for Mobile Ad hoc Network”, Asian Journal of Research in Social Sciences and Humanities, vol. 6, no. 7, 2016, pp. 934-949.
[5] S. Subramanian et al., “Congestion control for vehicular safety: Synchronous and asynchronous MAC algorithms,” in Proc. 9th ACM Int. Workshop Veh. Inter-Netw., Syst., Appl. (VANET), 2012, pp. 63–72.
[6] X. Yang and A. P. Petropulu, “Co-channel interference modeling and analysis in a Poisson field of interferers in wireless communications,” IEEE Trans. Signal Process., vol. 51, no. 1, pp. 64–76, Jan. 2003
[7] K. Gulati, A. Chopra, B. Evans, and K. Tinsley, “Statistical modeling of co-channel interference,” in Proc. IEEE Global Telecommun. Conf. (GLOBECOM), Dec. 2009, pp. 1–6.
[8] F. Baccelli, B. Blaszczyszyn, and P. Muhlethaler, “An ALOHA protocol for multi-hop mobile wireless networks,” IEEE Trans. Inf. Theory, vol. 52, no. 2, pp. 421–436, Feb. 2006.
[9] P. D. Marco, P. Park, C. Fischione, and K. Johansson, “Analytical modelling of IEEE 802.15.4 for multi-hop networks with heterogeneous traffic and hidden terminals,” in Proc. IEEE Global Telecommun. Conf. (GLOBECOM), Dec. 2010.
[10] Q. T. Hoang and X. N. Tran, “Improved cross-layer cooperative MAC protocol for wireless ad hoc networks,” in Proc. Asia–Pacific Signal Inf. Process. Assoc. Annu. Summit Conf. (APSIPA), Dec. 2014, pp. 1–7.
[11] C. Buratti and R. Verdone, “L-CSMA: A MAC protocol for multihop linear wireless (sensor) networks,” IEEE Transactions On Vehicular Technology, Vol.65, No.1, January 2016, pp. 251–265.

©IJRASET: All Rights are Reserved



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089 (24*7 Support on Whatsapp)