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A Particle Swarm and Clonal Selection Algorithm based Channel Assignment Algorithm in MRMC Wireless Mesh Network

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Abstract: Channel Assignment (CA) in MRMC Wireless Mesh Network (WMN) is an efficient device that exploits numerous non-intersecting channels to reduce the interference and augment the capability of WMN. However, CA could diminish the complete network interference; its consequences might cause certain design issues that impact the efficiency of the network. A good CA in wireless mesh networks could minimize numerous interference co-channels and enhance the throughput. The clonal selection approach is simulated using the rudimentary notion of adaptive immune reply to virus stimulus. The PSO is inspired using the social behaviors of swarms. Motivated by these two optimization methodologies, in this paper, a hybridized particle swarm aided clonal selection approach is introduced for resolving channel assignment issue, i.e., evaluating a lower-interference channel assignment depending on gathered data. Conflict Vector in Conflict Graph known as antigens in clonal selection algorithm having fewer affinity values are improved using the particle swarm optimization update operation. Then the clonal selection and mutation operation is employed iteratively to generate the optimum conflict vectors. The experimental results are carried out using NS2. From the outcomes, it is clearly shown that the suggested approach has better energy efficiency, packet delivery ratio, and less network delay, packet drop compared to existing algorithms.

Keywords: Multi-Radio Multi-Channel, Wireless Mesh Network, Channel Assignment, Particle Swarm Optimization, Clonal Selection Approach, Artificial Immune System.

I. INTRODUCTION

The internet services provisioning for future generation concentrates on every individual to have the accessibility to each and every digital device he uses. This inventive and progressive technique in the domain is the beginning of Wireless Mesh Network (WMN) [1] that provides higher bandwidth and absorbs lees price for deployment and monitoring. WMN is the upcoming generation network which intends at offering higher speed internet access to any individual and characteristics such as self-configuring and self-healing properties. The foremost limitation encountered with the scholars in the construction of WMNs was to pick an optimum pathway that evades interference and similarly rises the efficiency. The interference is not merely amongst the adjoining links that are allotted to the similar channel, nevertheless from adjoining channels and self- interference. An optimum methodology is essential for transmitting, and procedures need to be quick enough for covering the huge WMN. This is a probably disseminated network with the feature of self-organization and swift deployment [2]. Merging the benefits of wireless LAN and ad hoc network, WMN comprises of autonomous and disseminated nodes where accessing points does not have the energy restriction

Artificial Immune Systems (AISs) form a comparatively novel class of artificial intelligence algorithms modeled on some features of the biological immune system. The natural immune system has numerous abilities comprising the capability of differentiating amongst individual/self and external/non-self, the capability of identifying and extinguishing several pathogens, the capability of preserving a memory of preceding attackers and the capability of defending the organism from mischievous cells in the body [3]. Particle Swarm Optimization (PSO) is a fairly recent biologically-motivated machine learning method. PSO was originally inspired by the swarming behavior of groups of animals such as fish or birds. One of the utmost significant features of PSO approach is its higher convergence speed. The amalgamation of PSO's quick convergence capability with the higher skills of a CLONAL approach like absconding from optimal local offers a dominant device.

In the MRMC WMN, it is crucial to address the issue of the type of channel need to be used for a specific data transmission. The ability of multi-radio network hinges on the approach several channels allotted to various radio interfaces to construct the network with minimal interference. The quasi-static channel network is employed to address the issue of minimal interference that is identical to a certain discrepancy in graph color issues. Nevertheless, the channel assignment should obey the interference constraint that channel allotted to links of the node are approximately equal to the interference of that nodes.

In this paper, an Artificial Immune System in hybridization with Particle Swarm Optimization is employed as an optimization tool for introducing an optimal channel assignment approach for the MRMC WMN. In addition to the minimization of network interference, the innate aim of this paper is to minimize the network throughput.

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In this hybrid optimization approach, the exclusive notion of particle swarm intelligence is inserted using the clonal selection approach. The clonal selection approach could attain a global search in a quick and stochastic manner. Nevertheless, there is a huge repetition in reiterating its search for the optimum results that considerably diminishes the convergence efficiency of this approach. Therefore, by means of employing the notion of particle swarm intelligence incorporated an enhancement operation in the clonal selection approach. The successful information transmission cannot occur between two interfering links at a similar time period if both are on similar channels. The proposed methodology preserves the topology of the WMN, in a way that the entire links present in the single-channel also present in the multiple channels.

A brief overview of the limitations of Channel Assignment Algorithm in MRMC WMN along with the motivation for the proposed approach in combination with the meta-heuristic algorithms is given in this section. The existing methodologies for channel assignment using diverse intelligence techniques are given in section 2. The proposed Hybrid particle swarm optimization based clonal selection algorithm for channel assignment in MRMC WMN is briefly explained in section 3. The performance evaluation and analysis of the experimental results conducted is explained in detail in section 4. The conclusion for the paper and its references are given in section 5 and section 6, respectively.

II. RELATED WORK

The issues of channel assignment could be resolved either centrally or in a disseminated way. Numerous methodologies are being suggested for the issue like greedy graph theoretic-depended approach, genetic algorithm [4] and greedy and Tabu-aided approaches [5]. In [5], the centralized approaches having lesser bounds attained from semi-definite programming (SDP) and linear programming designs is matched. Whereas the consequences exhibit that these approaches outperform the approach suggested in [6], a huge gap in the efficiency having lesser bounds are witnessed. This proposed place for upcoming enhancements.

The issue of channel assignment could be observed as the variance of the graph-coloring issue. In [7], an immune methodology was employed for the graph-coloring issue using the competitive outcomes compared to the ones attained using the finest evolutionary approaches. In [8], MOM for CA is given that is performed in the course of multiple radio WMNs planning procedure. Defined predicted traffic, its objective comprises of diminishing individual handoff issues, diminishing traffic load alterations to attain load balancing, and exploiting complete throughput. CA is a significant feature in WMN. However, it still requires an ascendable MOM from a globalized network viewpoint.

A novel immune approach is given depending on the V-detector to resolve the multiple objective optimization issue (V-detector) [9]. The benefit of this approach is that it develops the crowding factor in update function to enhance Pareto-front. Nevertheless, the procedure employs non-uniform mutation that is merely suitable for constant variance decision domain. This has descent globalized exploring capability in the previous phase and localized exploring capability in the subsequent phase. As the decision domain is discrete in WMN, the evolution might halt in the subsequent phase [10]. In [11], a novel channel assignment approach is suggested known as multichannel multicast (MCM) approach, to address the issue of channel allotment for multicast in WMNs. The MCM approach employs entire accessible channels of a WMN, but not merely non-intersecting channels. Employing merely non-overlapping channels could make simpler the channel assignment as there is no intrusion amongst any two non-intersecting channels. The experimental outcomes in [11] exhibited a cautious usage of entire channels that could considerably enhance the throughput of the network.

The suggested channel assignment approach in [11] is enhanced in [12]. Its approaches are known as M4 that overcomes the issues of MCM hidden terminal. It is notable that scholars had presumed that the multicast tree is priori built. In [13], a genetic-motivated methodology is suggested for resolving the issue of channel assignment and building of the multicast tree. They intended to obtain a multicast tree that has minimal clashes amongst one another. In this study, channel assignment is accomplished through a heuristic methodology. Limitations of this channel allotment technique are the presence of probable interference amongst the nodes on a similar phase and not employing the entire channels in certain situations. In [14], the issue of channel assignment and multicast tree development is considered conjointly for resolving. These employed Integer Linear Programming (ILP) for this case. Nevertheless, this methodology is not ascendable and merely could be employed on smaller dimension networks.

In [15], an effective channel scheduling approach is suggested to attain a near-optimum outcome depending on the meta-heuristic approaches such as genetic approach, tabu search, simulated annealing, etc. So as to form an exploration much effectively, certain adjacent producing approaches are suggested for this approach. The performance is estimated using certain simulation experiment considering the energy consumption and executing time of the approach. The results exhibited that the suggested methodology is effective for resolving the issue of channel scheduling in WMN.

In [16], the notion of localized multicast is suggested to check the interference and resolve the issues of the hidden channel in multicast communication. Depending on the notion, the CA approach is proposed that considers the interference of localized multicast and upcoming weight of every node (LMFW). This approach completely takes into account incompletely intersecting channels and orthogonal channels to enhance network efficiency. Experimental results exhibited that the suggested methodology could minimize and enhance the capability of WMNs. In [17], suggested CA have several multiple factor considerations and is given that merely takes into consideration of forwarding weight in the course of channel assignment. In [18], a quick and effective methodology for frequency channel assignment in multiple hop WMN is presented through a novel heuristics for resolving this prolonged coloring issue. The heuristics are orders of magnitude quicker when compared to the precise outcome methodology during the return of optimal outcomes consistently.

III. Proposed Hybridization Particle Swarm Based on Clonal Selection Algorithm for Channel Assignment

A mesh network of nodes having multiple radio interfaces is given, where a unique channel need to allotted for every link. Uniform traffic is presumed for entire links, and non-interfering channels are assigned to all these links. The complete network interface is defined as the count of links that are being interfered. The intention of this approach is to reduce the complete network interference using the hybrid AIS and PSO based optimization techniques. The proposed methodology comprises of two stages. In the initial stage, hybridized Clonal Selection and Particle Swarm Optimization are employed to obtain optimum and best solutions deprived of interference constraint. In the subsequent stage, these interference constraints are eradicated for a feasible channel assignment function f.

Network Model: A WMN using stationary routers are considered where every route comprises of some radio interfaces. This network is typical an undirected graph where the edge (i,j) referred to as the link that specifies the connections amongst the node i and j having the radio interfaces with the same channel. The wireless links have broadcasting nature of transmission that might interfere with other communication links. In this methodology of the quasi-static channel assignment, the interference level typically based on the traffic link.

The group of communication links that interferes with one another is represented using a conflict graph. Initially, a group of conflict vertices V_c is created in the network.

$V_c = \{I_{ij} \mid (i,j) \text{ is the communication link}\}$

The conflict G_c is given using the V_c as the conflict vertices and E_c (l_{ij}, l_{ab}) as the conflicting edge that refers to the link (i,j) and (a,b) as the communication link interfering with one another if there are on similar channels.

Consider a WMN, having N number of nodes, the issue of channel assignment is to evaluate the function $f: V_c \rightarrow K$ as to diminish the entire network interference $I(f)$

$$I(f) = |\{(u,v) \in E_c | f(u) = f(v)\}| \quad (1)$$

Satisfying the interference constraint

$$\forall i \in N, \quad |\{k | f(e) = k \text{ for some } e \in E(i)\}| < R_i \quad (2)$$

Where u, v refers to the vertices in V_c, k refers to the K channels, R_i is the number of the radio interface.

PHASE – I: Particle Swarm Optimization based Clonal Selection Algorithm

i. Initialization: Random population individuals are initialized known as B-cells or antibodies signifying the group of candidate solutions. Every individual is determined as the vector of integers having a finite length $L = |Vc|$ as the permutations of the conflict vertices in conflict graph Gc. Here P refers to the individuals in the current population and N is the dimension of population.

ii. Affinity Estimation: The estimation of affinity I_{aff} is given as:

$$I_{aff} = \frac{I(f)}{|V_c|} \quad (3)$$

Where $I(f)$ refers to the network interface and Vc refers to the conflict vertices. This affinity refers to the conflicts that exist after channel assignment when matched with the issues in the single-channel network.

iii. Antibodies Update using PSO algorithm: The individual's antibody vectors are considered as the particles vector $X = [X_1, X_2, X_3, \ldots X_n]$ for the update.

$$V_{n+1} = wV_n - c_1 rand_1(Cur_{affn} - X_n) + c_2 rand_2(global_{affn} - X_n) \quad (4)$$

$$X_{n+1} = X_n + V_{n+1} \quad (5)$$

Here V_n refers to the velocity of the particle; the initial velocity is $V_0 = 0$, Cur_Affn refers to the present particle affinity value and $global_{aff}$ refers to global particle affinity value. V_{n+1}, X_{n+1} refers to the updated velocity and particle. c_1 and c_2 refers to cognitive and social acceleration, respectively. $rand_1$ and $rand_2$ refers to two different random values. W refers to the inertia weight and defined as

$$W = W_{max} - \left(\frac{W_{max} - W_{min}}{Itr_{max}}\right) \times itr \quad (6)$$

iv. Clonal Selection: Each individual or antibody is cloned multiple times depending on the evaluated clone number N_c which is given as

$$N_c = round\left(\frac{\beta n}{i}\right) \quad (7)$$

Where β refers to the multiplicative factor, i refers to the location of parental antibody, n refers to the parameter monitoring the complete offspring antibodies, and $round()$ is a rounding function that rounds to its closest integer.

v. Mutation operator: The mutation in the proposed approach refers to the inversion proportional to the affinity of every antibody depending on

$$x1 = x + \alpha N(0,1) \quad (8)$$

$$\alpha = \frac{1}{\beta 1} \exp(-I(f)) \quad (9)$$

$x1$ refers to the mutated version of the antibody x, $N(0,1)$ refers to the arbitrary variable having mean value 0 and standard deviation value as 1. $\beta 1$ refers to the factor that monitors the decay of exponential inversion function and F is the affinity value.

Hybrid Particle Swarm based Clonal Selection Algorithm:

i. The initial population is randomly generated known as individuals or antibodies of the population size n.
ii. Evaluate the Affinity of the generated antibodies using equation (3), sort the antibodies in the ascending order depending on the affinity values.
iii. Select N/2 lowest affinity value antibodies known as N1 and higher affinity values antibodies known as N2.
iv. The N1 population is improved using the particle swarm operation given in equation (4) and (5).
v. The clonal selection approach is employed on N2 populations and is obtained using the equation (7)
vi. Then the mutation operation is used on the obtained results of N2 Population using the equation (8)
vii. Now combine the improved N1 and N2 Population
viii. Check the stopping criteria has been attained or else go to step 2.

PHASE- II: Removal of interference constraint

The optimal solution individual obtained from the initial phase (hybrid particle swarm immune system) might violate the interference constraints. Thus, these constraints are to be eliminated in this phase by means of recurrently employing the merging procedure. The procedure work as follows:

Amongst the entire nodes in the network that violates the interference constraint such that the node count is lesser compared to the channel assigned to each communication link, where the nodes are chosen whose difference is maximal. Let i be the selected node. The number of channels allotted to i is minimized by 1, in a way that novel channel could be allotted to link (i, j). let the two channels ch_1 and ch_2 incident on i are selected, then the entire links assigned to ch_1 are switched to ch_2. This switching is done repeatedly on the entire links which are connected with a channel being switched from ch_1 to ch_2. It is accomplished as to conserve the interference constraints. The two links are linked if both are incident on a similar node. This phase is diagrammatically represented in Fig

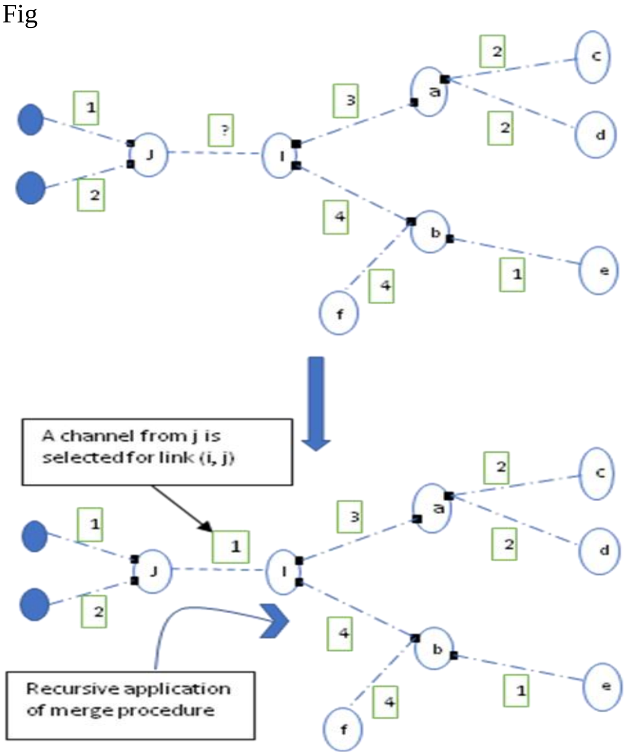

FIG1.

At the completion of a single merging approach, numerous different channels present on i and others are minimized by at most one deprived of any novel channel being presented. Therefore, the recurrent procedure resolves interface constraints. Finally, a channel ch_3 j is picked for usage through the link (i, j). In the worst case, the whole merge function might visit the entire nodes and their its incident links having a complexity of $O(|V||E|)$.

IV. RESULTS AND DISCUSSIONS

In this section, the experimental outcomes obtained for the proposed hybrid channel assignment algorithm is present using different performance metrics. The performance of this algorithm is judged using metrics such as End-to-End delay, Energy Consumption, Throughput, packet delivery ratio, Energy Efficiency, Packet Drop, Cost Evaluation of the network. The analysis for all these approaches is carried out using Network Simulator – 2 (NS2). An MCMR WMN is randomly generated using 105 nodes, among which 97 are client nodes, 4 are mesh routers, and 4 are mesh gateways.

The experiment is carried out in a coverage area 1000*1000 with simulation period of 150 milliseconds.

Table 1 represents the parameter values employed for the proposed assignment algorithm.

Table 1: Parameters for Network Simulation

Parameters	Values
Simulation Period	150ms
Coverage Area	1000*1000
No of Nodes	105
No of Mesh Routers	4
No of Mesh Gateways	4
No of Mesh Clients	97
Traffic Type	FTP
Agent Type	TCP
Routing Protocol	AODV
Initial power	1000 J
Idle Power	0.1 J
Queue Type	Drop-Tail

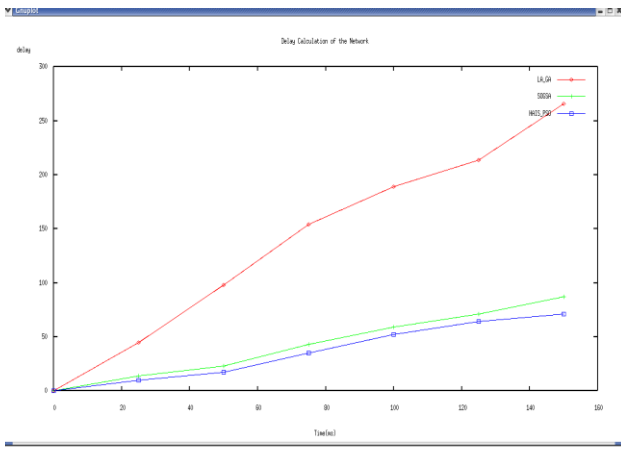

Fig 2: Comparison of Network End-to-End Delay

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The suggested methodology is matched with the previously introduced channel assignment algorithm such as Learning Automata & Genetic Algorithm based Channel Assignment, Swarm Optimization based gravitational search optimization channel assignment. In addition to this, the proposed hybrid approach is compared with the existing traditional Clonal Selection Algorithm for channel assignment in WMN.

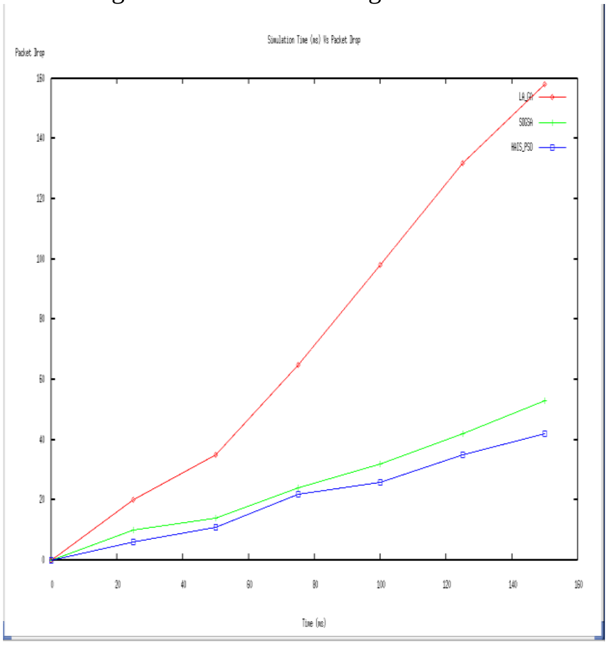

Fig 3: Comparison of Network Packet Drop

The performance estimation matching is accomplished using some of the metrics given below:

- Average end-to-end delay: This is defined as the time period it consumes for a packet to reach the endpoint once it leaves the source. The average evaluated the entire receiving packets is further evaluated.
- Network throughput: This is defined as the complete quantity of information bits specifically obtained by receivers segregated by the time amongst obtaining the initial and final packet.
- Average packet loss ratio: This is defined as the packets count obtained ineffectively divided by the complete number of packets supposed to be carried. The average evaluated on the whole receivers is the average packet loss ratio.

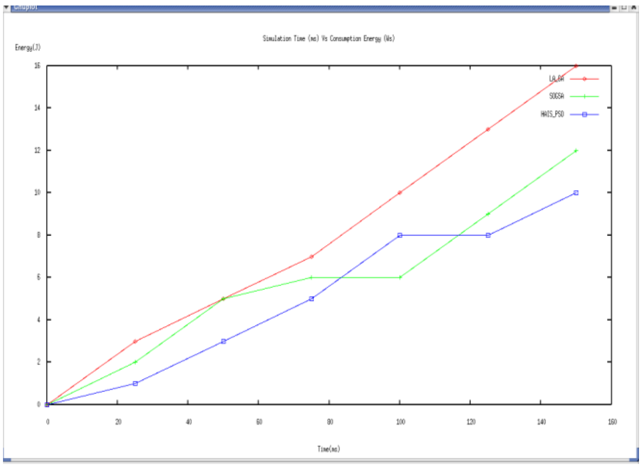

Fig 4: Comparison of Network Consumption Energy

Fig 2, Fig 3, Fig 4, Fig 5, Fig 6, Fig 7 and Fig 8 represents the comparison of Network End-to-End delay, Network Packet Drop, Network Consumption Energy, Network Energy Efficiency, Network Packet Delivery Ratio, Network Throughput, Network Cost Calculation of the suggested hybrid channel assignment approach with the existing channel assignment approaches mentioned above. From Fig 2, Fig 3 and Fig 8, it is inferred that the proposed channel assignment approach has a lower delay, less number of packet drops and minimum cost when compared to the existing algorithms.

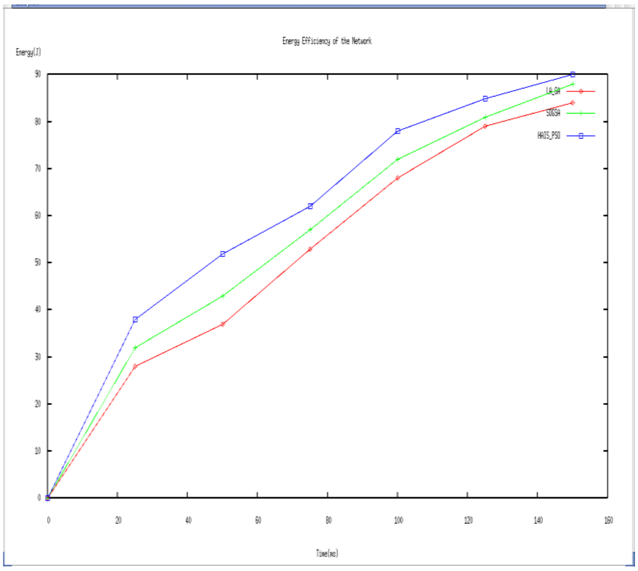

Fig 5: Comparison of Network Energy Efficiency

From Fig 4, it is inferred that the energy consumption is more or less equivalent for the proposed hybrid and particle swarm-based gravitational search channel assignment algorithm whereas it is high in case of Learning automata-based genetic algorithm assignment algorithm. From Fig 5, Fig 6 and Fig 7, it is clearly inferred that the proposed approach has higher network energy efficiency, packet delivery ratio, and high network throughput when compared to the other existing channel assignment algorithms.

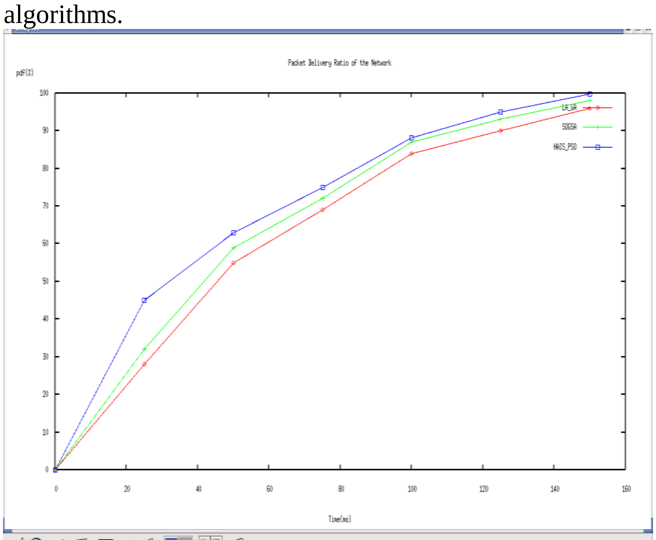

Fig 6: Comparison of Network Packet Delivery Ratio

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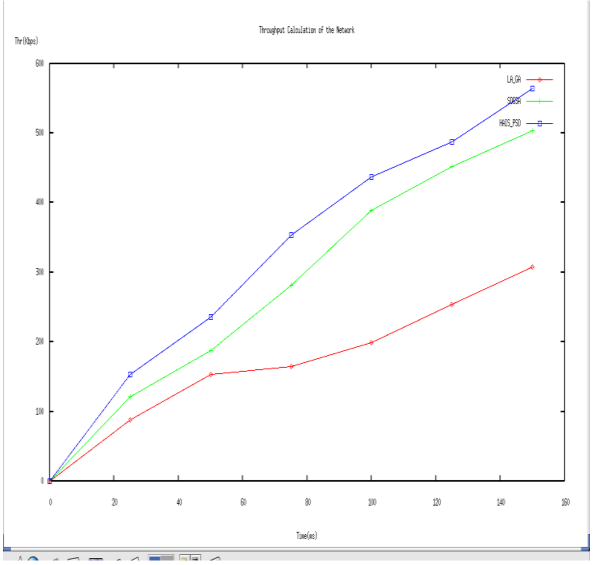

Fig 7: Comparison of Network Throughput

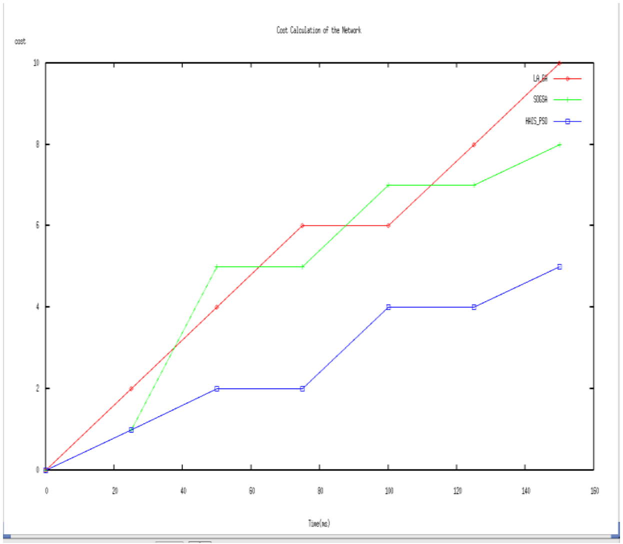

Fig 8: Comparison of Network Cost Calculation

V. CONCLUSION

In this paper, an optimum channel assignment algorithm is presented using an artificial immune system and swarm intelligence. The proposed methodology is implemented in two different such as the selection of optimum channel and removal of interference constraints for the constructed optimum channel. The antigens with low-affinity values in clonal selection algorithm are improved using the particle swarm optimization velocity and position update operation. In this, the benefits of AIS and Swarm intelligence are hybridized to obtain optimum channel assignment approach in the MRMC WMN. The performance evaluation of the proposed channel assignment algorithm using NS2. The proposed hybrid particle swarm optimization clonal selection channel assignment algorithms are compared with existing algorithms and shown that this approach has better network efficiency, through and packet delivery ratio.

REFERENCES

1. Akyildiz, I. F., X. Wang, W. Wang. Wireless Mesh Networks: A Survey. – Elsevier Computer Networks Journal, Vol. 47, 2005, pp. 445-487.
2. Wu D, Bao L, Regan AC, Talcott CL. Large-scale access scheduling in wireless mesh networks using social centrality. J Parallel Distrib Comput 2013; 73(8):1049–65.
3. Brabazon., A., ONeill, M. (2006). Biologically Inspired Algorithms for Financial Modeling, Natural Computing Series, Springer-Verlag, Berlin.
4. Chen, J., Jia, J., Wen, Y., Zhao, D., Liu, J., 2009. A genetic approach to channel assignment for multi-radio multi-channel wireless mesh networks. In: 1st ACM/SIGEVO Summit on Genetic and Evolutionary Computation, 39-46, Shanghai, China.
5. Subramanian, A.P., Gupta, H., Das, S.R., Cao, J., 2008. Minimum interference channel assignment in multiradio wireless mesh networks. IEEE Trans. Mobile Comput. 7 (12), 1459–1473.
6. Marina, M.K., Das, S.R., 2005. A topology control approach for utilizing multiple channels in multi-radio wireless mesh networks. In: Proc. of IEEE International Conference on Broadband Networks (BroadNets), Boston.
7. Cutello, V., Nicosia, G., Pavone, M., 2003. A hybrid immune algorithm with information gain for the graph coloring problem. In: GECCO, LNCS 2723, pp. 171–182.
8. Rezgui J, Hafid A, Ben Ali R, Gendreau M. A variable neighborhood search method for multi-objective channel assignment problem in multi-radio WMNs. The IEEE 35th Conference on Local Computer Networks (LCN), 2010; 64–71.
9. Liu F, Gong M, Ma J, Jiao L, Zhang W. Optimizing detector distribution in V-detector negative selection using a constrained multi-objective immune algorithm in a wireless network. IEEE Congress on Evolutionary Computation (CEC), 2010; 1–8.
10. Uludag S, Imboden T, Akkaya K. A taxonomy and evaluation for developing 802.11-based wireless mesh network testbeds. International Journal of Communication Systems 2012; 25(8):963–990.
11. Zeng, G., Wang, B., Ding, Y., Xiao, L., Mutka, M.W., 2010. Efficient multicast algorithms for the multichannel wireless mesh network. IEEE Transactions on Parallel and Distributed Systems 21 (January (1)), 86–99.
12. Nguyen, H.L. and Nguyen, U.T. (2008) 'Channel assignment for multicast in multi-channel multi-radio wireless mesh networks,' Journal of Wireless Communications and Mobile Computing, Vol. 9, No. 4, pp.557–571.
13. Cheng, H. and Yang, S. (2011) 'Joint QoS multicast routing and channel assignment in multi-radio multi-channel wireless mesh networks using intelligent computational methods,' Applied Soft Computing Journal, Vol. 11, No. 2, pp.1953–1964.
14. Jahanshahi, M., Dehghan, M. and Meybodi, M.R. (2010) 'A mathematical formulation for joint channel assignment and multicast routing in multi-channel multi-radio wireless mesh networks,' Journal of Network and Computer Applications, Vol. 34, No. 6, pp.1869–1882.
15. Meta-heuristic algorithms for channel scheduling problem in wireless sensor networks, Kil-Woong Jang, Volume25, Issue4, April 2012, pages 427-446.
16. An efficient channel assignment algorithm for multicast wireless mesh Networks Wenxiao Shi∗, Shaobo Wang, Zhuo Wang, Ending Wang, Int. J. Electron. Commun. (AEÜ) 89 (2018) 62–69
17. Lin JW, Lin SM. A weight-aware channel assignment algorithm for mobile multicast in wireless mesh networks. J Syst Softw 2014;94:98–107.
18. Fast heuristics for the frequency channel assignment problem in multi-hop wireless networks, Aizaz U. Chaudhry∗, John W. Chinneck, Roshdy H. M. Hafez, EuropeanJournalofOperationalResearch251(2016)771–782
19. Balusu, N., Pabboju, S. & Narasimha, G. An Intelligent Channel Assignment Approach for Minimum Interference in Wireless Mesh Networks Using Learning Automata and Genetic Algorithms. Wireless Personal Communications, 2019, DOI: https://doi.org/10.1007/s11277-019-06214-3

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