Routing in VANET Based Opportunistic Network Optimized By Metaheuristics

Tejinder Kaur Khattra, Dr. Manish Mahajan

Department of Computer Science and Engineering, CGC COE Landran, Mohali, Punjab

Abstract - Opportunistic networks can withstand the linger in connection without getting failed to deliver the information satisfyingly. This occurs by allowing information transfer from the root node successively towards goal node through various intermediate nodes, which can hold the information until there is a better possible hop towards the next intermediate node. Choice of next intermediate node every time becomes the basis of the performance of the opportunistic network routing. Swarm Optimization technique like Bacterial Foraging optimization allows the nodes to choose the next hop in a random and bunched up way. It not only exploits the common data of nodes, but also includes the bunched greed of nodes towards the most suitable next hop. The proposed algorithm enhances the Ant Colony Optimization technique to achieve better hops and eventually cut down the dropped packets count, overhead ratio and average latency. The algorithm has been inspected and contrasted circumspectly with Ant Colony Optimization against diverse parameters.

Keywords - Opportunistic Networks, Vehicular Ad-hoc Networks, Ant Colony Optimization, Swarm optimization, Bacterial Foraging Optimization.

I. INTRODUCTION

Opportunistic network is an implementation of mobile ad-hoc network where timely information transmission is crucial even in the absence of a dedicated origin to goal node connection. Opportunistic networks, as the name describes, the root node successively communicates with the goal node with the aid of intermediate nodes. They entirely lack an end-to-end connection, rather surrounded by rapidly moving intermediate nodes in which the connection duration is extremely short that the connection does not stay for long. It ends as soon as it is built. Relaying information from one node to another directs it towards the goal node through appropriate routing. Vehicular Ad-hoc Network (VANET) is known as a technology that integrates the new generation wireless network capability to vehicles. Between the mobile nodes and roadside units, the VANET builds a robust ad-hoc network. Node-to-node communication is also permitted. Using different ad-hoc networking tools such as IRA, WiMAX IEEE 802.10, Wifi IEEE 802.11 b/g, the VANET can achieve the affective communication between nodes. At the traffic management and providing safety information, the VANET is mainly focused. Safety and traffic management involves getting real time information and straight forwardly influencing the lives of individuals going on the road. Straight forwardness of VANET instruments guarantees more noteworthy productivity. Safety is realized as prime quality of Vehicular Ad Hoc Network (VANET) framework. Without prior knowledge of each other, most of all nodes in VANET are vehicles that can form self-organizing networks. It is very compulsory to add safety features in vehicles so that damage to property and life could not occur. To transmit warning about regional information to other vehicles, environmental hazards and traffic and road conditions, the VANETS inculcate sufficient potential. On the road, the main aim of VANET is to absolute the user's choice and builds their drive snug and safe. It is harder to maintain a seamless handoff and a steady connectivity to the internet when vehicles move at high speed [1]. For number of potential applications, the VANET communication (IVC and RVC) can be used with highly diverse requirements. In VANETs there are three major classes of application: commercial, safety oriented and convenience oriented. The approaching vehicles, curves and surface of the roads, and surrounding road are monitored by the safety applications; the traffic management type is managed by the Convenience application and the streaming audio and video, entertainment and services as web access is provided by the Commercial applications [2]. The VANET has distinctive characteristics: Rapidly Changing Network Topology – in a VANET, the vehicles moving at high speed that lead to quick changes in network topology; Time Critical – information's timely delivery is very crucial; Wireless Communication – through the connected wireless nodes, the exchange of information takes places; Variable network density – according to the traffic density, the network density is changed; High Mobility – nodes present in VANET are at a very high speed. Only if node location is predictable from attacks and other security threats these moving nodes can be protected. In VANET the high mobility leads to various other issues; High computability – the computational capacity of a node is increased by computational sensors and computational resources; No Power constraints – in various network the power constraint always exists but via the long life battery, the vehicles (or nodes) are able to provide power to onboard unit (OBU) in VANET; and Frequently changing information – from other vehicles and roadside units the ad-hoc nature of VANET motivates the nodes to gather information. Information related to traffic and environment also changes very rapidly when vehicles move and change their path [2]. In this paper, Bacterial Foraging Optimization is suggested to esteem the network performance. In second section, the related work is explained. In third and fourth section, methodology and the algorithm of the proposed work is discussed. In fifth section, results are explained and sixth section conclusion is discussed.

II. LITERATURE REVIEW

In [3] vehicle mobility will cause the communication links between vehicles to frequently be broken with in VANETs. From the routing protocols, such links failures require a direct response, in network scalability and in routing overhead. To address this issue a new hybrid location-based routing protocol is proposed. In a manner, new protocol combines features of reactive routing with location-based geographic routing in a manner that efficiently uses all the location information available. To gracefully exit to reactive routing as the location information degrades, the protocol is designed. This protocol is scalable and has an optimal overhead, even in the presence of high location error; it has been shown by the analysis and simulation. An enhanced protocol is provided that can be deployed in all VANET-type yet pragmatic location-enabled solution environments. In [4] for partially connected VANETs a Border node Based Routing (BBR) protocol is proposed, in the sparse network condition the challenges of VANETs is examined. Due to low node density and high node mobility the BBR protocol can tolerate network partition. With a Geographic and Traffic Information (GTI) based mobility model performance epidemic routing and BBR are evaluated. A limited flooding protocol such as BBR performs very well under rural network conditions, and the advantage of not relying on a location service required by other protocols proposed for VANETs. In [5] for vehicular ad-hoc networks (VANETs) a class of routing protocols is presented called the Intersection-based Routing Protocol (IGRP), in city nvironments, which outperforms the existing routing schemes. On an effective selection of road intersection the Intersection-based Routing Protocol (IGRP) is based through which a packet must pass to reach the gateway to the Internet. While satisfying Quality-of-Service (QoS) constraints on tolerable linger, bandwidth usage, and error rate, the selection is made in a way that guarantees with road intersections, high probability and network connectivity. To transfer packets between any two intersections on the path the Geographical forwarding is used, to individual node movements the path's sensitivity is reduced. To achieve this, the QoS routing problem is mathematically formulated as a constrained optimization problem. Specially, for the end-to-end delay, bit error rate (BER) and connectivity probability of a route, the analytical expressions is derived in the two-way road scenario. To solve the optimization problem a genetic algorithm is proposed. When compared with several prominent routing protocols, such as Optimized Link-State Routing (OLSR), Greedy Perimeter Stateless Routing (GPSR) and Greedy Perimeter Coordinator Routing (GPCR), the proposed approach of this paper gives optimal or near-optimal solutions and significantly improves VANET performance. In [6] with the optimal parameters setting of OLSR this work is dealt, by defining an optimization problem a well-known mobile ad-hoc network routing protocol is proposed. To find automatically optimal configurations of this routing protocol, a series of representative metaheuristic algorithms (PSO, DE, GA, and SA) are studied in this article. To accurately evaluate the performance of the network under their automatically optimized OLSR a set of realistic VANET scenarios (based in the city of Malaga) have been defined. In [7] to enhance routing performance in the one-way multi-lane highway scenario a Passive Clustering Aided Routing protocol is proposed. For constructing a stable and reliable cluster structure during the route discovery phase, the PassCAR was the suitable participant. To compete for a participant using the proposed multi-metric election strategy, each candidate node self-determines its own priority on the based metrics such as link lifetime, node degree, and expected transmission count. When PassCAR is compared with original PC mechanism it increased the successful probability of route discovery, in the created cluster structure, it also selects more suitable nodes. As well as the packet delivery ratio is significantly improved by the well-constructed cluster structure and due to its preference for reliable, durable and stable routing path it achieved the higher network throughput. In [8] between two location-based routing protocols, a performance analysis is presented: DREAM (Distance Routing Effect Algorithm for Mobility) a largely tested position, stable based scheme SIFT (Simple Forwarding over Trajectory), a novel, spatial-aware, trajectory and scalable based approach. For VANETS (Vehicular ad-hoc network) this study was accomplished under a realistic urban mobility model, within a highly deployed evaluation network of up to 1000 nodes. In VANETS, the classical ad-hoc schemes do not perform well because they were not designed to handle efficiently mobility handicaps. In dynamic scenario, Position-based techniques perform better, but they do not perform efficiently in some highly dynamic scenarios, like VANETS. In VANETS the Trajectory-based protocols perform more efficiently since they are spatial-aware. In realistic scenario concerning delivery ratio, route length and control overhead, the SIFT perform better than the Dream. In [9], for VANETs a BBR protocol is proposed in rural and sparse areas. With the DSR protocol and GTI mobility model the performance of the BBR protocols has been compared and evaluated using OPNETTM. With rapid topology change and frequent partition, for the network the BBR performs well. At the point when the network is profoundly parcelled, BBR still has a high packet delivery ratio, yet with long packet delivery delay. With DSR, the packet delivery ratio falls quickly to zero as the network partitions and the delay ends up plainly unbounded. BBR has comparable execution to DSR when the network is completely associated. In [10] a vehicular mobility model is proposed, on the road which reflects real world vehicle movement. They study the performance of the MANET routing protocols that is based on the mobility that is GPSR and AODV. They watch the downsides of the MANET conventions and contend the wrongness of straightforwardly applying those MANET conventions to VANETs. To these protocols they proposed simple modification which makes them more suitable for small scale VANETs. They introduce a two-phase routing protocol for the large scale VANETs that incorporates map information. With roads of high vehicular density and forward packet the proposed protocol defines overlay graph. By making traces follow the mobility model they generate vehicular mobility traces for different road layouts in Orlando. Social information [12] of vehicles plays crucial role selecting a next vehicle to forward the data packets. Considering social information of a node depicts its status in group, if it has fair connections with other nodes or not. Capable of connecting with other nodes makes it more suitable to act as a forwarder. Ant Colony Algorithm [11] inculcates the ant-like behaviour of nodes in search of goal or food. In [14], the Ant Colony Optimization algorithm is integrated with game theory to calculate Shapley value of each node (Shapley Value [13] of a node describes its significance in message transferring) to get lowered average delivery delay and elevated delivery probability. In the past few years, Swarm Optimization (SO) techniques have been recorded as the aspirants of more highly admired outcomes when the optimization is concerned. Bacterial Foraging Optimization (BFO) is one such sub-type of SO that follows the footsteps of biological microbes like bacteria in their food hunt using the very basic actions like spinning and tumbling in a bunched up way more productively.

In this paper, we have proposed a BFO based method which outperforms the prior ACO algorithm in a VANET based Opportunistic Environment.

III. PROPOSED METHODOLOGY

Figure 1 shows the methodology for the proposed algorithm, whose step-wise explanation is given below:

Step1: The VANET is deployed.

Step2: Source node is initiated.

Step3: Nearby nodes of the current node are determined.

Step4: Node with shortest distance is selected using Dijkstra's algorithm.

Step5: In case, optimized node is not achieved, go to step 6. If an optimized node is achieved, it is checked if it matches the destination node or not. If yes, the loop stops at DESTINATION. If no, nearby nodes of the current node are checked (step 3 started again) to find the next forwarder node.

Step6: Apply Bacterial Foraging Optimization Algorithm.

Step7: If optimized node is achieved, step 8 is started, else, shortest path is recalculated (step 4).

Step8: The newly found node is checked against the destination node, if they do no match, then, rescan of nearby nodes is done (step 3), else the loop is stopped at DESTINATION.

Proposed Algorithm

In the proposed work, Bacterial Foraging Optimization Algorithm (BFO) is used. The BFOA is stirred by the social event scrounging conduct of microscopic organisms, for example, E.coli and M.xanthus bacteria. In particular, the BFOA is energized by the chemotaxis direct of microorganisms [15] that will see substance slants in the earth, and push toward or far from particular signs. Microorganisms see the making a beeline for sustenance in context of the slants of chemicals in their condition. So in like manner, microorganisms emanate pulling in and repulsing chemicals into nature and can see each other moderately. Utilizing speed instruments (for example, flagella), microscopic organisms can move around in their condition, every so often moving loudly (tumbling and turning), and in distinctive conditions, moving co-ordinately that might be implied as swimming. Bacterial cells are managed like administrators in an area, utilizing their perspective of sustenance and distinctive cells as motivation to move, and stochastic tumbling and swimming like improvement to re-discover. Dependent upon the cell-cell interchanges, cells may swarm a sustenance source, and also may commandingly rebuke or caress each other. The information prepares strategy of the count for engaging cells stochastically and all in all swarm toward optima. This is achieved about an array of triple processes on a state of sham cells: 1) 'Chemotaxis' – the cost of cells is lowered individually by their closeness to diverse cells and cells skate the manipulated cost face one at a time, 2) 'Reproduction' – only the pioneers in the above said cells may create the heirs, and 3) Elimination-dispersal' – loser cells are scrapped and new arbitrary samples are infused as fresh ones.

Pseudo code:

Input: $Prob_{size}$, $Cells_N$, N_i, N_r, N_{tc}, N_{cc}, st_{size}, D_{bss}, W_{ass}, H_{rep}, W_{rep}, P_{li}
Output: $cell_j$
Population ← initialize population ($cells_k$, $Prob_{size}$)
For (L=$0_{to}N_i$)
For (N=$0_{to}N_r$)
For (j=$0_{to}N_{ts}$)
Chemotaxis and Swim ($population$, $prob_{size}$, $cells_n$, N_{cc}, st_{size}, D_{bss}, W_{bss}, H_{rep}, W_{rep})
For *(cell∈population)*
If ($cost(cell) \leq cost(cell_m)$)
$Cell_{m \leftarrow cell}$
End
End
End
Sort by $cell_{health}(population)$
Select ← by $cell_{health}(population, \frac{cellc_n}{2})$
population ← select
population ← select
End
For (*cell∈population*)
If ($random() \leq p_{di}$)
cell ← create cell at *random location ()*
End
End
Return ($cell_m$)

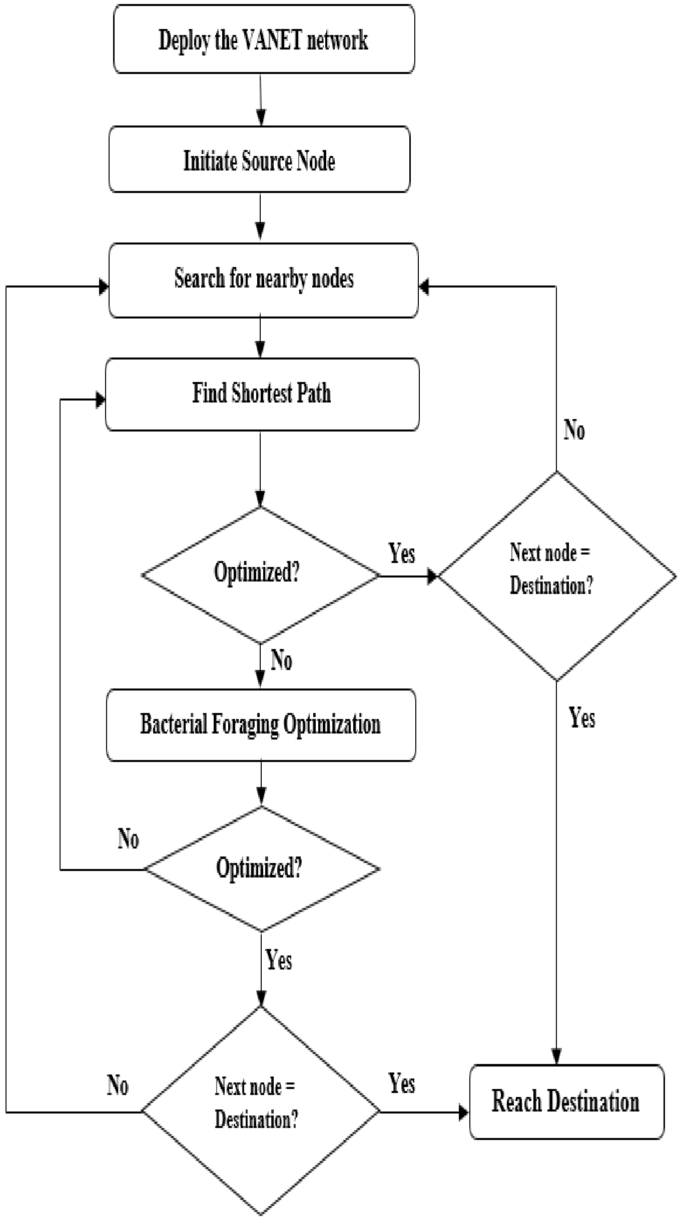

Fig.1: Flowchart of methodology

V. RESULTS

The table 1 shows comparison of throughput between the ACO and PSO. PSO has better throughput as compare to the ACO. VANET is simulated using the ONE (Opportunistic Network Environment) simulator. Simulation time is set to 15000s. Parameters bothered include the throughput, number of packets dropped, overhead fraction and average latency.

Table 1 Comparison of throughput between ACO and PSO

No. of nodes	Throughput with ACO	Throughput with BFO
66	371571.2959	403485.5537
96	367212.0255	399555.4353
156	37205.33305	419491.784
231	378373.5549	412685.9678
276	384728.2823	418457.7059
306	381671.8795	395410.0557
366	381919.4144	421366.6948
396	382159.0055	431874.5042
456	381692.8742	425756.6571
486	385021.8428	396272.0641
531	385021.8428	409737.4076
546	383027.2876	443506.3927
606	384705.5969	412834.7252
906	387593.3945	418002.5426
1206	386295.7107	420551.2651
1506	387863.2166	413999.7735
2106	386424.5751	423294.9049

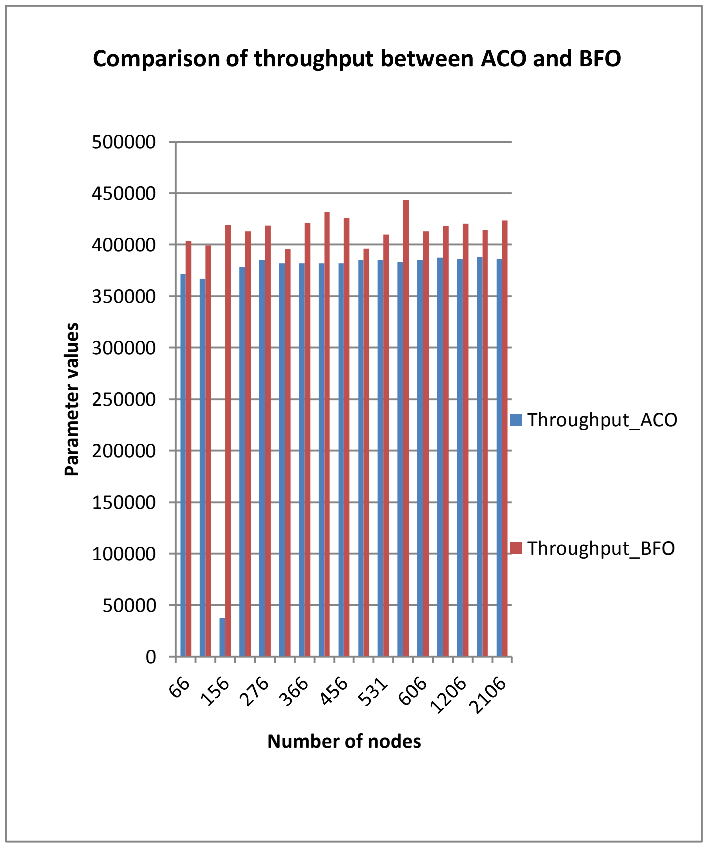

Fig.2 Comparison of throughput between ACO and BFO

Table 2 Comparison of dropped packet between ACO and BFO

Number of nodes	Dropped with ACO	Dropped with BFO
66	1348.46	1708
96	1915.73	1731
156	2688.325	1617
231	2973.87	1656
276	2935.67	1623
306	2844.945	1754
366	2545.075	1606
396	2460.08	1546
456	2221.33	1581
486	2101	1749
531	1901.405	1672
546	1914.775	1480
606	1667.43	1655
906	970.28	1625
1206	658.95	1611
1506	467.95	1648
2106	370.54	1595

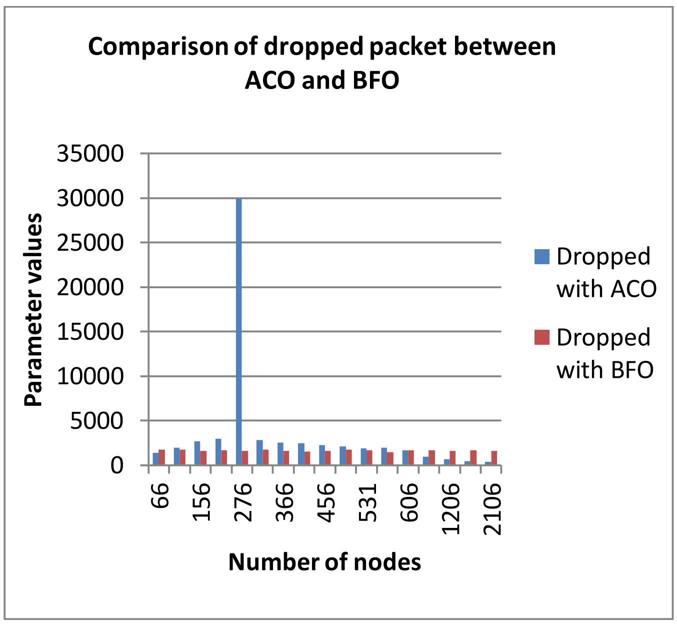

Fig.3: Comparison of dropped packet between ACO and BFO

Table 3 Comparison of overhead_ratio between ACO and BFO

No. of nodes	Overhead_ratio with ACO	Overhead_ratio with BFO
66	17.2879	11.0522
96	18.5873	11.1973
156	23.5861	10.4611
231	22.5099	10.7124
276	21.467	10.4993
306	20.8102	11.3503
366	19.8431	10.3919
396	20.901	10.0039
456	19.0274	10.2298
486	18.9288	11.3185
531	18.6952	10.8213
546	18.0787	9.5744
606	17.3274	10.7069
906	17.6479	10.5161
1206	17.5948	10.422
1506	17.8293	10.6639
2106	16.9065	10.3207

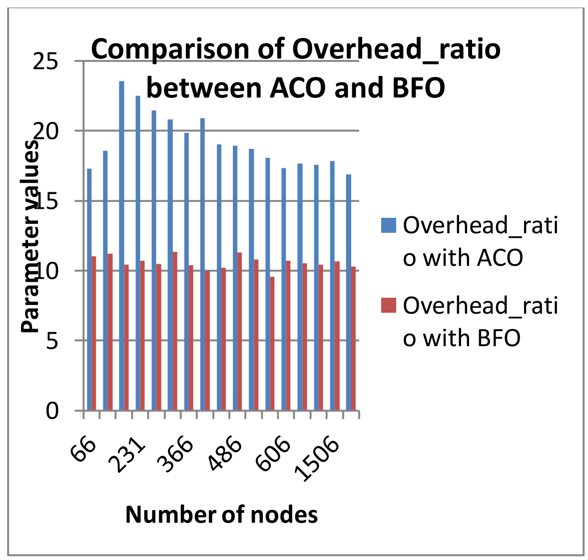

Fig.4: Comparison of overhead_ratio between ACO and BFO

Table 4 Comparison of latency_avg between ACO and BFO

No. of nodes	latency_avg with ACO	latency_avg with BFO
66	4387.876043	3895.27628
96	4367.342684	3946.423133
156	3988.638675	3686.970004
231	4069.881958	3775.541404
276	3881.249307	3700.427573
306	4270.253755	4000.371414
366	4037.997755	3662.569775
396	4285.570809	3525.820358
456	3988.371275	3605.438477
486	4457.933506	3989.153172
531	4077.890492	3813.914186
546	3953.013352	3374.442093
606	3814.456703	3773.605464
906	4225.547435	3706.351103
1206	4274.868792	3673.181837
1506	4074.932475	3758.443438
2106	3899.750713	3637.475904

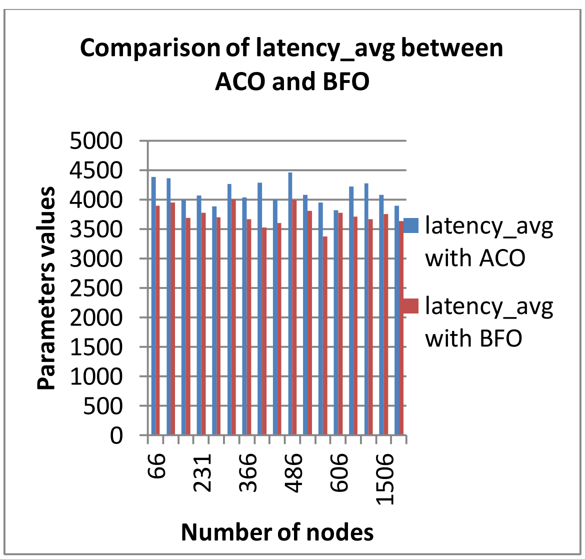

Fig.5: Comparison of latency_avg between ACO and BFO

Table 5 Comparison of delivered packet between ACO and BFO

No. of nodes	Delivered packet with ACO	Delivered packet with BFO
66	122.3	187
96	170.3	185
156	209	194
231	266.5	191
276	292.6	194
306	307.2	183
366	325	195
396	311.4	200
456	343.8	197
486	346.9	183
531	350.1	190
546	368.9	205
606	381.4	191
906	382.5	193
1206	384.6	195
1506	379.3	192
2106	401.3	196

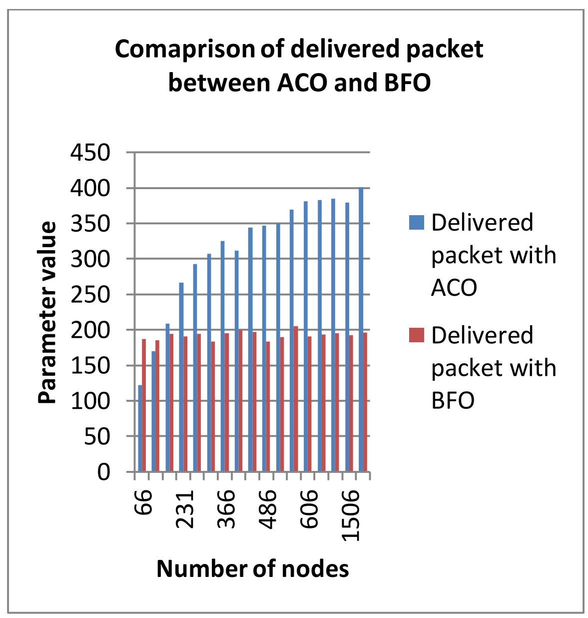

Fig.6: Comparison of delivered packet between ACO and PSO

V. COCLUSION AND FUTURE SCOPE

In this paper, we have recommended a method for routing in opportunistic networks and have circumspectly assessed and contrasted its outcomes with Ant Colony Optimization Algorithm against diverse parameters over varying number of nodes. The recommended Bacterial Foraging Optimization method is skilful enough to cope with the demerits of ACO. BFO provides elevated throughput, dropped overhead and average latency. Significant fall in dropped packets has been recorded for normal to moderate high node matter. Common node data and swarm behaviour are harmonized to esteem the outcomes. In the time ahead, the suggested method may be harmonized with some other familiar array of instructions. More sophisticated algorithms may be brought into limelight for cost-cutting and shrinking the shortest way.

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