On The Improving Of Routing Protocols In Ad-Hoc Network By Using Optimization Algorithms

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Abstract

In this paper, a novel improved method is presented to perform the local repair process of AntHocNet protocol. In the novel proposed method, in the case of failed connection, the node that checks the connection looks for the link that leads to node which follows the out-of-service node instead of the destination node. If it is existed, then the path will be repaired and completed quickly.

Keywords: Algorithms; Path Optimization Algorithm; Ad-Hoc Network

1. Introduction

Ad hoc mobile network MANETIS a set of mobile nodes that communicate cooperatively with each other without any pre-built infrastructure. These nodes may be computers or devices such as laptops, PDAs and mobile phones that share a wireless connection. Due to the fact that the nodes change their physical location by moving, the network structure may change unexpectedly, causing changes in the link status between each node and its neighbors. Thus, nodes that join or leave the communication range of a particular node in the network will certainly change their relationship with their neighbors by detecting a connection failure or adding a new one. This can result in a large number of updates in the routing table for each node in .MANET the performance of a dedicated mobile network (MANET) is closely related to the ability of routing protocols to psychologically adapt to unexpected changes of network topology and connection status [5]

The study was carried out on a protocol .AntHocNet where AntHocNet operations can be divided into four distinct stages [6]

1. Prepare routing information.
2. Data routing
3. Preserve existing tracks and explore new ones.
4. Handling connection failures .

In our research, we worked on the stage of addressing connection failures, specifically the process of repairing the route locally.Local repair

2. Research objective

1-Improve the performance of the routing algorithm in Ad-hoc network protocols by finding an optimal route in a small time.

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2-Compare the performance of the routing protocol before and after applying the proposed algorithm according to the following evaluation criteria:

The delay time is End-to-end delay.

Productivity Throughput.

Packet delivery ratio packet reception rate.

3. Materials and methods of research

A mobile device with an Intel core i5 processor, a 64 pyramid, 4GB memories, and a Windows 7 operating system was used.

The emulator used is Opnet 14.5 in the(c) programming language.

4. AntHocNet protocol

AntHocNet is a hybrid and adaptive routing algorithm that uses reactive and proactive routing. Specifically, it combines the process of interactive route preparation with the process of optimization and proactive route maintenance. The way Anthocnet collectsto store and use routing information is inspired by the ant Colony algorithm, where routing information is stored in two routing tables: the formon table and the neighbor Table [7]

Each field in the formon table contains information about the path from node (i) to destination (d) through neighbor (j) this information includes the formon value (τ), the value of which indicates the relative quality of going over node (j) when moving from node (i) to destination (d) the value of the default formon.

As for the neighbor's table , it contains the address of the wireless nodes to which it has a wireless link.

Algorithm work

The algorithm consists of two main parts: the reactive part and the proactive part.

Interactive part: it starts at the beginning of any communication session [8,9]

At the beginning of each transmission the source node searches its own phormon table, to find out

Whether it has any routing information available for the desired destination.

If there is no information about the route, it starts the process of setting up the interactive route, where

The source node sends a group of ants through the network to find a path to the destination. This group is called the front reactive ants.

Each intermediate node receives a copy of the interactive front Ant, redirects it, this is done

By broadcasting a broadcastin case there is no routing information towards the next node in the phormon table of the current node. If the information is available, the Ant is directed directly to the node next to it and the method is called unicast .unicast and the interactive front ants store the nodes that they visited on their way.

When the first reactive forward Ant arrives at the destination it is transformed into a reactive reverse Ant ،

While the arriving ants are subsequently destroyed.

The reactive reverse Ant traces the path that the forward Ant followed to return to the source. In

His way, he collects information about the quality of each of the links of the route. It updates routing tables for each visited node based on quality information.

The proactive part: it is carried out during the track maintenance process [10]

The algorithm begins with the implementation of proactive route maintenance, in which it tries to update, increase and improve the available routing information. This process continues as long as the data exchange session is continuous from two sub-processes: pheromone diffusion and proactive ant infestation. The goal of the first sub-process is the dissemination of the formone information laid down by the ants, since the nodes periodically broadcast messages with the best obtained formones to neighboring nodes, enabling them to derive

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new formones themselves and then also publish them [11]. It is a very effective methodology, as we have already indicated, but it causes some slowness in adapting to changing conditions at a high pace or some temporarily erroneous information. For this reason, the subformone diffusion process is an easy and simple, but rather unreliable way to disseminate formone information [13,12], so the formones obtained in this way are stored separately from the ordinary formone that was laid by ants and is called the virtual formone. This pheromone is used in the second sub-process, which is the proactive Ant sampling. All source nodes of data exchange sessions in this process send proactive forward ants to the destination. These ants build a path in a random way, so the node chooses the next jump according to some probability in each intermediate node. Unlike the interactive front ants, these ants never broadcast by broadcast dumping. Both ordinary and virtual formulae are taken into account when calculating the probability of choosing the next jump. In this way, it is possible to leave the path followed by the previous ants and take the paths emanating from the pheromone transmission process. As soon as the proactive forward Ant reaches its destination, it will turn into a proactive reverse Ant, which travels backwards to the source node and leaves traces of the (normal, not virtual) formon along the path just like the reactive reverse Ant. Thus, proactive ants can follow the default pheromone, after which, upon reaching the destination, they turn into a regular pheromone. It can be said that the pheromone transmission process suggests new pathways and proactive ants test these pathways, which solves the previous reliability problem [12, 13]

5. **Improved algorithm for: AntHocNet**

When the source node S starts a communication session with the destination node D, and it does not contain routing information for d, it broadcasts an interactive request i.e. Ant forward .Fdsbecause of this initial broadcast, each neighbor of The receives an exact copy of the .FDs, refer to the set of replicas that originated from the same original Ant as the Ant generation. The task of each ant of the generation is to find what connects the Su path .D in. It consists of

Each node, the Ant is either unicast or multicast, according to whether the node has routing information for D Or Not. The routing information of node i is represented in its formula table Ti this value of the table represents the formula value that indicates the estimated quality of the transition from i through neighbor nto reach the destination .D if the formone information is available, the Ant chooses its next Jump N with the probability of Pnd [13]

β ≥ 1 $P_{nd} = \frac{(T^i_{nd})^{\beta}}{\sum_{j\in N^i_{jd}} (T^i_{jd})^{\beta}}$

)1(

Where T^i_{nd} is the set of neighbors i through which the path passes, and b is an information value that can control the exploratory behavior of ants is often equal to1.

In the absence of an LDH pheromone, ants are broadcast, and because of this broadcast, ants can quickly multiply through the network, following different paths to the destination. When a node receives several ants of the same generation, it compares the path traveled by each ant with the path of previously received ants of this generation: only if the number of jumps and travel time are within the acceptance factor A1 of that of the Ant. The best Ant in the generation, you will send. Using this policy, overload in the public network is restricted by removing ants that follow Bad Paths. However, the effect is to allow the ants that arrive first at the node to pass, while the subsequent ones meet the selection criteria set by the best ants that preceded them, and therefore have greater chances of being killed. Multiplier ants that result from broadcasting the best Ant before it arrives at the destination are close in performance to the best Ant and have higher chances of being accepted. The result is a set of

The tracks are "kite-shaped", as shown in Fig .[13] (1) in order to obtain a sufficiently discrete network of multiple paths, which provides much better protection in the event of a link failure, we also consider in the selection policy the first leap taken by the Ant. If this first jump is different from the one taken by the previously accepted ants, then we apply a higher (less restrictive) acceptance factor a2(in experiments, a2=2, a1=0.9)

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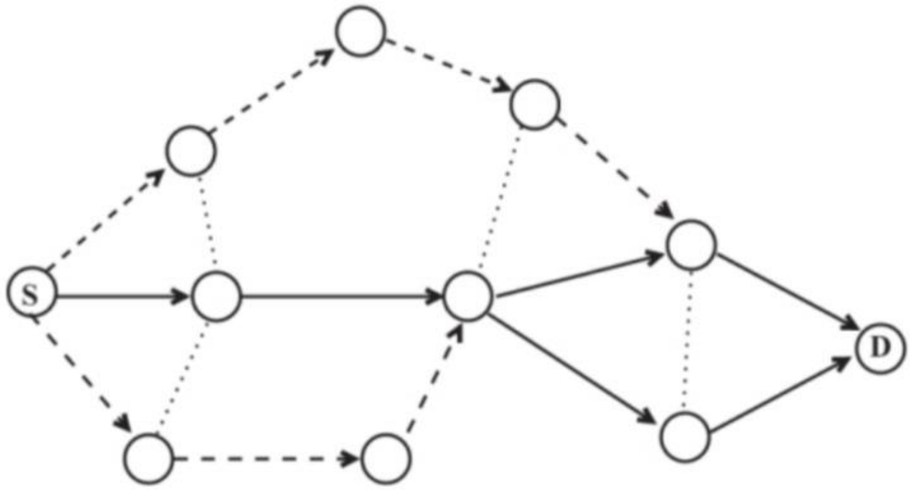

Figure 1: Ant paths from source to target

The result is a set of regularly scattered paths, as shown by

Combine the arrows of solid and dashed lines in the figure.[13] (1)

Each frontal Ant maintains a P-list of nodes 1,..the one you visited. Upon reaching the destination D, it is converted into a reverse Ant, which moves back to the source using (P if this is not possible because the next jump is not present for example and due to node movements the reverse Ant is ignored.(

The returning Ant incrementally calculates a TP estimate of the time it will take for a data packet to travel through P towards the destination, which is used to update routing tables, and defines this amount as the sum of local estimates at each node i, to reach the next node i+1 [15]

$$(2) - T_{P=} \sum_{i=1}^{n-1} T_{i+1}^{i} .$$

(3) $T_{i+1}^{i} = (Q^{i}_{mac+1})\ T^{i}_{mac}$

Where $T^{i}_{mac}$is calculated as the average running time elapsed between the arrival of the packet to the MAC layer and the end of a successful transmission. So if $T^{i}_{mac}$is the time it takes to send a packet from node i, node i updates its estimate as follows [15:[

$$T^{i}_{mac} = \alpha T^{i}_{mac} + (1-\alpha) t^{i}_{mac} \quad (4$$

And since $T^{i}_{mac}$is calculated in the MAC layer, it includes channel access activities, so it represents the local congestion of the shared Medium. The front ants calculate a time estimate similar to Tp, which is used to filter the ants.

At each node i, the reverse Ant sets up a path towards destination d, creating or updating an entry in theT^{i}_{nd} Formula table. The value of the formula T^{i}_{nd}represents the average cost-inverse run in terms of the estimated time and number of hops to travel to D across .n ifT^{i}_{d} is the travel time estimated by the Ant, and H is the number of jumps, the value used to update the running average is defined as follows[15]

1-

$$T^{i}_{d} = \left(\frac{T^{i}_{d} + hT_{hop}}{2}\right), \quad (5$$

Where T_{hop}represents the time required for one jump at the time of unloading.

In the same way $T^{i}_{nd}$is calculated

$$T^{i}_{nd} = \gamma T^{i}_{nd} + (1-\gamma) T^{i}_{d}, \quad (6$$

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If the route preparation process is successful, a number of good routes will be provided between the source and the destination. On the other hand, if no reverse Ant returns to the source after a certain period of time (in experiments it is about 1 second) the data is cached and the whole process restarts. This is repeated a number of times (most cases 3), after which the temporary data is discarded.

] Random routing of data[14

Nodes in Anthocnet are forwarding data randomly. When a node has several jumps following destination d, it randomly selects one of them with probabilityP_{nd}. $P_{nd}$is calculated in the same way as the interactive front Ant, but with a higher exponent (it is set to 2), in order to be more greedy regarding which paths are better. According to this strategy, we do not have to choose in advance how many tracks to use, their number is determined automatically according to their quality. The probabilistic routing strategy leads to the spread of data load according to the estimated quality of the routes. If the estimates are updated, this leads to an automatic load balancing. When the route is clearly worse than others, it will be avoided, and congestion will be relieved. Other routes will receive more traffic, which will lead to increased congestion, which will lead to an increase in delays from

Tip to tip. By continuously adapting the data traffic, the nodes try to evenly distribute the data load across the network.

Proactive Route Inspection and route maintenance [14]

During the operation of the data session, the source node sends preemptive forward ants according to the data transmission rate (one ant per data packet (n) is usually unicast, and selects the next hop according to the formula_values using the same formula as the forward reactive Ant. If a frontal Ant arrives at the destination without a single broadcast, it searches an existing path. It collects up-to-date quality estimates for this pathway, and the reverse Ant updates the formone values of the intermediate nodes, just as the reactive reverse ant does. On the other hand, if the Ant is broadcast at any time, it leaves the currently known tracks and explores new ones.

After broadcasting, the Ant reaches all the neighbors of the broadcasting node. It is possible that in these neighbors he does not find a form for his destination, so it will have to be broadcast again. The Ant will multiply rapidly and flood the net, as do the reactive front ants. To avoid this, we limit the number of broadcasts to nb.

If the proactive ants do not find the way during the period of NB jumps, they are killed. The effect of this is that the search for new routes is concentrated around existing ones, so we are looking for improvements and route variations. To better guide the front ants, we use welcome messageshello messages. These are short messages (in our case they contain only the sender's address) that are broadcast every second by the nodes. If a node receives a welcome from a new node n, it adds N to its routing table. After that he expects a welcome message from N every second.

Using these messages, the nodes contain form information about their immediate neighbors in their routing table. So when an ant reaches a neighbor for its destination, it can go straight to its goal. Welcome messages also serve another purpose: they allow to detect broken links. This allows nodes to clean old entries from their routing tables.

Disconnection of the link [4]

Each node tries to maintain an updated view of its immediate neighbors at any time, in order to quickly detect link failures, before they lead to packet loss. The presence of a neighboring node can be confirmed upon receipt of a welcome message, or after any interception or successful exchange of signals. The disappearance of a neighbor occurs when such an event does not occur for a certain period of time, as the loss of a welcome message, or when a unicast transmission to this neighbor fails.

When it is assumed that a neighbor has disappeared, the node conducts a number of actions. First, it removes

The neighbor is from the neighbor list and all associated entries are from its routing table. Then you broadcast a link failure notification message. This message contains a list of destinations where the node has lost its best route, the best new estimated end-to-end delay and the number of jumps to this destination (if it still has entries for the destination). All her neighbors receive notification and update their form using the new estimates. If, in turn, they lose their best or their only route to a destination due to a failure, they also broadcast a notification, until all the nodes involved are notified. If a link failure is detected due to a failure to send a data packet, and

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there is no other path available for this packet, the node tries to fix the path locally (and does not include this path in the link failure notification). The node broadcasts a path repair ant that travels to the destination in question like a reactive front ant: it tracks the available pheromone when possible and is otherwise broadcast.

One of the differences is that it has the maximum number of broadcasts so that the spread is limited. The node waits for some time, and if a reverse repair Ant is not received, it concludes that it was not possible to fix the path. Packets that have been cached for this destination in the meantime are ignored, and the node sends a link failure notification about the missing destination.

The other difference is that the algorithm continuously updates the path between the source and the target, and if one of the links fails, it tries to modify the path to a new one, but it will be next to the old one, provided that the transmission takes two jumps.

However, there are cases when the node is far from the target, the local repair process will fail despite the presence of a route to the target, and this leads to increased time delays and data loss, as shown in Figure (2). This situation will be remedied by broadcasting the ants to search for the node next to the node at which the connection failed instead of searching for the target. Link failure notifications keep routing tables updated on routes about master link failures. However, it can sometimes get lost and leave hanging links. A data packet following such a link arrives at a node where no other phormon is available. The node will then ignore the data packet and send a unilateral warning to the previous packet jump, which can remove the erroneous routing information.

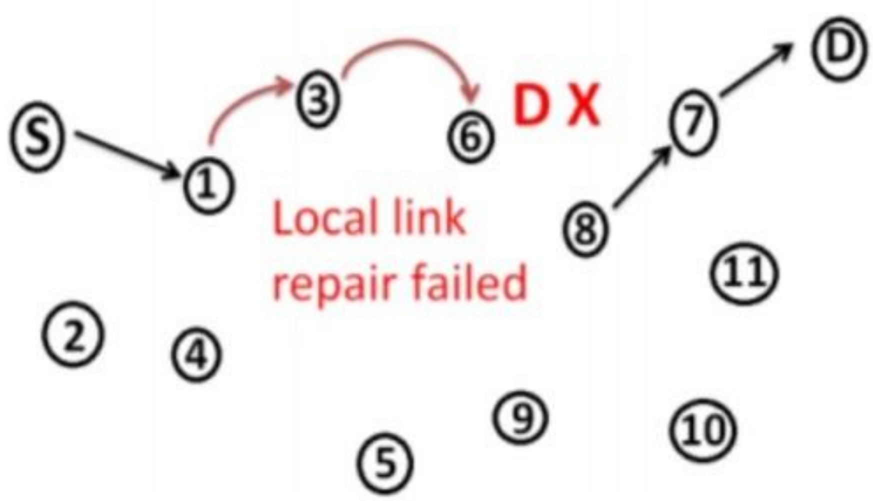

Figure 2: failure of the local repair process due to distance from the target

6. **Analysis and discussion**:

The Opnet 14.5 program was used for emulation. The algorithm was applied to two types of networks, the first with a small number of nodes and the other with a larger number in order to study the effect of the number of nodes on the algorithm's work. It was taken into account that the simulation was performed on a network of mobile devices and not on a huge network such as a wireless sensor network, so a scenario was chosen with a number of 5 nodes and an increased random speed shown in Figures (3), (4) and (5), and another scenario with a number of nodes 30 and an increased random speed shown in Figures (6), (7) and(8), where the algorithm was tested before and after modification and evaluated by performance evaluation criteria: delay, packet receipt rate and throughput. Table(1) shows the transactions and protocols used in the simulation.

Table (1)

The area of the area where the nodes are scattered	500m*500m
MAC Media Access Control Layer protocol	802.11
Prevalence	Two Way Ground
Movement model	Random Way Point Model
Transport protocol	UDP
Simulation time	50 Seconds

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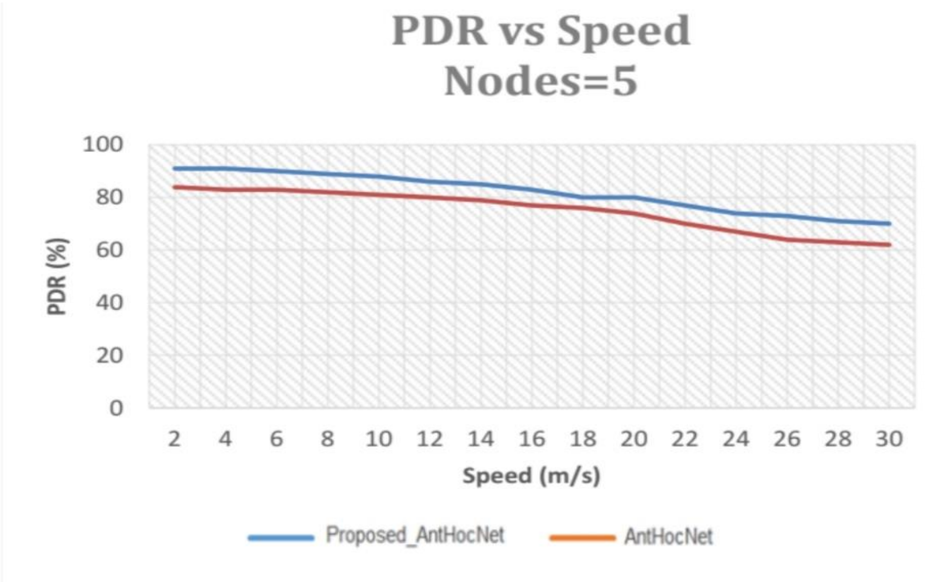

Figure 3: packet receipt rate decreases with increasing traffic speed in a network of 5 node

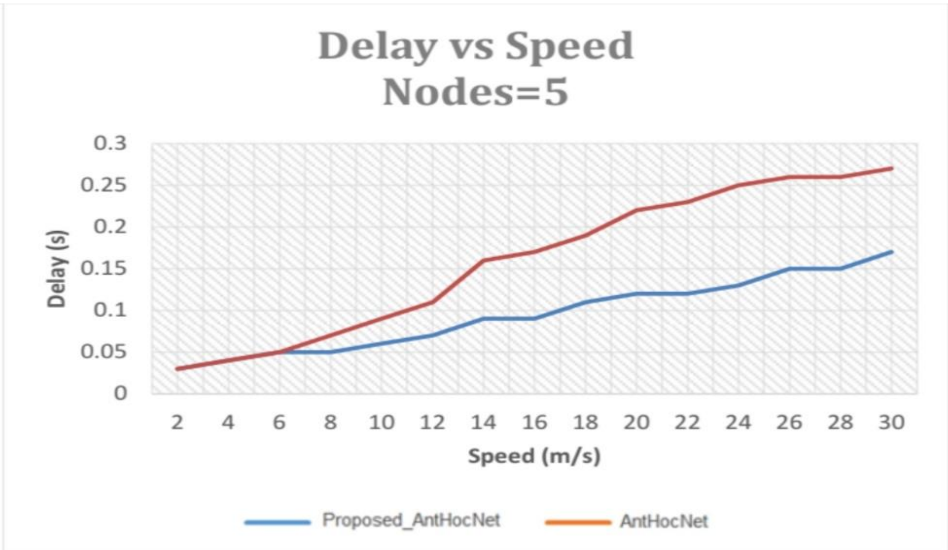

Figure 4: delay increases with increasing speed of movement in a 5-node network.

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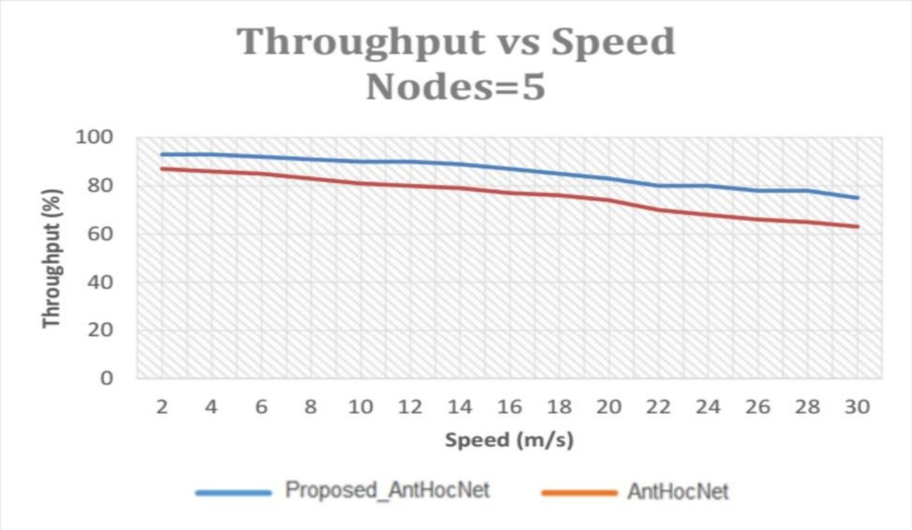

Figure 5: reduced productivity with increasing speed of movement in a network of 5 nodes

In Figures (3), (4) and (5) we note that increasing the likelihood of performing local repair local repair with the proposed algorithm helps to find the alternative path better, which leads to a reduction in the percentage of packet drop loss as a result of transmission failure at the out-of-Service Node.

As for the time taken to find the alternative node, it affects the packet arrival time, which is greater if the local repair process fails, as the original algorithm will return to the source node to search the entire network for the alternative path.

As for productivity, fairly stable values appear with increasing speed, in addition, the results of the improved algorithm are better than the basic one

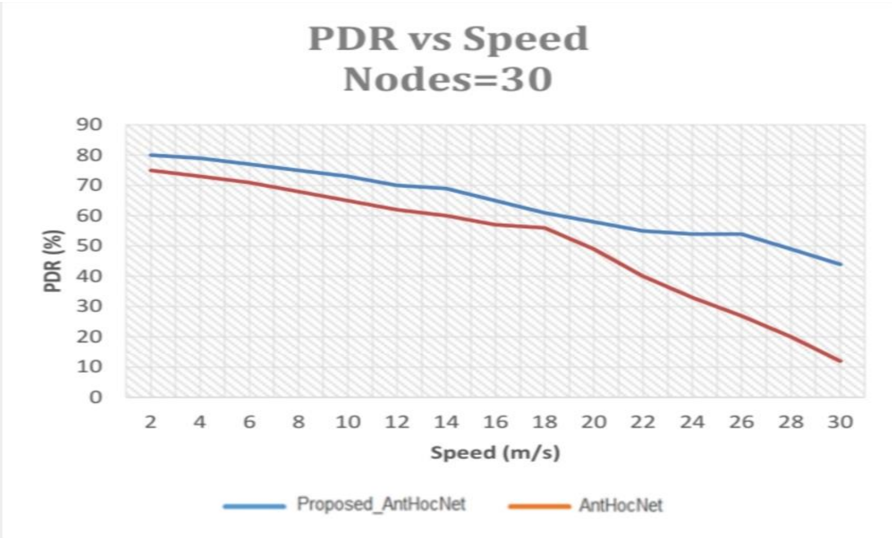

Figure 6: packet receipt rate decreases with increasing traffic speed in a network of 33 nodes

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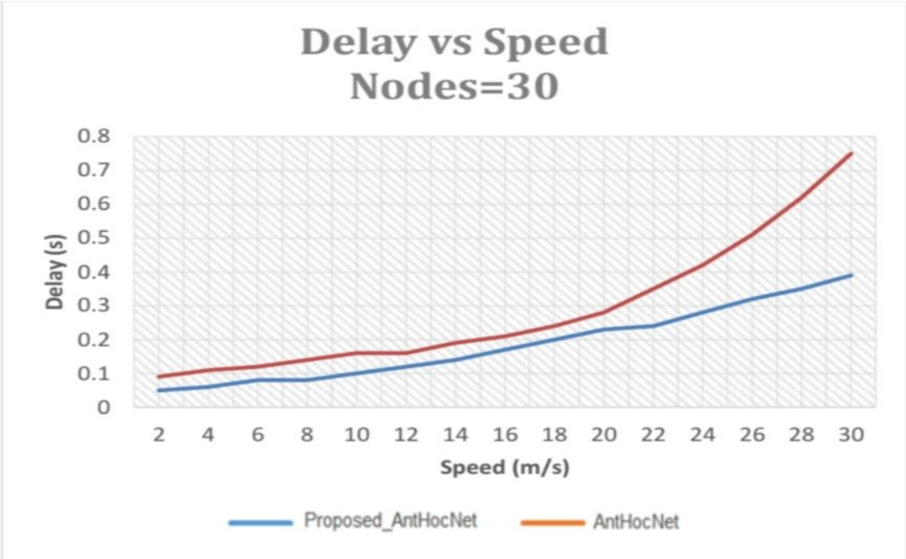

Figure 7: the delay increases with increasing speed of movement in a network of 33 nodes

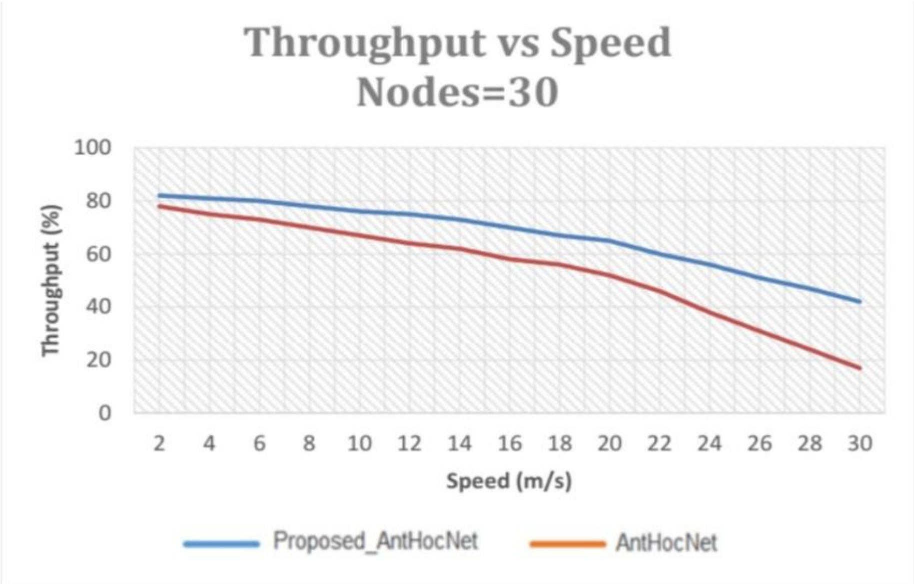

Figure 8: reduced productivity with increasing speed of movement in a network of 33 nodes

In Figures (6), (7) and (8) we note that increasing the number of nodes helps to find the replacement node by a larger percentage, and with increasing speed the mobility increases and with it the percentage of interruptions increases. While the network in our proposal maintains a high connection percentage as a result of the constant correction of routing tables.

Increasing the number of nodes negatively affects the delay due to the length and abundance of routes, but the proposed algorithm gives a better result due to the implementation of local repair localmore accurately and faster as a result of increasing the number of nodes, which leads to a shortening of time.

We notice a decrease in the value of productivity with increasing speed, due to the high number of moving nodes, which leads to an increase in interruptions, but also the performance of the improved algorithm is better due to its superiority in fixing the path and improving productivity.

7. Recommendations and future prospects:

The proposed algorithm modifies the protocol header and routing table in order to calculate and add the information of the next two nodes instead of just the next one. These modifications will cause an increase in network load (Overhead)and, consequently, network performance.

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Future recommendations of the research, is to work on reducing the network load resulting from the modification to obtain better performance of the algorithm .

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