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A developed Shadow Agent based on Ad-hoc Routing used to Optimize the Performance of DSR in different Network Environments

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Abstract— in this research paper, Dynamic Source Routing were under certain studies from different aspects including a comparison between DSR performance according to different environments and with other protocols. DSR is a well-known ad hoc protocol, which is restricted to small networks. A new developed Agent used to enhance the performance of the DSR. A developed shadow Agent has made a new step forward to solve the problem of routing maintenance. This developed Agent has the ability to control the routing in the network which normally holding a routing table to increase the utilization of the routing protocol. The developed shadow Agent has played a major role to handle the expected dis-connectivity that may happen when the Agent changes its location,

Keywords— Ad-hoc routing algorithms, performance analysis, optimization.

I- Introduction

Mobile ad-hoc networks were in fact the biggest gate for intensive research in the last several years because of its potential and huge number of applications. Unfortunately, their lack of infrastructure makes them difficult to optimize. It even makes impossible to provide performance guarantees, so that the best, which can be done, is to design network mechanisms and to observe when and why some of them are better than other; depending on the environment, which can be the most appropriate depending on the situation .This, is particularly the case for the routing algorithms. A lot of routing algorithms have been implemented; for instance two surveys [1],[2]. Several classification of routing algorithms have been stated in [3], they were classified as uniform or non-uniform protocols with respect to the fact they assign some particular roles to certain nodes or not. In case of cluster based routing, some nodes are assigned the special role of cluster heads. Routing protocols are also hierarchical or not. Cluster based routing algorithms are typical examples of hierarchical routing protocols [4]. Some protocols rely on position information. The most known categorization of the routing protocols is the distinction between proactive versus on-demand, or reactive, protocols. Proactive routing protocols try to maintain updated route information at any time, on-demand routing protocols update the routing information only when requested. Some protocols are also hybrid, both proactive and reactive. Routing algorithms can also be classified into based on full versus reduced topology information.

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II- Related Works

In the last few years, several research centers all round the world have studied and analyzed various ad-hoc Routing Protocols; regarding to its potential and by its consideration within different metrics as basis for performance evaluation. They have used different simulators and real-world environment as well. Johnson, et al. [1] they have analyzed the performance of dsr routing protocol for certain criteria so far. Dsr shows better delay performance than other reactive protocols due to fast route discovery process. David et al. [2] they have analyzed Dsr performance by which Dsr performs well when number of nodes is less but slightly underperforms with increase in the number of nodes. Samir R. Das et al. [3] they found that dsr protocol has better performance than aodv in terms of packet generated. Dsr protocol outperformed aodv protocol in terms of number of packets dropped and aodv protocol have better performance over dsr Protocol in term of packet delivery ratio. Sapna. Et al. [4] compared and analyzed the performance of AODV and DSR using random waypoint mobility model with variable pause time using ns-2 simulator. They found that DSR outperformed AODV in delay and throughput on less stressful situation i.e., with small number of nodes and lower load and mobility while AODV out performed DSR in more load, high mobility. They also found that DSR low throughput and delay was due to aggressive use of caching and stale routes. Rajesh Deshmuklh et al. [5] performed simulation of AODV and DSR for Vehicular Ad-hoc network with and without RSU (Road Side Unit) using Estinet Simulator and found that throughput was highest for AODV compared to DSR. Amit N. Kapil. Et al. [6] analyzed the performance of AODV and DSR using Random Waypoint mobility model. They found that packet loss of DSR was higher than AODV for a small amount of time compared to AODV. DSR was better and stable in multiple paths and absence of periodic packet broadcast as in the case of AODV.

III- Motivation

Most common protocols for mobile wireless networks build on the assumptions that nodes in the network are willing to participate to the networks existence by forwarding packets for other nodes. In general, most mobile devices operate on battery power, which means that each transmission has a cost in terms of power consumption. This results in a conflict, since nodes have to perform the task of forwarding data, from which they achieve no benefits and as a result consume their own battery power.

- ### *Difficulties for routing in general*

The most well-known barriers related to routing difficulties in the area of routing protocol design and analysis issues are:

1-Limited connectivity due to transmission range of signals.

2- Low bandwidth.

3- Higher error rates.

4- Vulnerable to interference.

5- Power consumption.

6 - No specific devices to do routing.

7- Dynamic nature - high mobility and frequent topological changes.

V- Our Approach

We have proposed an Agent based Dynamic Source Routing (DSR) where the Agent plays a role for controlling the transfer process between nodes in the network. This Agent can dynamically set upon the node, which has the best utilization, and can handle as many loads as possible, so the network will have better performance and highest byte rates. This Agent control the routing process in the DSR protocol. When the node is in active process that may lead to overload, then it should jumps to the next node. The node that has better utilization than other nodes in the network normally has excellent degree of performance and speed, but to less reliability. Because, when a node has sent a message to an agent, which in that time, has jumped to another node, then this may lead to loosing message transferred throughout the network. When there is a very big amount of messages, then it may lead to the failure of the routing process. To terminate this fact, we have used a shadow Agent to solve the problem of forwarding the message to the new location of the Agent, and broadcast it to the new Agent location. The Agent should wait for a while until the Agent handles all messages. The time required for the shadow Agent will be determined and can estimate network size upon the maximum time required for a message transmission; in this case, all the messages, which had sent after the Agent has changed its location, which means to its new location. The shadow Agent plays the role of defending the network from expected failures due to unknown and unexpected changes in the Agent place.

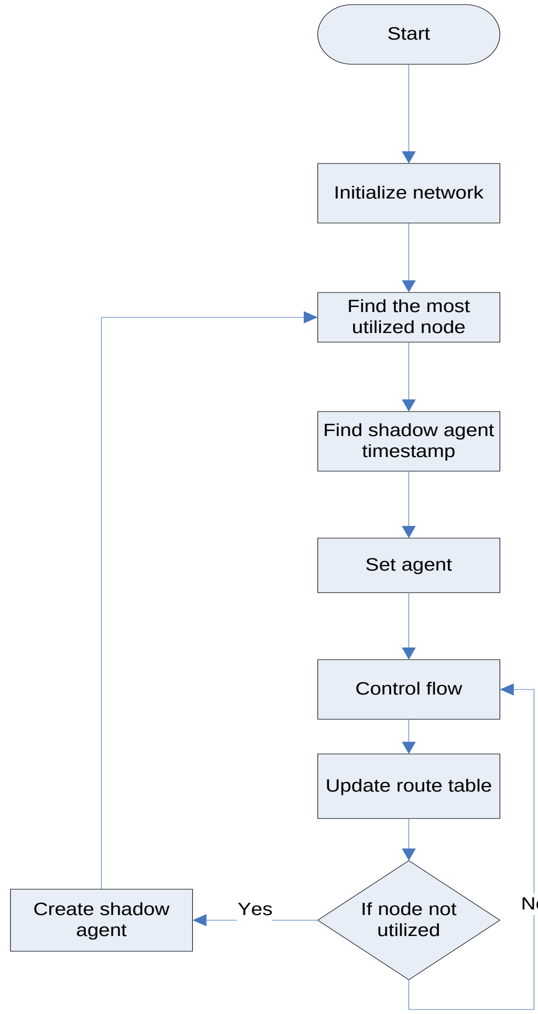

Figure1- Design Flow Diagram

- ### *Pseudo-code for Agent Based DSR*

1. Initialize Network: where the topology, all nodes, the properties, and the network properties are set out.
2. Find the most utilized Node: in this step, the most efficient Node for the Agent detected upon its network placement and energy power.
3. Find Shadow Agent timestamp: in this step, a period for holding the shadow agent is set out and this period is determined by the longest message delivery time estimated between the largest distances between two nodes.
4. Set Agent: in this phase, the Agent on the better utilization node should be set.
5. Control flow: In this step, the agent checks for nodes, performs the route discovery iteratively, and does the delivery between nodes.
6. Update Route Table: In this stage, the agent updates the routing table it holds.

7. Create Shadow Agent: in this step, a shadow agent created such that it receives any late messages and treat them as if they are going to the agent to its new location.

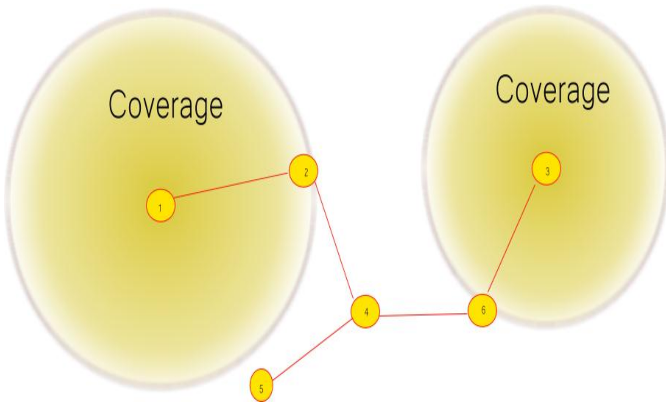

Figure-2. Network, which represents Node coverage.

As shown in the figure2, the connected nodes can connect to each other upon the coverage of each node. Each node has a utilization value which is used to set the location of the Agent so that, the Agent is replaced on the most utilized node in the network.

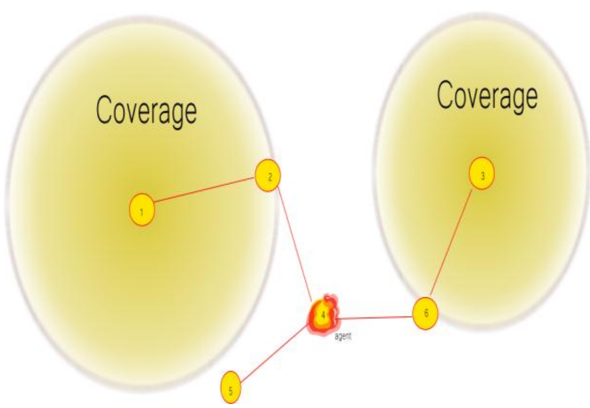

Figure3- Agent selection

In case of the Agent node has the state of overloaded, then the Agent must searching for another node, which has better utilization where the shadow Agent placed to receive any late messages and redirect them to the new location until all nodes get aware with the new location of the Agent.

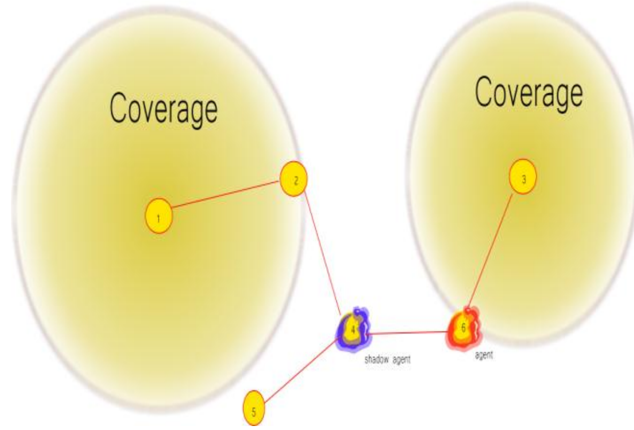

Figure4- Agent movement and building shadow Agent

A- ***Sending and Receiving messages Scenario***

When a node starts to send a message to another node in the Network, the message first will be send to the Agent, which holds routing information, and then the Agent sends the message to the target node, for examples, suppose that node1 starts to transmit a message to node 3. First, the message will be send to the Agent, and then the Agent should resend it to the target upon the routing table it holds. However, let us say that, the Agent has moved when the message was sent, then the message will be delivered to the old location where the shadow Agent was located. In this situation, the shadow Agent will re-transmit the message to the Agent, which in its role will set out the route for the message to continue.

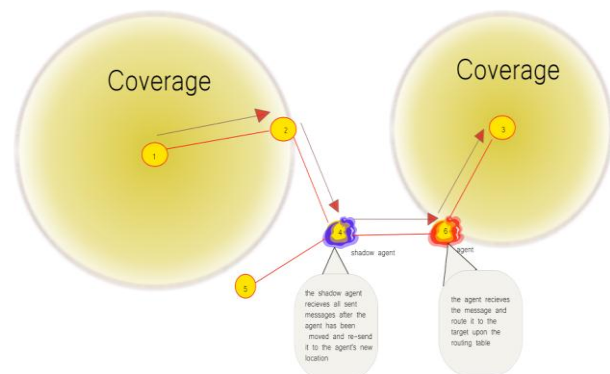

Figure5- Routing using the developed Approach

B- Simulation Model

In our Simulation model, we have used the Network Simulator (NS 2.34), which was under a discrete event simulator that simulates some different (IP's) networks.

1- Simulation Environment

Simulation environment consists of 20 wireless nodes forming an ad-hoc network, moving about over a 500 meter X 500 meter flat space for 200 seconds of simulated time. The output each run of the simulator accepts as input a scenario file that describes the exact motion of each node and the exact sequence of packets originated by each node, together with the exact time at which each change in motion or packet origination is to occur. In order to enable direct, fair comparisons between the protocols, the protocols simulated under identical loads and environmental conditions. We pre-generated number of different scenario files with varying movement patterns and traffic loads. We ran our simulations with movement patterns generated for five different pause times: 0, 50, and 100, 150 and 200 seconds. A pause time of 0 seconds corresponds to continuous motion and a pause time of 200 seconds, (the length of the simulation) corresponds to no motion. Table-1 provides the simulation parameters.

Table1- Simulation Model Parameters

Parameter	Value
Maximum Speed	20 meters/second
Simulation Time	200 seconds
Environment Size	500 meter x 500 meter
Packet Size	512 bytes
Traffic Type	CBR (Constant Bit Rate)
Packet Rate	4 packets/second
Mobility Model	Random Way Point
CBR sources	10

2- Movement Model

Nodes in the simulation model moves according to a Model, which we call it, random waypoint Model. The movement scenario files, we have used for each simulation; characterized by a pause time. Each node begins the simulation by remaining stationary for pause time seconds. Then it selects a random destination in the 500 X 500 meter space and moves to that destination at a speed distributed uniformly between zero and maximum speed. Upon reaching the destination, the node pauses again for pause time seconds, selects another destination, and proceeds there as previously described, repeating this behavior for the duration of the simulation.

3- Performance Metrics

We have chosen the following performance metrics to compare the performance of the routing protocols as defined by the RFC 2501 Mobile Ad-hoc Networking (MANET): Routing Protocol Performance Issues and Evaluation Considerations [9].

- ***Throughput*****:** defined: defined as the total number of packets received by the destination. Throughput is a measure of effectiveness of a protocol.
- ***Packet delivery fraction:*** is the ratio of the data packets delivered to the destination to those generated by the CBR sources.
- ***Packet delivery fraction***: defined as a measure of efficiency of the protocol.
- ***Average end-to-end delay:*** It is the average amount of time taken by the packet to go from source to destination. Delay is an important metric, which is very significant with multimedia and real-time traffic.
- ***Routing overheads:*** defined as the total number of routing packets transmitted during the simulation.
- ***Packets lost:*** It is the measure of number of packets dropped by the routers due to various reasons.

B- *Analysis of Simulation Environments Results*

Our simulation analysis for DSR performance was under noisy, loosely and heavyweight environments with respect to the developed DSR implementation using the Agent based approach. When we have considered the noisy environment, we found that the performance of the Agent based approach was increased. Because of the load on the nodes, where the Agent was located, almost handled and the Agent does not require a lot of changing, or the changes were limited to a small circle which are nearby nodes. That indeed proves the increasing performance of our approach, the implementation of such approach is easy due to the managed changes that may occur in the network load. On the other hand, when considering the heavyweight environment. We found that the load on the nodes forces the change of the Agent placement. The chain of the shadow Agents gets bigger which in its role will decrease the performance of the network. The implementation of such approach is difficult to realize, because of its complex chain of changes, which may occur in the network's agent location selection. In the loosely environment the approach add value to the routing path of a message be maintaining a routing table which can reduce the percent of losing in such an environment the implementation is easy due to fact that the loosing is occurring out of the protocol range. The following figures are comparison results among three environments, the first criteria was the delay time where the heavyweight environment shows a delay percentage higher than the other two environments.

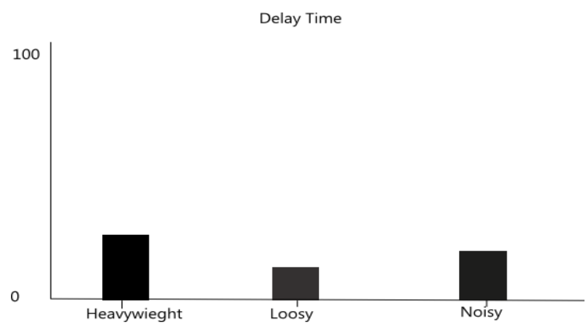

Figure6- Delay time comparison

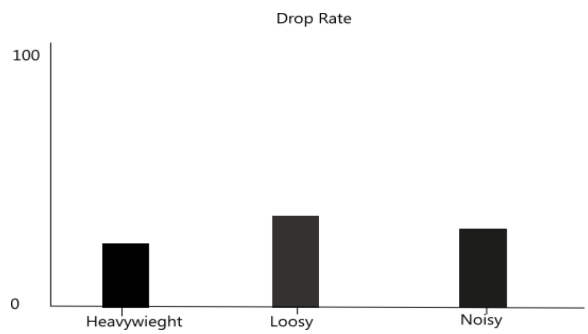

Figure7- Drop Rate comparison

Because the heavy weight environment has many nodes, which in their role forces longer time for the route discovery to which the agent may cause surely more delay. On the other hand the loosely environment shows a high packet drop rate than the other two environments, the following figure8 and figure9 shows a comparison between these environments. When considering the pause time for those mentioned environments, we found that the loosely environment has more pause time average than the other two environments.

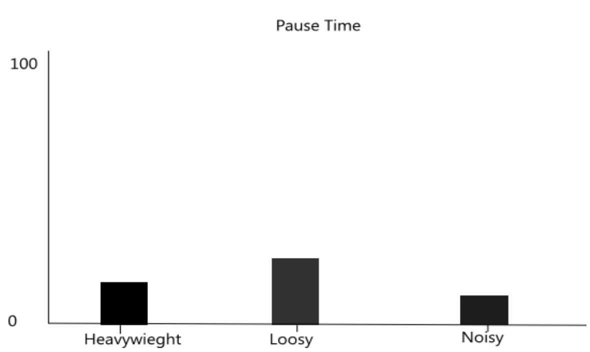

Figure8- Pause-time comparisons

C- *Agent based DSR compared to other protocols*

We have compared DSR with AODV and DSDV protocols from certain points of view, such as the throughput on bit rate, and average delay time vs. speed, routing packet overhead. The following figures shows the comparison among the three protocols according to bit rate on throughput**.** The figure10 shows that the DSR protocol starts with a throughput lower than the AODV and the DSDV then it increases due to the bit rate to a certain limit; after that, it starts to decrease slowly while the other protocols starts with resident throughput then it decrease.

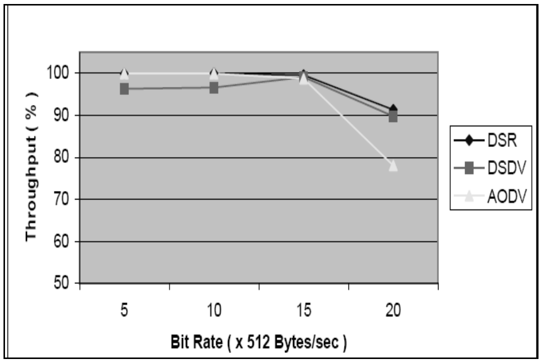

Figure9- Throughput comparison

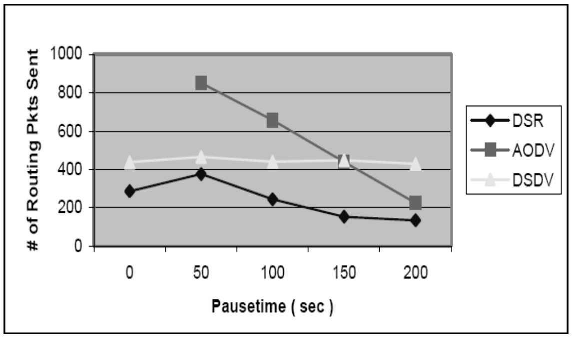

Figure10- Throughput on bit rate

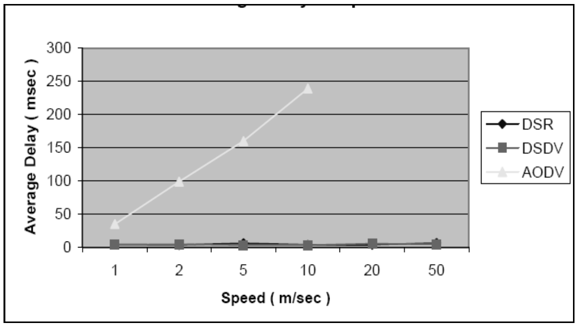

Figure11- Average Delay vs. Speed

Figure11 shows the comparison between the three protocols according to average delay VS speed. Unlike the DSR and the DSDV protocols, the AODV shows a very increasing delay time when the speed increased but in the other protocols, it shows a resident situation even if the speed increased.

Conclusion

We have investigated Dynamic Source Routing performance in noisy, loosely and heavyweight environments for the developed DSR implementation using an Agent based approach. By considering the noisy environment, we found that the performance of the Agent based approach was increased. Because of the load on the node, where the Agent was located, has been almost handled and the Agent did not require a lot of exchange or somehow the changes were limited to a small circle which nearby nodes, which indeed improves the performance of Agent based approach. We compared performance of routing protocols DSR, AODV and DSDV for mobile ad-hoc networks considering UDP as transport protocol and CBR as traffic generator. Our simulations have shown that performance of a routing protocol varies widely across different performance differentials. Results indicate that reactive protocols AODV and DSR performed significantly better than DSDV regardless of the mobility rates and movement speeds. However, we have observed that the overheads of DSR increase with the increase in network size, hence decreasing its performance. We have found that, DSR performs better than AODV for low traffic loads, since it discovers routes more efficiently. Thus, the results of our simulations show that there is a need for developing the routing protocol for Ad-hoc networks. The investigated protocols do not have this advantage of our developed Agent, hence, DSR still used as the base protocol for adhoc routing.

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