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IMPROVED AODV ROUTING PROTOCOL BASED ON THE ENERGY MODEL

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ABSTRACT

The QoS routing generates a significant number of control messages (overhead), which are necessary for the discovery and maintenance of routes. Indeed, the nodes must establish a mechanism to store and update the link-state in a mobile environment. This mobility in ad-hoc environment makes maintaining the link-state very difficult and costly. In addition to node mobility, lack of energy can cause breaks in the established paths, the protocol must be able to react quickly to such event by recalculating valid routes. In this paper we propose a management approach of routing based on one of the largest existing reactive routing protocols which is AODV, and able to minimize routing messages (overhead) in contexts with strong constraints. This approach takes into account a metric based on energy consumption during the route discovery, in order to increase the lifetime of the network, and also allows such applications to consider, when resources are lacking, the maintenance of QoS connections of users with the highest priority. The traditional mechanisms based on AODV aim to use parameters TTL ART,. . . for reduction of routing messages in the phase of route discovery and maintenance phase. However, it is conceivable that in certain application environments do not challenge these parameters for the overhead reduction, and to consider management rested on a policy of distribution of RREQ messages between mobile nodes, based on the energy level residual of each node, which allows more to extend the lifetime of the network for applications sensitive to energy use. This paper is structured in four sections. The first section provides a brief presentation on the reactive protocol AODV. The second section consists of a depth classification of the main algorithms that have influenced us, for reflection on the overhead reduction. As specified by the traditional approaches, we propose a modification of this management and we introduce this modification to the AODV protocol. The third section concerns the presentation of the proposed algorithm. The fourth section lies within the validation of our approach by simulations that we perform in different contexts, then we analyse the consequences of this modification.

Keywords: *Wireless computing; ad hoc; algorithm; routing protocols; validation; simulation*.

1. INTRODUCTION

AODV routing protocol [10] is part of the family reactive; it is of distance vector type. It has two phases: the route discovery and route maintenance, it based on the flooding in the route discovery process, which is detrimental to performance in QoS terms, and for available resources in the network, which suffers from a remarkable limitation. In this algorithm, when a mobile wants to send a packet to a destination, and there is no route in routing table to reach this destination, it broadcasts a type of route request packet called RREQ. This packet is spread by flooding throughout the network. When this packet arrives at the destination, latter sends the source of RREQ a response packet called RREP, this packet, to arrive at the source, passes through the reverse path of the corresponding

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request RREQ, causing the route activation in the intermediate nodes. When the packet arrives at the source of traffic, the data transfer can begin towards the destination. Another type of packet called RERR is used in the route maintenance phase to resolve the problem of node mobility. In [4, 5], we found that there is a mechanism for rebuilding local routes between the intermediate nodes.

2. CLASSIFICATION OF APPROACHES

Given the mobility in ad-hoc networks, the amount of traffic routing, that generates the reactive protocols for establishing and maintaining the routes has negative QoS influences. The reduction of this amount is used to improve performance network where most applications require a certain QoS, and provides an opportunity for information to be circulated despite difficult conditions [4]. Among these protocols, we find AODV that generates a considerable amount of routing traffic to the route discovery phase. Traffic routing is further increased by another additional traffic used for the detection and repair of the route frequently interrupted due to node mobility. In this section, we present the form of a figure and a large table that record the existing algorithms for reduction of traffic routing in AODV protocol. In [11], the reduction of routing traffic based on the phase of route maintenance by the search for stable routes, selecting those that are less congested.

However, the choice of congested routes to transmit data between the source and destination drives the instability of links, which are part of the route found. To do this, a new metric called AIQL was introduced to select a route with the smallest value AIQL. The latter is the sum of IQL for all intermediate nodes to the intermediate node that responds with the packet RREP (or destination).

Approach [3] is based on the parameter ART which defines the duration that the route must remain in the routing table after the last transmission of a packet on that route, and if a route is not used to this time period, the node removes the route in its routing table. This approach has shown the need to think about adapting the ART to network size, and to keep the route as long as possible. Some scenarios have been made in [6], for example, in a network of 10 nodes, the search for a single route between source and destination for data transfer generates at least 6.086 K. The network size and number nodes that communicate with each other are among the increase factors in traffic routing, the effect of these factors [6] is justified in a scenario for different numbers of nodes (10,20 and 30), and that by increasing the nodes number that communicate with each other. The VON algorithm [8] relies on speed to remove the nodes of high mobility, in order to reject the RREQ. More than the speed of nodes, another algorithm called EVON [7] allows a node , that becomes overloaded, the dissemination of RREQ after a timeout in order to search for roads consisting of nodes less mobile and less overloaded.

Therefore, it allows a more stable construction of routes, and prevents further spread of control messages to establish new path if necessary and keep them, which causes a delay to the source in seeking the destination. This improvement of VON shows that with less control messages a path may be established between the source and destination with a shorter deadline.

In [12], the proposed solution is the integration of routing by the source in AODV protocol in order to allow the accumulation of paths at the nodes during route discovery. To do this each node adds its own address to the RREQ and RREP packets as they go through, and updates its routing table with all the information contained in these packets and adds a reverse route to each node whose address is inserted in RREQ. Progressive research [9] is a proposed approach to reducing traffic routing; the source uses the TTL parameter of the IP header as the number of hops of RREQ. In the first broadcast of the RREQ source node, the initial value of TTL is TTL_START. If it receives the RREP packet before the expiration of a waiting time, called RREP_WAIT_TIMEOUT, then the route discovery process is completed successfully. Otherwise, the source node rebroadcasts the RREQ by incrementing the TTL of a TTL_INCREMENT, and the waiting time is larger than RREP_WAIT_TIMOUT. If no response is received by the source node, it increments the TTL_INCREMENT and waits the RREP packet. After a maximum number of attempts RREQ_RETRIES, in case there is no answer, the phase of route discovery stops.

During the discovery process, the nodes try to find a path with the smallest number of hops as the optimal route. However, this route is not always reliable, because the distance between two adjacent nodes can be larger, and therefore,

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the route becomes brittle found to node mobility [5]. For example, suppose a node S wants to establish a route to a destination D, it sends the RREQ to neighbor V, so V must register a path r_VS to S, suppose that S is in the tip of the scope of V, and the latter is in the end of the range of S, then a sample movement of S or V in the opposite direction causes a breakdown of r_VS. To resolve this problem, an algorithm called OAODV is proposed in [10], which allows V to not broadcast the RREQ since the r_VS path is cut. The decision not to broadcast the RREQ message is based on a distance calculated by the algorithm OAODV, and the distance between S and V, and the distance between their new positions v' and s' of V and S respectively.

In [2], the parameter LIFTIME is used to prevent the retransmission of packets, which are useless in the phase of route discovery. The reduction of this phase is performed in the approach [1] by limiting the number of routes; this limitation is the restriction of RREQ packets to disseminate. Therefore, if a node behaves as the source, it generates and sends the RREQ packet. Otherwise, it is not allowed to send this packet to all its neighbors, it is necessary that the number of RREQ to disseminate is less than or equal to a predefined number in the algorithm [3], and therefore the number of neighbors receiving the RREQ is strictly limited. This restriction is based on the distance between nodes. If a neighbor receives the RREQ packet, it broadcasts it to neighbors called priorities that are situated in an area bounded by a distance called r_th and radio transmission range of node R (r_th <R). Relative neighbors, who were between the node location and the r_th, do not receive the RREQ, except in one particular case where the number of RREQ is broadcast to more than the number of priority neighbors. The results obtained in [3] show that this approach also allows to find the routes consisting of nodes that are connected for a long time.

3. PRESENTATION OF OUR ALGORITHM AODV-ROE

We have presented in the previous section some existing approaches, to reduce the number of control packets in the AODV routing protocol. In this section, we present a new approach AODV-ROE (AODV Reduction Overhead and Energy), whose routing metric is based on the consumption of energy to reduce the number of control messages needed to discover and maintain a route. This new protocol has the main objective to ensure that network connectivity is maintained as long as possible, and that the energy level of the entire network is similar. We have grouped these two goals in the deployment of several scenarios ad-hoc. The AODV-ROE routing protocol is a reactive protocol, it is based on one of the most important current routing protocols which is AODV. One of the major problems of the routes in an ad-hoc network is operating their energy for routing need, knowing that the nodes based on their batteries and thus a reduced autonomy of energy, which is too limited in this type of network. Therefore, our goal is that, medium or low consumers are not too disadvantaged in terms of energy when selecting a route. In other words, the goal is to reduce as possible the energy problem and reducing the overload in the network.

We present in this section the AODV-ROE in order to reduce the number of control messages and to balance energy consumption among all nodes in the network. In search of a route, each node uses local information about the level of its own energy to decide whether to participate in the process of path selection. We use a mechanism based on the thresholds that allows a node to conserve energy hungry by refusing to relay RREQ packets according to its energy level.

The originality of our approach lies in the fact of using just the phase discovery of the highway to reduce the overhead, and that decision making in AODV-ROE is distributed on all nodes, and requires no global information on the network.

In the AODV protocol [1], the mobile node did not have much choice, and is obliged to relay RREQ packets for other nodes. The basic idea of the protocol AODV-ROE is to enable each mobile node to participate in an intelligent process for selecting a route between a source and destination, and relay RREQ packets on behalf of other nodes. Each node determines from its residual energy Er, a decision based on three levels, the first level is a permanent level characterized by an energy value exceeds a certain threshold v_2; this level node will accept and then relay the request packet RREQ. The second level is a level characterized by a probability value between two thresholds v_1 and v_2, i.e v_1 <Er <v_2, at this level, the node will transmit the request packet RREQ to all neighbors nodes, but with a

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probability P, operating under the context of use. If this value is lower than (Er <= v_1), the package of RREQ is simply rejected.

Routing policy followed by our approach AODV-ROE allows each destination to receive a request packet only when all intermediate nodes along the route have good levels of energy, and consequently, the first message received by the destination is considered taking a route reasonably powerful, and essentially with an energy sufficient enough, which makes the routes for the reliable transfer of data between sources and destinations

4. PERFORMANCE STUDY

In order to demonstrate the algorithm performance AODV-ROE and view its improvements over other protocols, we first implemented, and integrated AODV-ROE to the source code of the simulator ns-2 (version ns-2.34), using a set of programming languages with this interactive calculator. Then we perform the following routing scenarios with strong constraints in order to verify a priori that the algorithm AODV-ROE operates according to its specification, and show its contribution in terms of performance metrics below.

4.1 The performance metrics studied

In this scenario, it is also assumed that 50 mobile nodes moving on a surface 600m x 800m. The transmission range of 250 m is assumed, with the rate Data transmission is 2Mbit/s, each simulation was run for 1000 seconds. The source nodes Constant Bit Rate (CBR) UDP traffic with transmit a transmission rate equal to 4 packets per second, and the data length payload of each packet is 512 bytes. The mobile nodes are assumed to move randomly according to the random waypoint modality model [6], with two parameters: the maximum speed and node pause time determine the mobility model.

Each node starts its movement from a position chosen randomly and it moves toward a target location, which is also chosen randomly in the field of simulation, with a rate as random (uniformly distributed between 0 m / s and maximum speed). The maximum speed is 60 m / s. When a node reaches target location, it remains there for a time (pause time), that period shall be 30 seconds in our simulation, then the node repeats the same procedure with further displacement.

4.2 Analysis of results

In this section, the simulation results of AODV-ROE are discussed and compared with conventional reactive protocol AODV, DSR and DSDV proactive protocol regarding the performance metrics outlined above. We present in what follows, simulation results of scenario 2 and their interpretations.

- Packet Delivery Fraction (PDF):

Figure. 1 and Figure. 2 show the rate packets delivered to the protocols AODV, DSDV and AODV-ROE. Comparing with AODV which represent the reactive case and protocol DSDV which represents the proactive case, our proposal AODV-ROE represent a better rate of packets issued.

The measurements showed that the rate of packets delivery when using of AODV-ROE is large compared to the rate of that of AODV and DSDV. Indeed, we note that the curve of AODV-ROE is above the other curves. For our algorithm this rate is high, then the rate of packets loss is low and consequently AODV-ROE provides valid routes between sources and destinations.

In addition, a high density, we note that the delivery rate of AODV-ROE is higher for a low or average charge. At high load, this rate is 70% for 50 CBR connections, and high speed, the rate of PDF is 97% for 60 m / s. We explain this by a diffusion Intelligent performed by AODV-ROE, to build more route reliable. This construction roads strategy increases the likelihood of having paths formed by nodes with a value of very high energy especially high density of nodes, high load.

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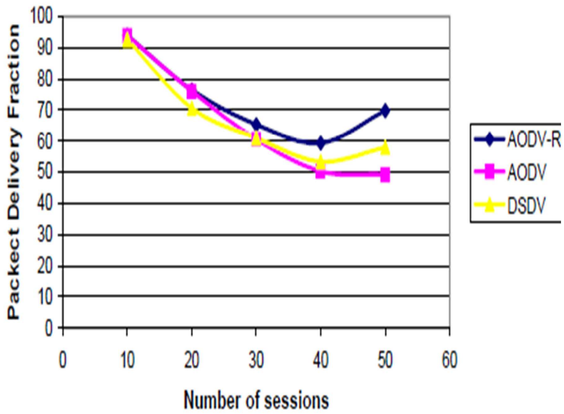

Figure 1: Packet Delivery Fraction Vs Number of Sessions

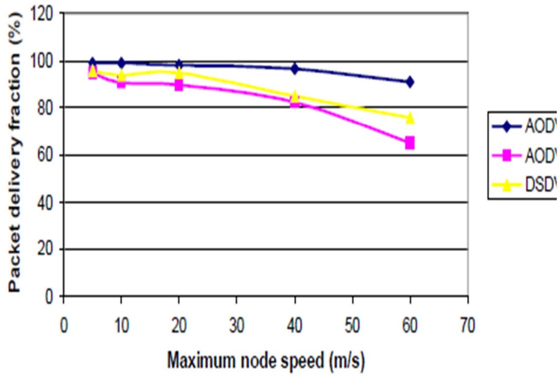

Figure 2. Packet Delivery Fraction Vs Maximum node speed

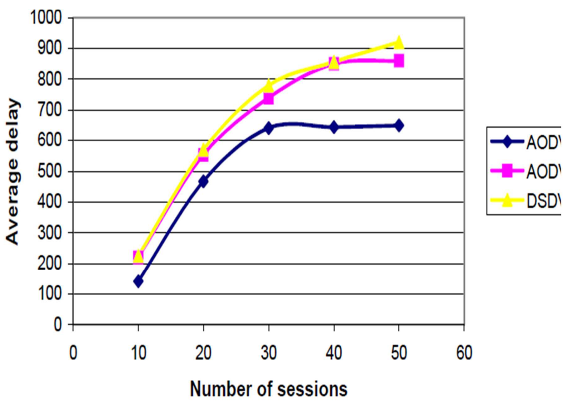

Figure 3. Average delay Vs Number of sessions

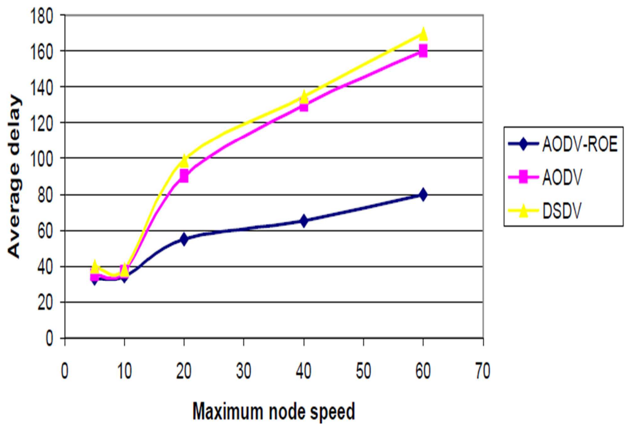

Figure 4. Average Vs Maximum node speed

- Routing Overhead:

To find a route, the routing algorithm, during the process of discovery / maintenance of routes spreads more control packets in the network. To measure this signaling overhead, we calculated the ratio between the amount of packets control (in bytes) and the amount of data packets (in bytes) transmitted in the network during the simulation time. We can notice in Figure.6, the overload values according to the modes speed in the network. The difference between our algorithm AODV-ROE and other routing algorithms nodes speed. This is due to the fact that more mechanisms introduced in our algorithm to maintain the paths, compounded by the fact that the roads become more valid with greater speeds in standard protocols, on the contrary, in our algorithm AODV-ROE, roads are not increasing with the sensitive to node mobility. The algorithm AODV-ROE was tested for the case of high mobility. Because, in every node moving, the algorithm re-initializes its routing table and therefore it starts again learning a new table that risks to be re-initialized if another node also moves. Recall that for zero mobility, algorithm AODV-ROE gives the best performance in terms of overload than all other algorithms. Unfortunately, because of cited elements above.

The algorithms compared with AODV-ROE remain inadequate for ad hoc networks of high mobility. A slight degradation of the routing overhead for AODV protocol over to AODV-ROE is shown in Figure.5. However we note that AODV-ROE performs better than AODV and DSDV, because AODV-

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ROE select stable paths with optimal bandwidth, this is confirmed by the improvement the packet delivery fraction.

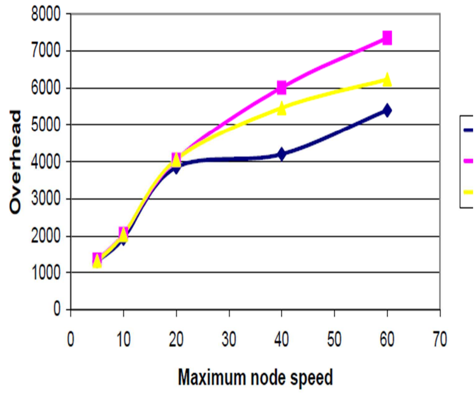

Figure. 5. Overhead Vs Maximum node speed

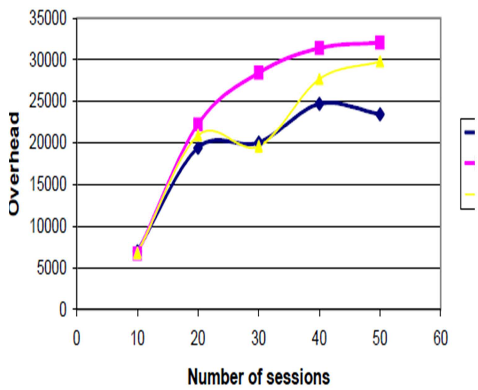

Figure. 6. Overhead Vs number of sessions

5. CONCLUSION

In this paper we have been able to ascertain, through a set of experimental results in the presence of our algorithm AODV-ROE, that the choice of routing protocol actually affects the rate of energy consumption in ad-hoc networks and the amount of control messages necessary for the discovery and maintenance of roads. We have seen that in this context, reactive protocols outperform proactive protocols. Moreover, we note that these protocols (DSR, AODV, OLSR) and all other standard protocols in the MANET group the IETF, are interested only in discovering the shortest path in the process of road discovery. However, a routing metric based on the consumption of energy can be more effective, which we have achieved with our proposed AODV-ROE, while reducing the number of control messages in different possible contexts, and results show that our approach is quite advantageous over other standards.

Finally, tests performed in this chapter to verify the proper functioning of the modified protocol AODV-ROE and parameters of the simulations, were used to confront the reality of two different scenarios assumed by the theory in settings with high constraints (high load: number of CBR connections and high mobility: increased rate of knots up to 60 m/s), and discover some problems that can be more complex to solve in practice related to current requirements, and necessary for the user in terms of quality of service. This leads us to think further of exploiting these results to improve service quality in other types of environments, taking into account other constraints. The next chapter presents a new analytical approach for mastering of service quality at the transport level, based on the calculation of two performance parameters that allow a source to guess TCP congestion control and a high load environment.

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