DYNAMIC NODE MOVEMENT CONTROL IN A MOBILE MEDIUM AD HOC NETWORK

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INTRODUCTION

A Mobile Ad-hoc Network (MANET), is an IEEE 802.11 framework, which is defined as a set of self-organizing mobile nodes. These nodes, communicate randomly with each other to provide a network with no fixed infrastructure or a central node to control. In MANET, nodes are moving randomly, and they are free to join or leave the network at any time. This random movements for the nodes leads to unpredictable topology changing in the network and cause connection loss rapidly[1][2].

A Mobile Medium Ad Hoc Network (M2ANET) proposed in [3], is a particular configuration of a typical MANET where all mobile nodes are divided into two categories: (i) the forwarding only nodes (shown in black in Fig. 1) forming the so called Mobile Medium, and (ii) the communicating nodes (shown in red in Fig. 1), mobile or otherwise, that send data and use this Mobile Medium for communication.

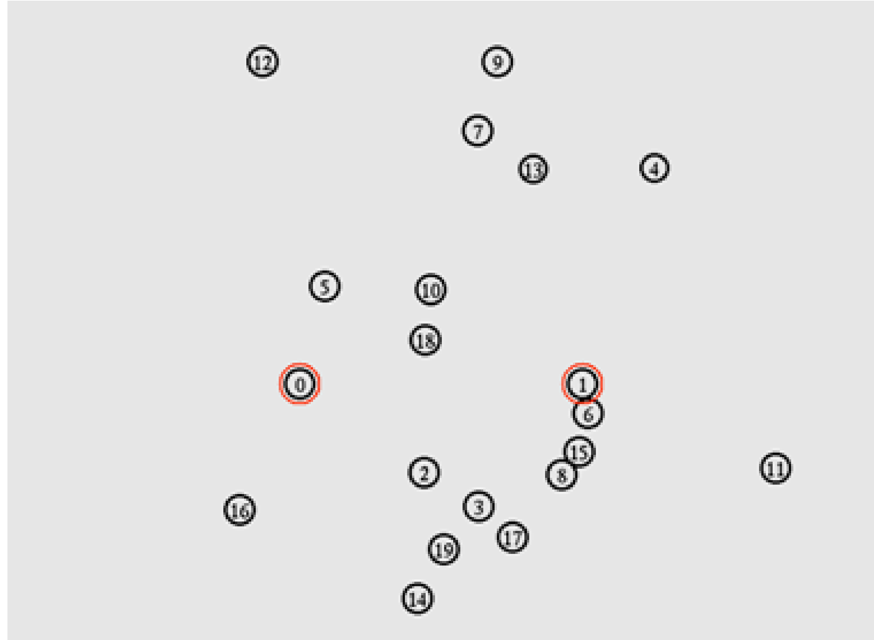

Figure 1 .ns2 simulation screen of a M2ANET

DYNAMIC MOVEMENT CONTROL IN MOBILE MEDIUM

The Dynamic Movement Control in Mobile Medium[4], is an attempt aimed at reducing the (number of) changes in the routing path during the data transfer between tow mobile nodes. Normally, the nodes move in random directions and at random speeds independent of whether they are forwarding packets or not. In the proposed Dynamic Movement Control for the Mobile Medium, the nodes that forward data are slowed down.

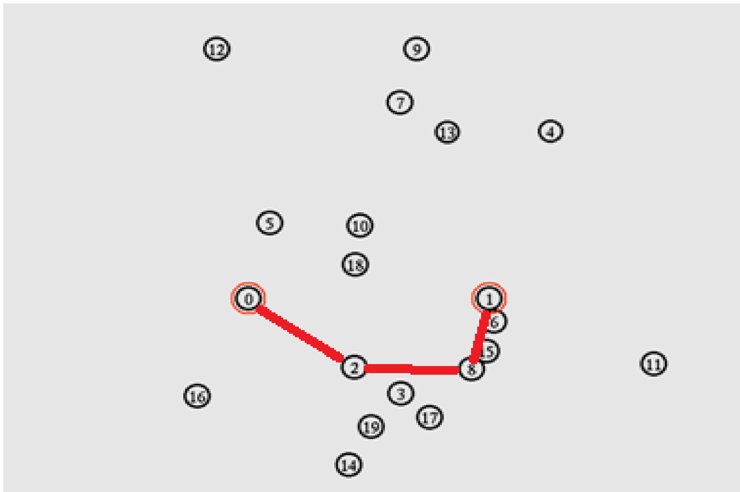

Figure 2 .Nodes on the forwarding path

Note that this decision to slow down does not require any global information or location data; it is solely based on the forwarding status of the node. In the ns2 simulation we used the actual path determined by the simulator to determine which nodes are in the forwarding state, Fig 2.

SIMULATION EXPERIMENT

A set of simulation experiments was conducted to evaluate the proposed Dynamic Movement Control for the Mobile Medium networks. Each simulation of a network consists of a different number of nodes roaming (RWP movement, average speed 4 m/s) in a square 1000 x 1000 meters. The node transmission range is 250m. The link data rate is 1 Mbps. Every packet has a size of 512 bytes. The buffer size at each node is 50 packets. Data packets are generated following a Constant Bit Rate (CBR) process [5]. The source and destination nodes are stationary and located at coordinates (50, 400) and (950, 600).

AODV PERFORMANCE

Reducing the speed of the forwarding nodes running the AODV routing protocol results in an improved delivery ratio for all but the very low node density (5 nodes over 1000x1000m region) scenario, Fig 3. The networks with a very few nodes in the Mobile Medium, i.e. with 5 and 10 nodes, as expected show very low delivery ratio. Under normal operating conditions for the Mobile Medium, with 20 or more mobile forwarding nodes, the performance improves gradually. Networks with a large number of nodes, more than 30 in a 1000x1000m area, as expected work well at any node speed with delivery ration ranging from 75% to almost 100%. The most interesting case is the network with a moderate number of nodes, 20 nodes over the area 1000x1000m. This scenario demonstrates best the benefits of the Dynamic Movement Control for Mobile Medium networks. In this scenario the delivery ration is very low 30% for nodes moving at the original speeds, but the performance improves significantly to 85% when the speed is reduced to 10% of the original speed.

DSDV PERFORMANCE

DSDV performance improvement is similar to AODV: low improvements at low node densities (5 to 10 nodes) and a gradual improvement with the reduction of the speed of the forwarding nodes at higher node densities, Fig. 4 and 5. In our experiments the overall delivery ratio is lower for DSDV than for AODV.

This is a common situation for the DSDV protocol when used in the ad hoc networks with a dynamically changing topology [6] and can be attributed to the proactive nature of the DSDV protocol where distributing the routing information to all the nodes and detecting a valid route can take a considerable time.

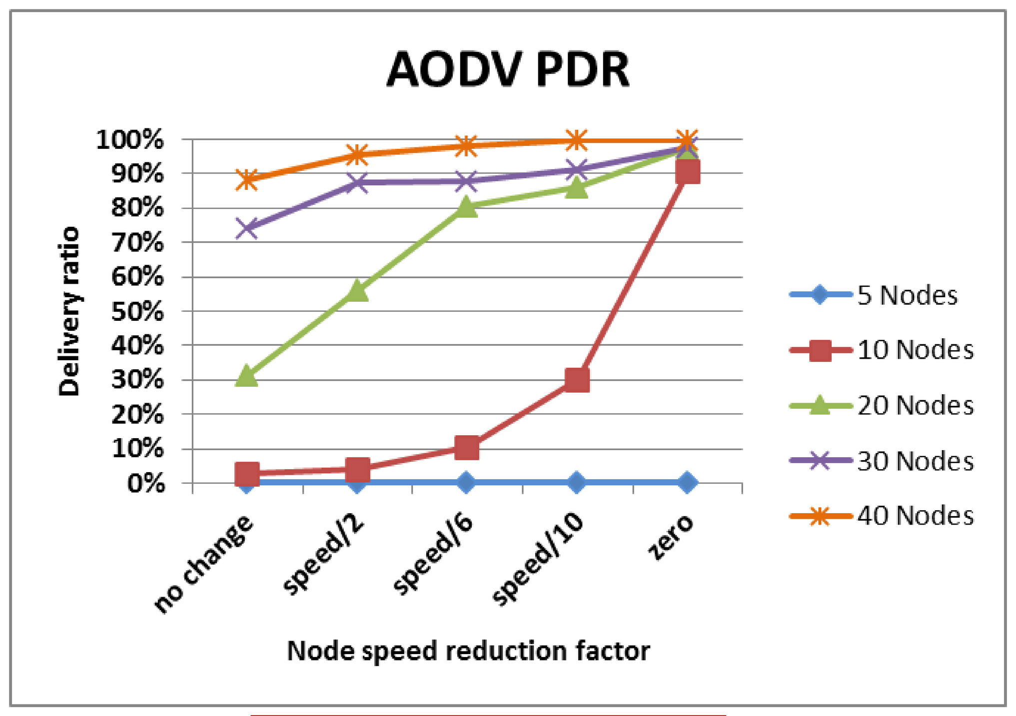

Figure 3. AODV delivery ratio

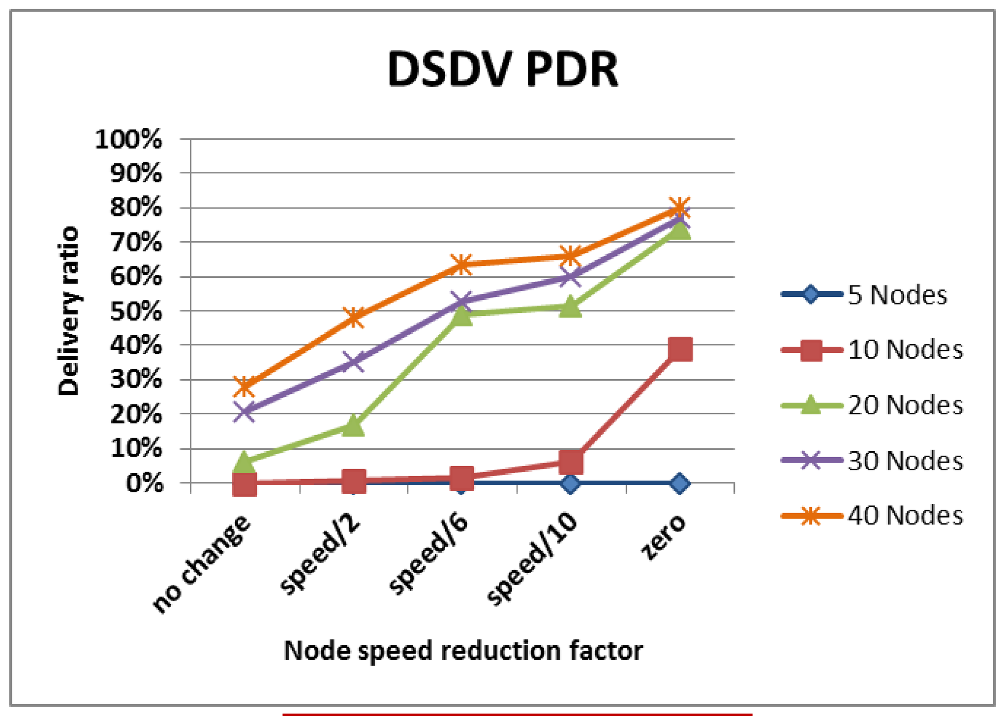

Figure 4. DSDV delivery ratio

In our experiments no routes were detected in networks with 5 nodes and it took approximately 80 seconds to detect the first route in the networks with 20 or more nodes running DSDV, which is considerably slower than the path detection delay observed for the AODV protocol, Fig. 5.

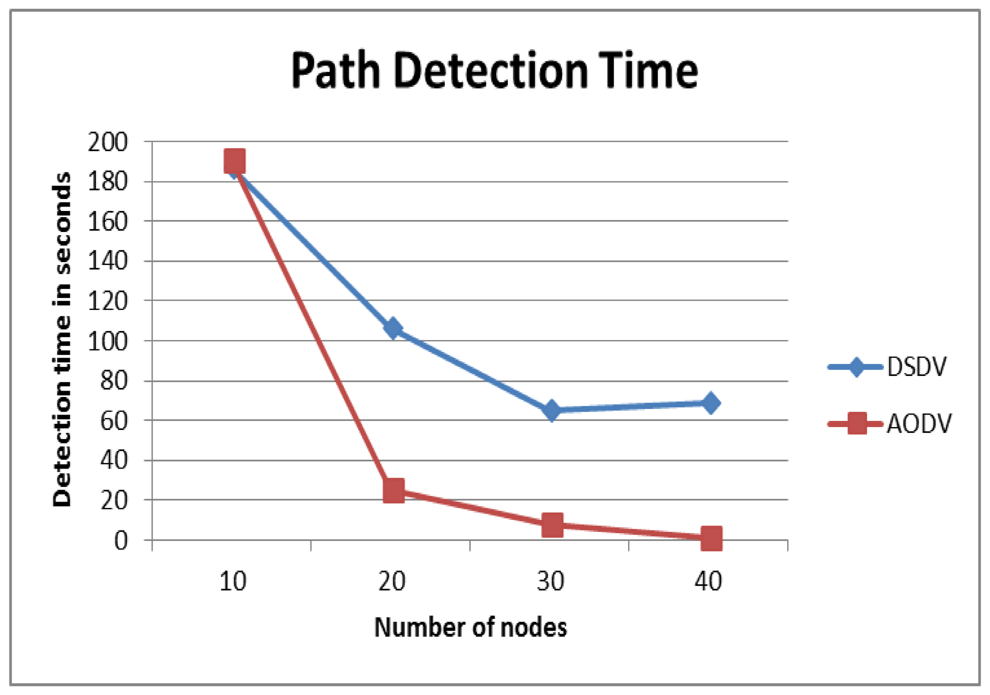

Figure 5. DSDV time to detect the first path.

CONCLUSION AND FUTURE WORK

The new mobility control mechanism is based on slowing down the nodes that are on the forwarding path for a flow.

The performance increased significantly with the lowering of the speed of the nodes actively forwarding the data, with a higher relative improvement for the networks with moderate node densities. The improvements were observed in the networks running two different routing protocols AODV and DSDV.

Next step in this research, is to adapt the Ant Colony Optimization (ACO) algorithm and modify it to control the mobile nodes random movements in the network using the two routing protocols AODV and DSDV. Then we plan to compare the new results with the result we have from the dynamic movement control in mobile medium.

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