Georgia Institute of Technology

ECE 6110 : CAD for Communication Networks

Project 3: Measuring Wireless Throughput Capacity

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Introduction

In this project, we simulate a wireless Ad-Hoc network in ns-3 using AODV and OSLR routing protocols. The aim of the project is to observe the efficiency of the system while varying the parameters like the number of nodes in the system, the transmission power and the traffic intensity. For simulation purpose, the wireless LAN is created in a 1000m by 1000m area.

Experimental Setup

The wireless LAN is set up in an area of 1000m by 1000m. The number of nodes, transmission power, traffic intensity and the routing protocols are inputs to the program. The nodes as per the input provided are placed in the wireless area at random positions. Each node then chooses a random peer to transmit its packets to. The data rate for transmission is dependent on the traffic intensity of the system. The efficiency of the system is calculated at the end of each run which is the ratio of total received packets in the system divided by the total packets transmitted by all the nodes.

Experiments were run to observe the behaviour of the system, in terms of the efficiency, by varying the different parameters for both the protocols.

To Run the Simulation:

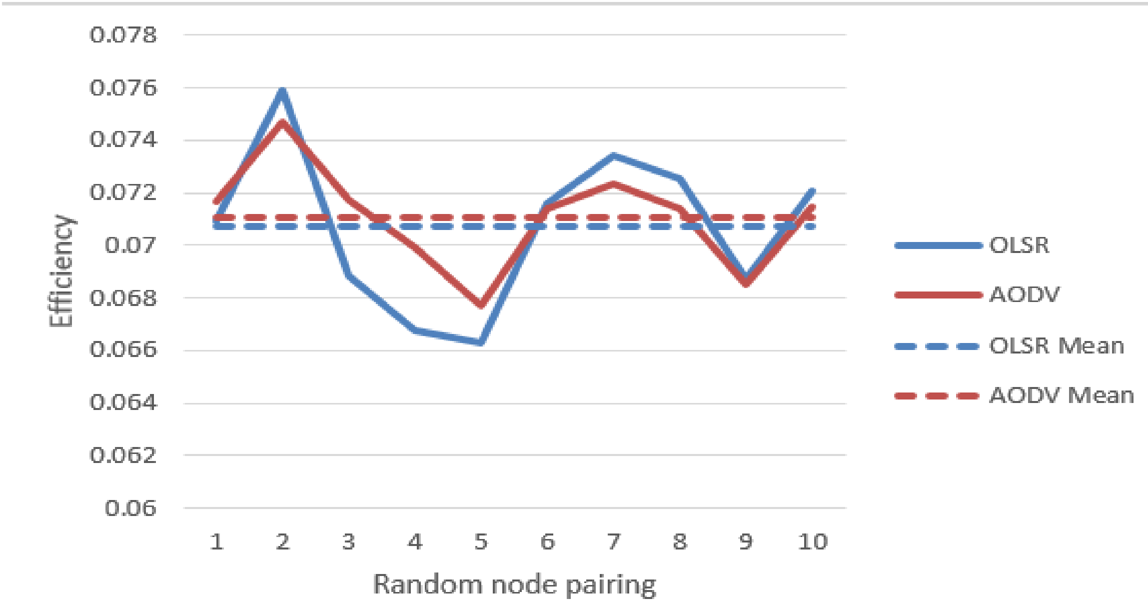
The following command in the terminal can be used to run the simulations:

./waf --run "p3 --nodeCount=50 --intensity=0.1 –transmitPower=100"

The above command would run the program with 50 nodes, with an traffic intensity of 0.1 and transmission power of 100mW. We ran our simulations for 10, 20,30, 40, 50 and 100 nodes. Intensities varying from 0.1 to 0.9 and Power varying from 100mW to 1000mW.

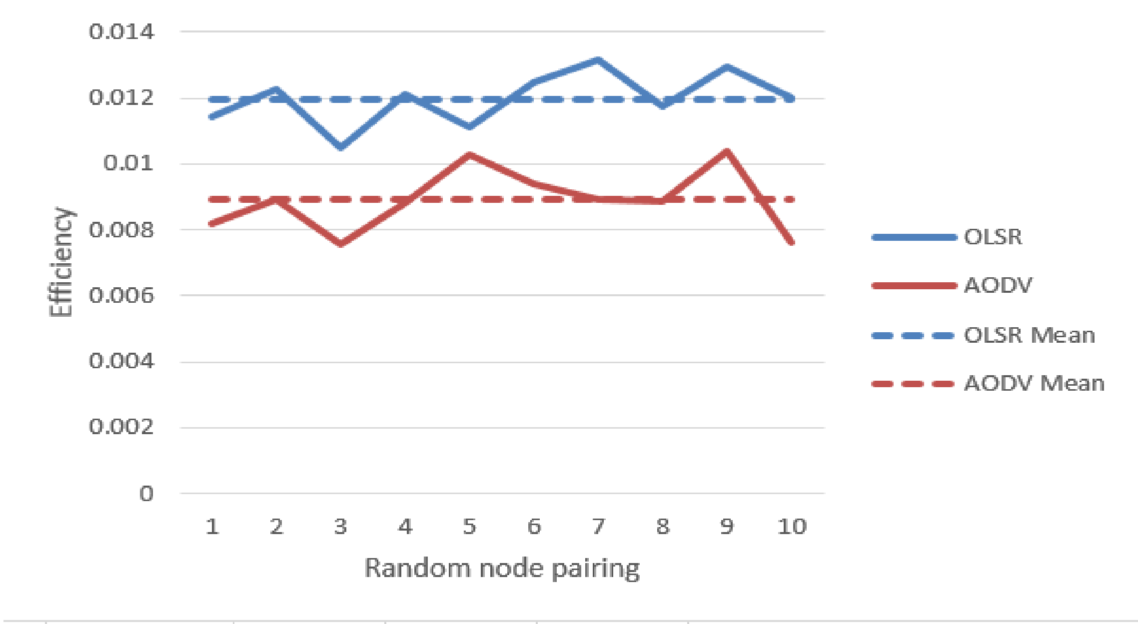
Results and Observations

When setting up the randomly paired nodes we utilized the pseudo-random number generator present in the C library (rand()). Due to which the same set of nodes are paired for each execution cycle. This is detrimental for an analysis of wireless networks as it would not simulate a realistic wireless environment as each fixed node pair would imitate a LAN network with fixed bandwidth taking into account transmission/propagation loss.
Therefore to gain a better understanding of the wireless environment we first setup the simulation with fixed values of Intensity (0.5) and Power (100mW) with node count of 10 and 50 but varying node pairs. This was done to visualize how different node pairings within the same environment affects the transmission efficiency. The variations in efficiency for 10 different node pairings can be observed as follows. In the following figures the X-axis represents the various pairings used (represented as a numerical counter).



N=10, I=0.5 P=100mW

In the above figure significant variations in the network efficiency can be observed. This can be accounted for if we take into consideration the area size, the small number of nodes and their transmission power, i.e. if the distance between two adjacent pair of nodes is significantly large it can result in reception of inaccurate data packets and the loss of a significant number of packets.



N=50 I=0.5 P=100mW

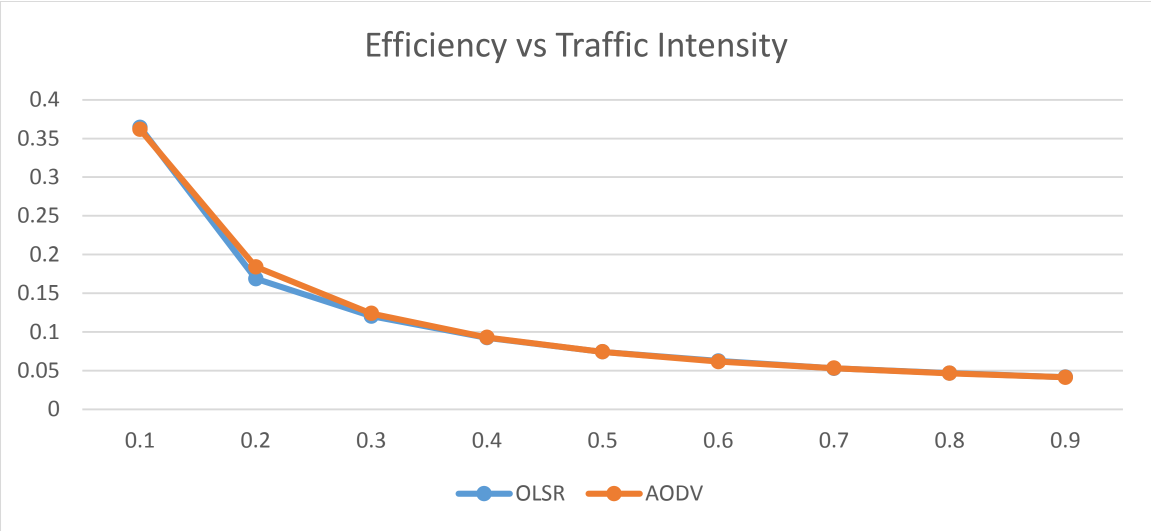
In the above figure even though the number of nodes has increased we observe a significant increase in the network efficiency. This is because, due to the increase in the number of nodes the chances of reception of inaccurate data packets due to transmission/propagation loss has been significantly reduced, also the loss in packets due to transmission distance or weak transmission power is also negligible resulting in a far superior network performance.

Due to the variations in efficiency we cannot always randomly select node pairs as it might lead to faulty data and inconclusive results. Therefore for all future simulations we utilize only fixed node pairs (the initial pairing is random) so as to minimize observable inconsistencies arising due to dynamic node pairing.

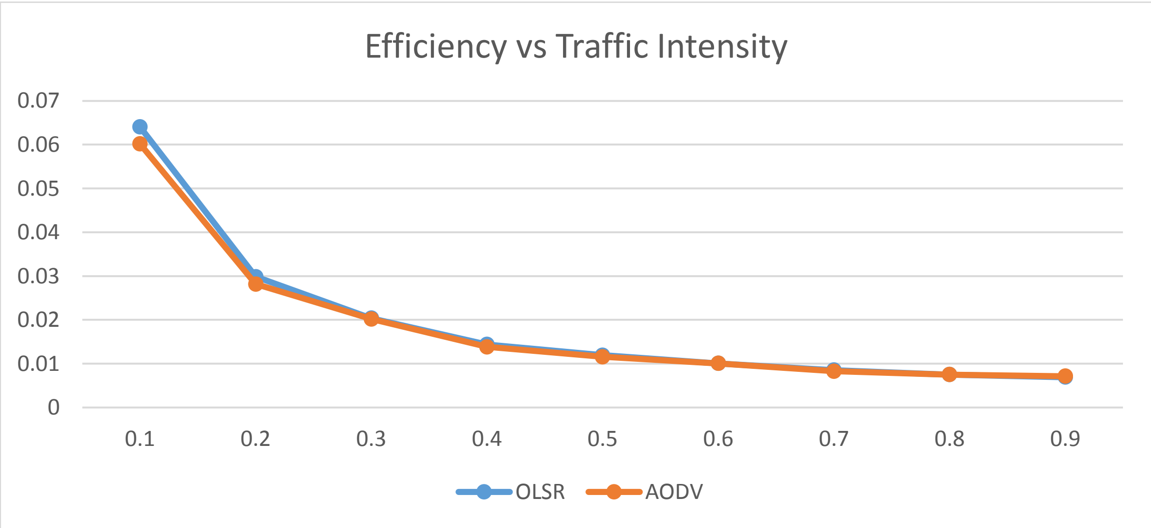
Efficiency vs Traffic Intensity

When we increase the traffic intensity, the data Rate of the system keeps increasing. This would mean that more number of packets would be transmitted during the simulation. Since more packets are transmitted, the probability that there might be collisions and hence packet drops due to noise is higher. Thus, the general trend is that with increasing intensity the efficiency of the system keeps reducing.
Also, we can observe from the graphs that the performance of both OLSR and AODV protocols yield almost the same efficiency, although OLSR outperforms AODV in most cases.

Input conditions considered: Nodes = 10, Power = 1000mW, Intensity varying from 0.1 to 0.9



Input conditions considered: Nodes = 50, Power = 1000mW, Intensity varying from 0.1 to 0.9

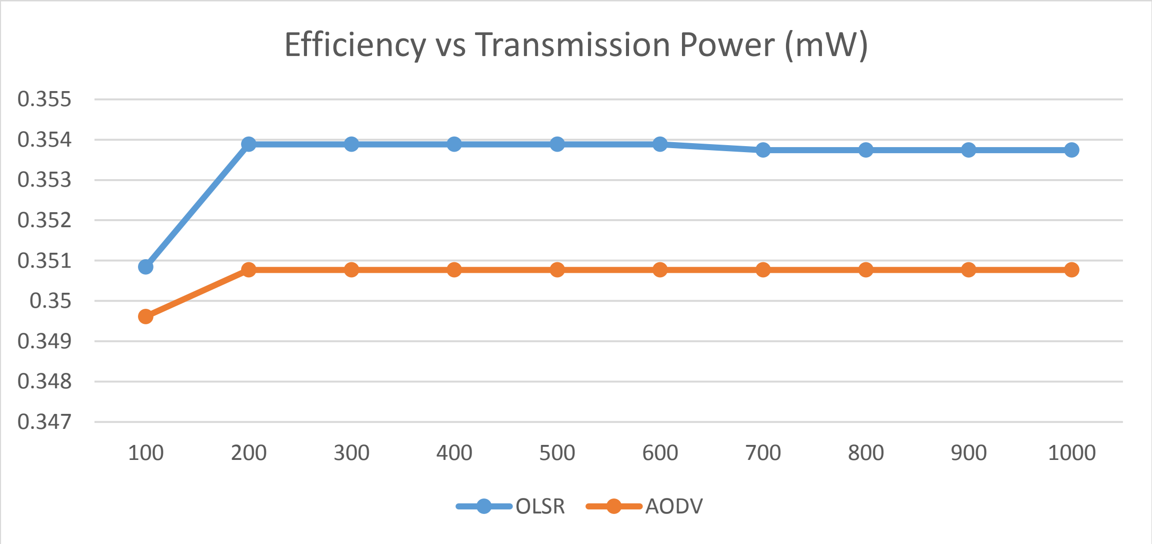


Efficiency vs Transmission Power

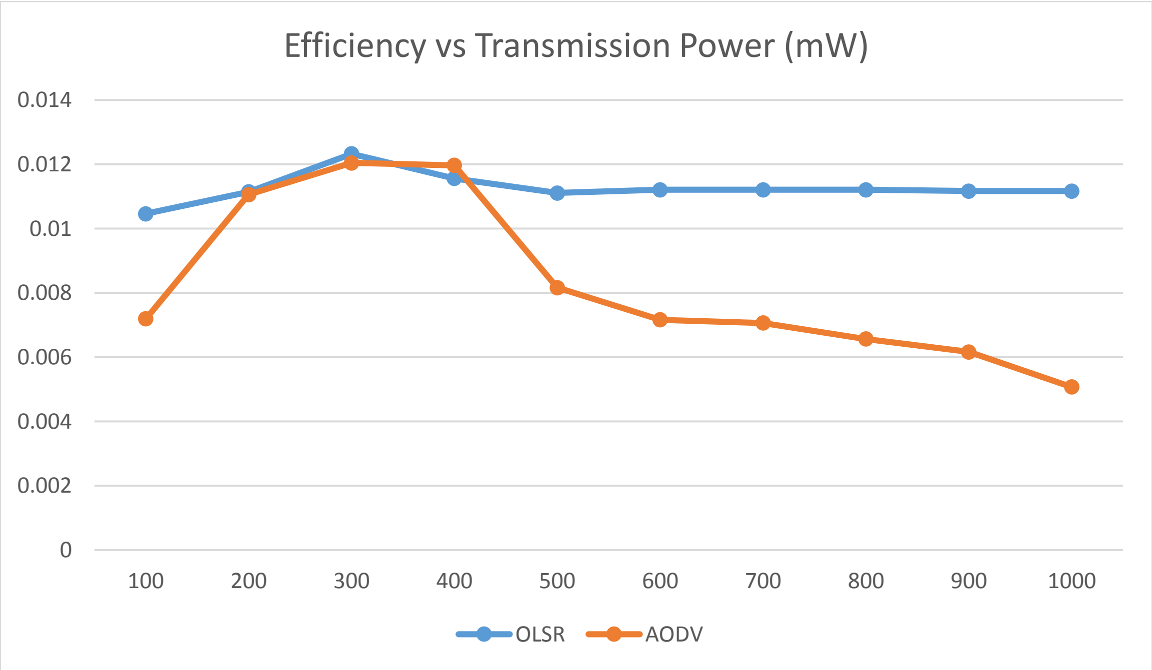
With increase in transmission power, the transmitted data can cover more distance before they are dropped. And thus, the efficiency should show some improvement when we increase the transmission power. This is seen in the simulation results, although the output seems to be almost constant after a certain point. We can also see that for higher number of nodes, the efficiency also might reduce, this might be because of increase in the probability of collisions.

We can see from the simulation results that OLSR marginally outperforms AODV.

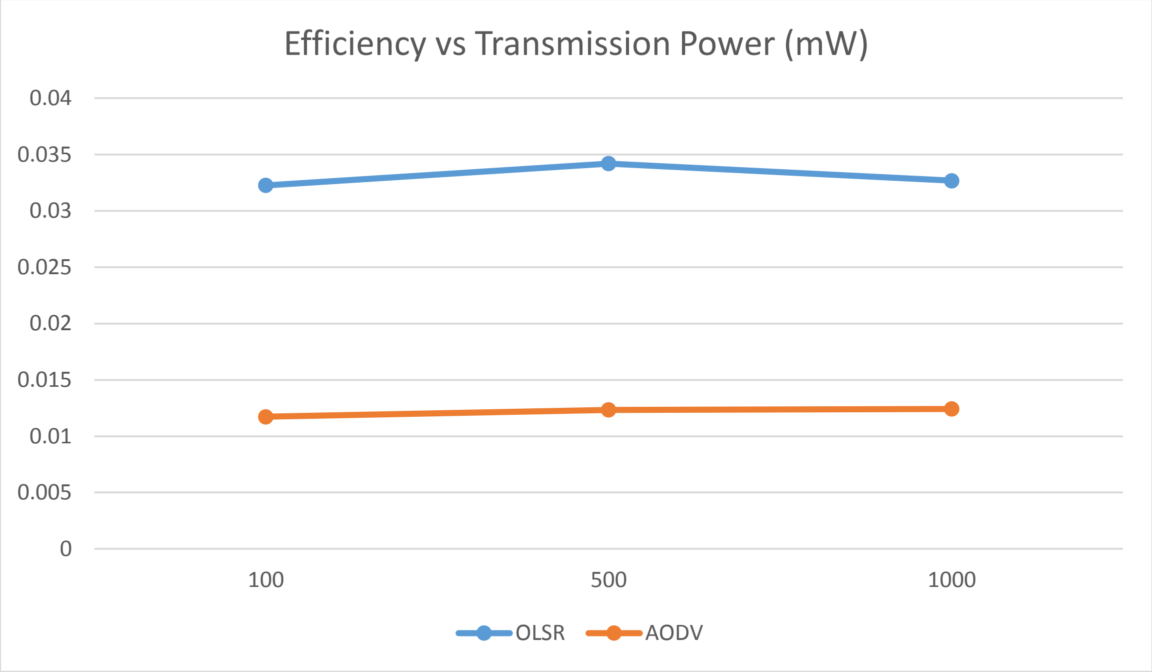
Input conditions considered: Nodes = 10, Intensity = 0.1 Transmission power varying from 100mW to 1000mW



Input conditions considered: Nodes = 50, Intensity = 0.5 Transmission power varying from 100mW to 1000mW



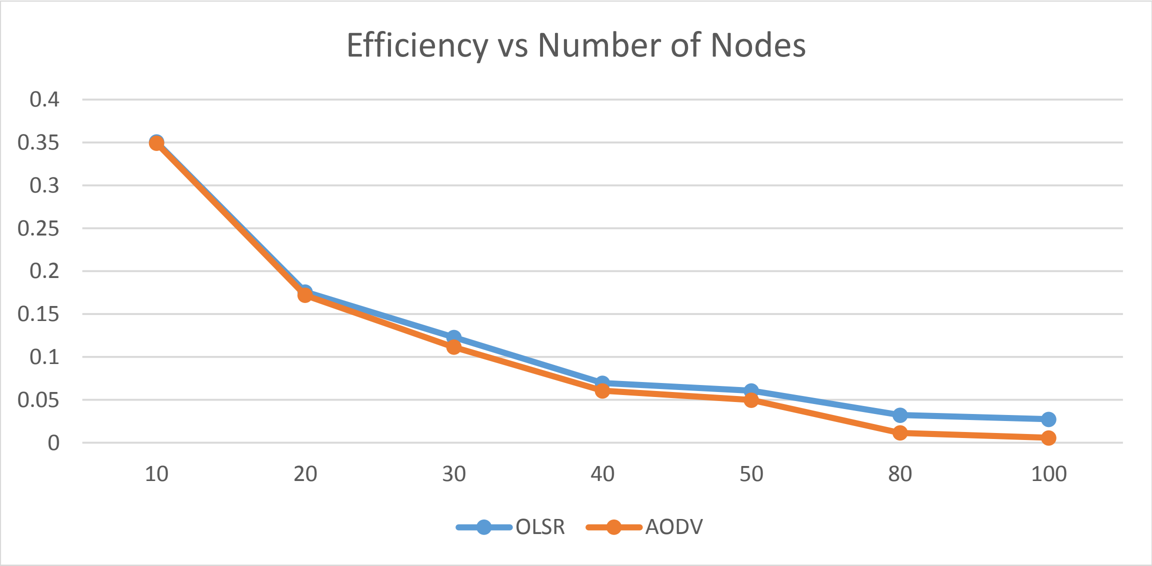
Input conditions considered: Nodes = 80, Intensity = 0.1 Transmission power varying as 100mW, 500mW and 1000mW



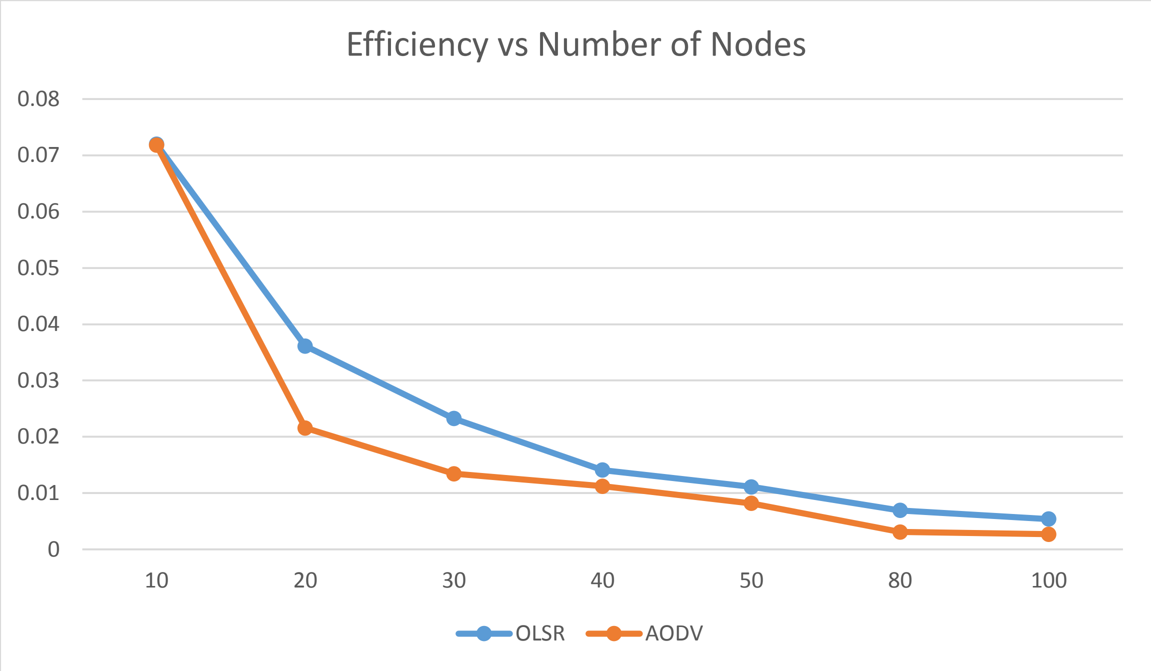
<u>Efficiency vs Number of Nodes:</u>

Increasing the number of nodes in the system, reduces the efficiency of the system exponentially. This is expected, because higher the number of nodes in the system, higher would be the number of transmissions going on in the system and thereby the chances of collisions is also higher.
We can see from the simulations that OLSR outperforms AODV in most cases.

Input conditions considered: Intensity = 0.1 Transmission power=100mW, Number of Nodes varying from 10 to 100



Input conditions considered: Intensity = 0.5 Transmission power=500mW, Number of Nodes varying from 10 to 100



Conclusion

Through our observations and analysis we can conclude that OLSR performance is equivalent to and in some cases better than AODV. Though the results are obtained by running simulations on fixed node pairing (initial pair selection is random) (limitation of pseudo random number generator), we can say that even for a truly random pair selection, the overall results will be as we have observed thus far.