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An Analysis and Performance Evaluation of KMPR selection in OLSR and AODV Protocols in a VANET network using NS-2

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Abstract: Recent advances in wireless technologies have given rise to the emergence of vehicular ad hoc networks (VANETs). In such networks, the limited coverage of Wi-Fi and the high mobility of the nodes generate frequent topology changes and network fragmentations. Vehicular Ad-hoc Networks (VANETs) are a special type of Ad-hoc networks. They can be utilized to guarantee road safety, to avoid potential accidents and make new forms of inter-vehicle communications so they will be an important part of the future Intelligent Transportation Systems (ITS).To enhance the safety of drivers and to provide the comfortable driving environment, messages decoding for KMPR (Kinetic Multipoint Relay) selection in OLSR (optimized link state routing) and AODV (ad-hoc on demand distance vector) Protocols in a VANET network using NS-2. As MPR (Multipoint Relay) selection in OLSR and AODV protocol in VANET suffer from message decoding issues that purpose to resolve message decoding issues and improve delivery time. We have proposed KMPR selection in OLSR and AODV protocol in VANET .The Performance of KMPR selection in OLSR and AODV protocol in VANET will be evaluated in terms of Packet Loss, Network Load, throughput, cost and delay using simulation platform NS-2 .In this paper we have proposed selection of KMPR for an analysis and performance evolution of all parameters and packet loss have shown to minimize that approximately 50% of the KMPR chosen the first step of the protocol.

Keywords: VANETs, Routing Protocols, OLSR, AODV, KMPR.

I. INTRODUCTION

Vehicular Ad-hoc Networks (VANETs) are a special type of Ad-hoc networks. They can be utilized to guarantee road safety, to avoid potential accidents and make new forms of inter-vehicle communications so they will be an important part of the future Intelligent Transportation Systems (ITS). The growth of the increased number of vehicles are equipped with wireless transceivers to communicate with other vehicles to form a special class of wireless networks, known as vehicular ad hoc networks or VANETs. To enhance the safety of drivers and provide the comfortable driving environment, messages for different purposes need to be sent to vehicles through the inter-vehicle communications.

The VANETs is the commonly used ad-hoc routing protocols initially implemented for MANETs have been tested and evaluated for VANET environments. VANETs share some common characteristics with MANETs. They are both characterized by the movement and self organization of the nodes. We consider the possibility of using ad-hoc and MANET protocols for VANET scenarios.

The OLSR protocol is a pro-active routing protocol, which builds up a route for data transmission by maintaining a routing table inside every node of the network. The routing table is computed upon the knowledge of topology information, which is exchanged by means of Topology Control (TC) packets. OLSR makes use of HELLO messages to find its one hop neighbors and its two hop neighbors through their responses. The sender can then select its Multi Point Relays (MPR) based on the one hop node which offers the best routes to the two hop nodes. By this way, the amount of control traffic can be reduced. Each node has also an MPR selector set which enumerates nodes that have selected it as an MPR node. OLSR uses TC messages along with MPR forwarding to disseminate neighbor information throughout the network. Host Network Address (HNA) messages are used by OLSR to disseminate network route advertisements in the same way TC messages advertise host routes.

The AODV (Ad hoc on-Demand Distance Vector) is an improvement of DSDV to on demand scheme. It minimizes the broadcast packet by creating route only when needed. Every node in network maintains the route information table and participates in routing table exchange. When source node wants to send data to the destination node, it first initiates route discovery process. In this process, source node broadcasts Route Request (RREQ) packet to its neighbors. Neighbor nodes which receive RREQ forward the packets to its neighbor nodes. This process continues until RREQ reach to the destination or the node who know the path to destination. When the intermediate nodes receive RREQ, they record in their tables the address of neighbors, thereby

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establishing a reverse path. When the node which knows the path to destination or destination node itself receives RREQ, it sends back Route Reply (RREP) packet to source node. This RREP packet is transmitted by using reverse path. When the source node receives RREP packet, it can know the path to destination node and it stores the discovered path information in its route table. This is the end of route discovery process. Then, AODV performs route maintenance process. In route maintenance process, each node periodically transmits a Hello message to detect link breakage.

The KMPR (Kinetic Multipoint Relay) is used to control the retransmission massage in OLSR and it has a delivery time faster than MPR (Multipoint Relay). This might comes from two properties of KMPR. Firstly, as described earlier, MPR suffers from message decoding issues, which we corrected in KMPR. KMPR is backbone maintenance and significantly less than MPR. Therefore, the channel access is faster and the probability of collisions is decreased. The benefit of KMPR: it is low routing overhead. Indeed, by using mobility predictions, the routing overhead may be reduced. The KMPR protocol was able to meet the flooding properties of MPR and this by reducing the MPR channel access and MPR broadcast delay.

In this paper, we have proposed NS-2 for the purpose of executing of KMPR two routing protocols OLSR and AODV in a VANET. The OLSR and AODV Routing Protocol for a delivery time and MPR suffers from message decoding issues.

II. MATERIALS AND METHODOLOGY

The main interest of the paper was evaluate the performance of AODV (Ad hoc on-Demand Distance Vector) routing protocol with KMPR selection algorithm for used retransmission control massage. The AODV (Ad hoc on-Demand Distance Vector) is an improvement of DSDV to on demand scheme. It minimizes the broadcast packet by creating route only when needed. Every node in network maintains the route information table and participates in routing table exchange. When source node wants to send data to the destination node, it first initiates route discovery process. In this process, source node broadcasts Route Request (RREQ) packet to its neighbors. Neighbor nodes which receive RREQ forward the packets to its neighbor nodes. This process continues until RREQ reach to the destination or the node who know the path to destination. When the intermediate nodes receive RREQ, they record in their tables the address of neighbors, thereby establishing a reverse path. When the node which knows the path to destination or destination node itself receives RREQ, it sends back Route Reply (RREP) packet to source node. This RREP packet is transmitted by using reverse path. When the source node receives RREP packet, it can know the path to destination node and it stores the discovered path information in its route table. This is the end of route discovery process. Then, AODV performs route maintenance process. In route maintenance process, each node periodically transmits a Hello message to detect link breakage.

The OLSR (optimize link state routing) is used to find shortest distance between source to destination when the data transfer. The KMPR (Kinetic Multipoint Relay) is used to control the retransmission massage in OLSR. It has a delivery time faster than MPR (Multipoint Relay) This might comes from two properties of KMPR. Firstly, as described in MPR suffers from message decoding issues, which we corrected in KMPR . KMPR is backbone maintenance is significantly less than MPR. Therefore, the channel access is faster and the probability of collisions is decreased. The benefit of KMPR: its low routing overhead. Indeed, by using mobility predictions, the routing overhead may be reduced. The KMPR protocol was able to meet the flooding properties of MPR and this by reducing the MPR channel access and MPR broadcast delay.

III. PROBLEM OVERVIEW

As MPR selection in OLSR and AODV protocol in VANET suffer from message decoding issues. We have proposed KMPR selection in OLSR and AODV protocol in VANET .The Performance of KMPR (Kinetic Multipoint Relay) selection in OLSR and AODV protocol in VANET will be evaluated in terms of throughput, routing overhead and broadcast delay using simulation platform NS-2.

The OLSR protocol is used in the .tcl file, where we are finding the shortest distance between the source to destination and then data flows from that particular path.

This protocol has been chosen since it presents a series of features that make it suitable for highly dynamic ad hoc networks and concretely for VANETs. These features are the following.

1) OLSR is a routing protocol that follows a proactive strategy, which increases the suitability for ad hoc networks With nodes of high mobility generating frequent and rapid topological changes, like in VANETs.

2) Using OLSR, the status of the links is immediately known. Additionally, it is possible to extend the protocol information that is exchanged with some data of quality of the links to allow the hosts to know in advance the quality of the network routes.

3) The simple operation of OLSR allows easy integration into existing operating systems and devices (including smart phones, embedded systems, etc.) without changing the format of the header of the IP messages.

4) The OLSR protocol is well suited for high density networks, where most of the communication is concentrated between a large numbers of nodes (as in VANETs).

5) OLSR is particularly appropriate for networks with applications that require short transmission delays (as most of warning information VANET applications) .

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6) Thanks to its capability of managing multiple interface Addresses of the same host, VANET nodes can use different network interfaces (Wi-Fi, Bluetooth, etc.) and act as gateways to other possible network infrastructures and devices (as drivers and pedestrian smart phones, VANET Base stations, etc.).

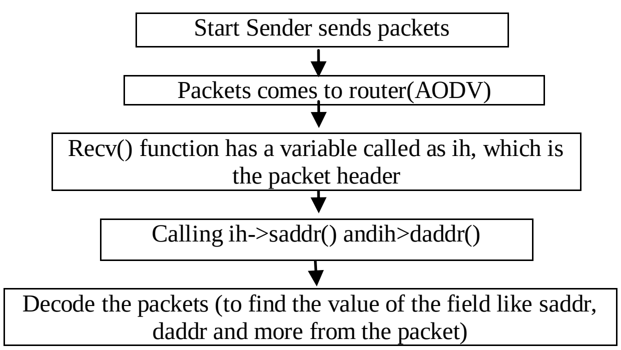
The main drawback of OLSR is the necessity of maintaining the routing table for all the possible routes. Such a drawback is negligible for scenarios with few nodes, but for large dense networks, the overhead of control messages could use additional bandwidth and provoke network congestion. This constrains the scalability of the studied protocol.

IV. KMPR (KINETIC MULTIPOINT RELAY)

In the first part of this section, we explain the method for message decoding. In the second part, we formally describe the basic KMPR protocol. Finally, in the last part, we shortly describe the forward decision of KMPR selector, example of KMPR Selection and Executing process of KMPR node.

A. Message decoding

For message decoding using header. i.e. header of the packets it include source address, Destination address, Source port, Destination port. KMPR selection applied after the message decoding and without message decoding KMPR does not work. Delivery time is improved by KMPR selection which transmits data directly to destination with the best possible hops and minimum time and for improving delivery time applied compress and decompress technique. Message Decoding Process as shown in the following Flow Chart from,



B. Basic Structure of KMPR

In order to reduce the effect of flooding messages to all nodes in the network, OLSR selects a subset of nodes, called *Multipoint Relays (MPR)*, to be part of a relaying backbone. In order to build this KMPR structure, each node gathers 2-hops neighborhood information and elects the smallest number of relays such that all 2-hops neighbors are covered by at least one relay. Nodes notifies the respective relays of their decision such that each relay maintain a list of nodes, called *kinetic Multipoint Relaying Selectors (KMPR Selector)*, which has elected it as KMPR as shown the following fig.A and fig.B and also show the forward decision of KMPR.

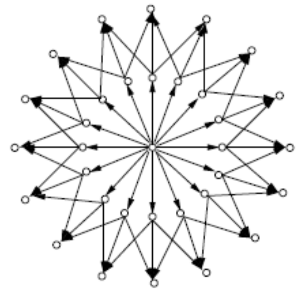


Fig. A.

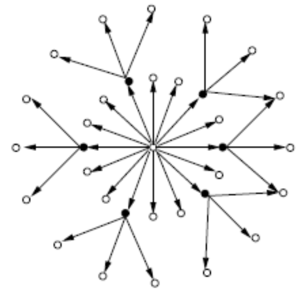


Fig. B.

Fig. A. All neighbor retransmission broadcast Fig B. Only KMPR relay broadcast Illustration flooding reduction using KMPR

C. KMPR Applied to AODV and OLSR

KMPR creates a set of KMPR selectors and their respective activations. Compared to MPR, the difference is that KMPR has computed actual and future KMPR selectors. Each KMPR selector and its relaying capability will be activated when its activation becomes valid.

Accordingly, we can see that OLSR can be easily adapted to use KMPR instead of MPR. It will still periodically send topology messages and the forwarding decision is simply kept transparent to it. Indeed, each OLSR TC message is forwarded by KMPR according to Definition 1. Although KMPR uses activations in order to maintain its set of KMPR selectors, each forwarding decision will be taken by each node based on Fig 4.3

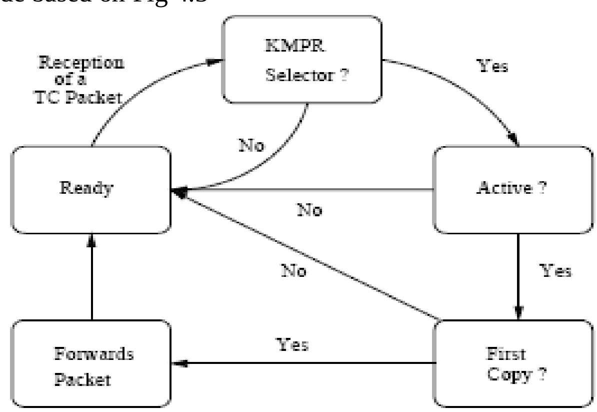


Figure 4.3: Illustration of the forwarding decision of KMPR

i) Example of KMPR Selection

Node	1 Hop Neighbors	2 Hop Neighbors	KMPR
B	A,C,F,G	D,E	C

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Node B will select C as its KMPR So all the other nodes know .That they can reach B via C. D->B route is D-C-B, Optimal route (i.e., path with Maximum bandwidth)

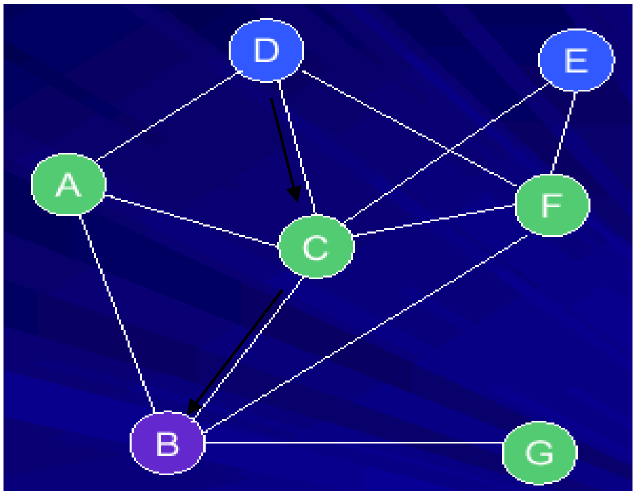

Fig i) D->B route is D-C-B, Optimal route

ii)KMPR Executing Process

- KMPR applied to an initiator node.
- Begin with an empty KMPR set.
- Compute the each node.
- Add in the KMPR set that has the maximum logical.
- Compute the activation of the KMPR node.
- Update all other nodes.
- Each node having elected a node KMPR for some activation is then a KMPR selector during the same activation.

V. PROPESED WORK

We have proposed KMPR (Kinetic Multipoint Relay) selection in OLSR and AODV protocol in VANET to resolve message decoding issues and to improve delivery time which are the key performance metrics in VANET.
Since $ns-2$ is a network simulator of general purpose, it does not offer a way for directly defining realistic VANET simulations, where the nodes follow the behavior of vehicles in a road, traffic lights, traffic signs, etc. To solve this problem, we have used the Simulation of Urban Mobility (SUMO) road traffic simulator to generate realistic mobility models. This tool returns traces with the mobility definitions that can be used by $ns-2$. In ns-2, two languages are used because the two requirements of the simulator i.e C++ is fast to run but slower to change code and OTcl is easy to code but runs slowly. So the Performance of KMPR (Kinetic Multipoint Relay) selection in OLSR and AODV protocol in VANET will be evaluated in terms of Packet Loss, Network Load, delay, throughput, and Energy using simulation platform NS-2.

VI. SIMULATION RESULT AND OBSERVATION

We have implemented the AODV-OLSR-KMPR protocol under ns-2 . The global parameters we used for the simulations are given in Table 1. We measured several significant metrics for VANETs routing,

- **Packet Losses**:-The total no. of packets dropped during the simulation.
- **Network Load**:- The load on the network is increased by increasing no. of hosts, with each host offering fixed load.
- **Throughput**:-It is the total no. of packets reaching their destination per unit time.
- **Packet Delivery Ratio (PDR)**:– It is the ratio between the number of packets delivered to the receiver and the expected number of packet sent.
- **Delay-** It measures the average end-to-end transmission delay.

Finally, we decomposed our performance analysis in different scenarios, were we fixed the parameters according to Table 2. In the different nodes combination compare to maximum simulation time to KMPR and normal protocols, we want to see when an increased no. of nodes the packet losses is decreases and other parameters will be change as shown in the table 2.

TABLE 1: Simulation parameters

Simulator	NS-2.34
Channel Type	Wireless
Radio- Propagation Model	Propagation/TwoRayGround
Network Interface Type	Phy/WirelessPhy
Antenna model	OmniAntenna
Interface queue type	Queun/DropTail/Priqueue
Protocols	AODV/OLSR
Simulation Area	300m X 300m
Number of Nodes	40
MAC Layer Protocol	IEEE 802.11
Traffic Type	CBR(UDP)
Max. Packet in ifq	50
Simulation End time	300s

TABLE 2: Simulation Summary

No. of Nodes → **Parameters ↓**	**5 nodes**	**10 nodes**	**20 nodes**	**30 nodes**	**40 nodes**
Packet Loss Normal	5032	4216	4284	2448	1768
Packet Loss KMPR	2516	2108	2142	1224	884
Network Load Normal	5.73	5.97	1.146	0.691	0.140
Network Load KMPR	199.69	189.98	139.19	103.00	67.55
Throughput Normal	100	100	100	100	100
Throughput KMPR	45.28	45.28	45.28	45.28	45.28
Cost Normal	673.29	195.00	152.61	178.14	30.54
Cost KMPR	211.50	156.19	114.44	52.36	30.54
Delay Normal	0.015	0.015	0.015	0.015	0.015
Delay KMPR	0.848	0.848	0.848	0.848	0.848

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Figure 6.1shown the creation of cluster with 40 nodes for AODV with KMPR selection respectively as it is shown in the NAM console which is a built in program in NS-2-allinone package after the end of the simulation process.

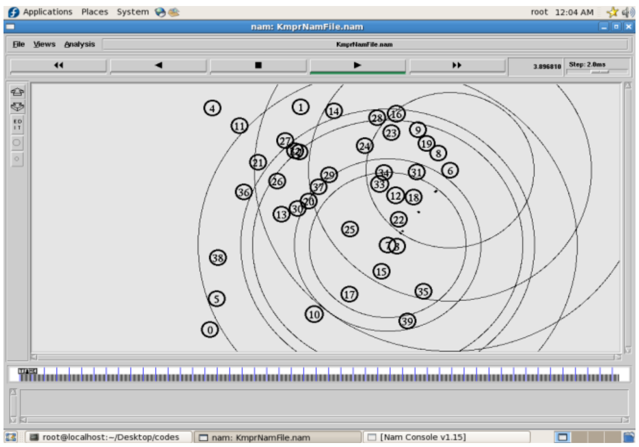
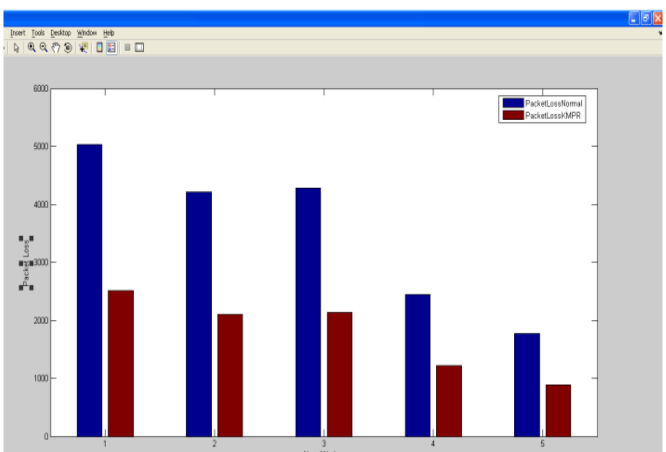


Figure 6.1 Screenshot of AODV+OLSR+KMPR: Route Discovery

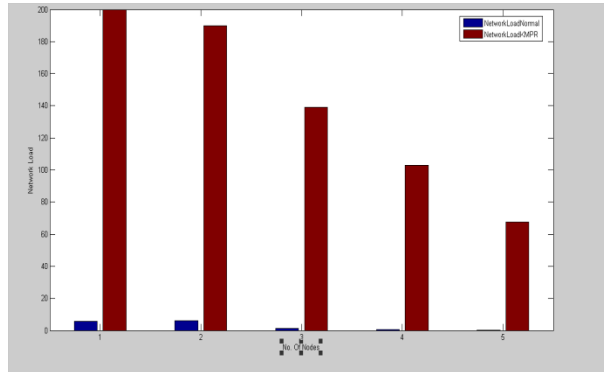
6.2 Comparison Nodes Vs Parameters

The selection of the AODV and OLSR without KMPR and with KMPR and we compare the no. of nodes Vs all parameters with normal AODV and AODV+OLSR+KMPR as shown in the following,

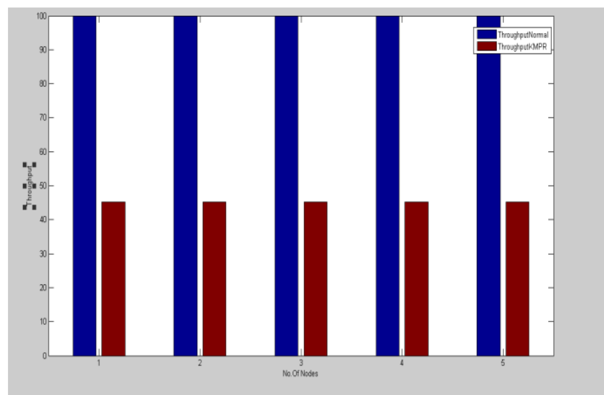
6.2.1Packet Losses:**-** The packet losses of the normal AODV are greater as compare to selection of KMPR+AODV+OLSR by 50%. When no. of nodes increases than packet losses decrease by using KMPR as shown in follows,



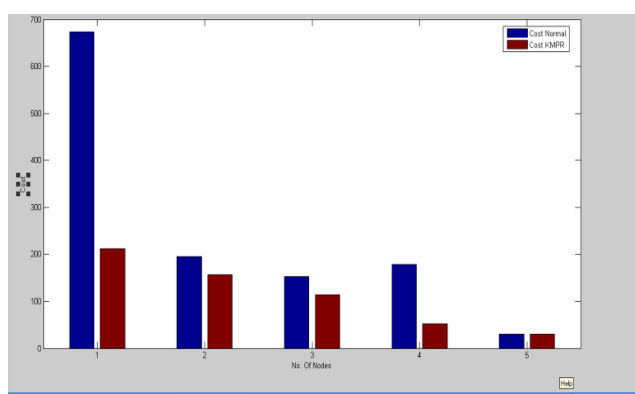
6.2.2 Network Load:**-** The Network load of the normal AODV is less as compare to selection of KMPR+AODV+OLSR as shown in Table 2 and following figure. When no. of nodes increases the network load also increases.



6.2.3 Throughput:**-** The throughput of the normal AODV is greater as compare to selection of KMPR+AODV+OLSR. Throughput should normally be 100% but due to losses it is always below 100 as shown in below,



6.2.4 Cost:- The Cost of normal AODV is greater as compare to selection of the KMPR+AODV+OLSR as shown in Table 2 and following figure. When no. of nodes increases the cost will be decreases.



6.2.5 Delay:**-** The delay of normal AODV is less as compare to selection of the KMPR+AODV+OLSR as in following fig.

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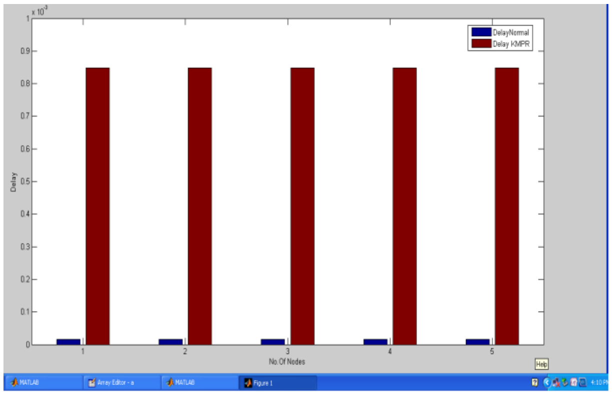

VII. XGRAPH

We implemented by using combination of 40 nodes as shown the following xgraphs,

7.1 packet losses:-

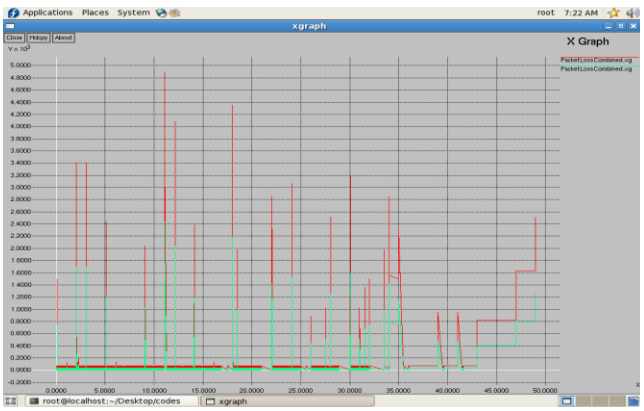

Figure 7.1 Screenshot of normal AODV and AODV+OLSR+KMPR: Packet Losses xgraph

7.2 Network Load

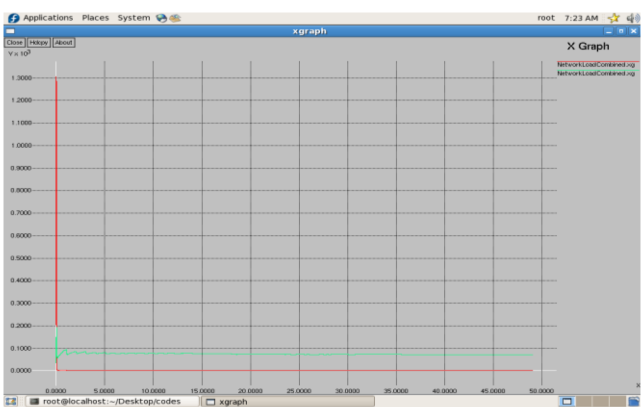

Figure 7.2 Screenshot of normal AODV and AODV+OLSR+KMPR: Network load xgraph

7.3 Throughput

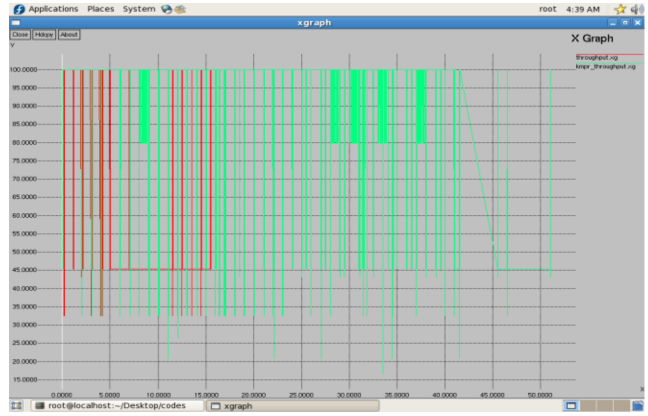

Figure 7.3 Screenshot of normal AODV and AODV+OLSR+KMPR: throughput xgraph

7.4 Cost:-

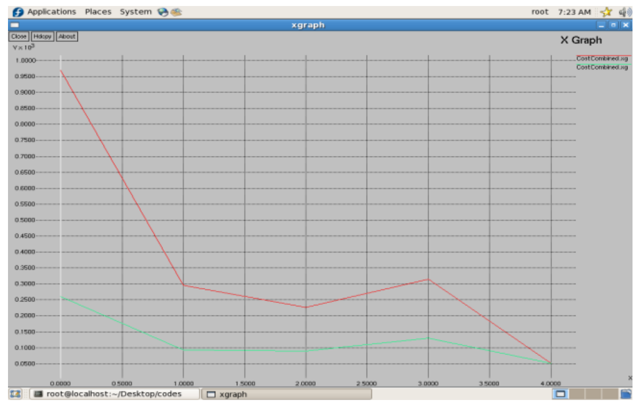

Figure 7.4 Screenshot of normal AODV and AODV+OLSR+KMPR: Cost xgraph

7.5 Delay

Figure 7.5 Screenshot of normal AODV and AODV+OLSR+KMPR: Dely xgraph

VIII. CONCLUSION

We have designed KMPR (Kinetic Multipoint Relay) selection in OLSR and AODV protocol in VANET to improve delivery times which are the key performance metrics in VANET.

In this paper we have to all concluded that the selection of AODV+OLSR with KMPR algorithm are all parameter such as Packet losses, network load, Delay, cost and Throughput have shown. The packet losses approximately 50% decreases of the KMPR chosen the first step of the algorithm. The network load increases because, when no. of nodes combination increases the network load increases. The throughput of the normal AODV is greater as compare to selection of KMPR+AODV+OLSR, so throughput should normally be 100% but due to losses up to 45%. The Cost of normal AODV is greater as compare to selection of the KMPR+AODV+OLSR. When no. of nodes increases the cost will be decreases. The delay of normal AODV is less as compare to selection of the KMPR+AODV+OLSR.

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