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QoS Enhancement with Optimization of Route Discovery Parameters for Dynamic Source Routing (DSR) Protocolin Densely Deployed Vehicular Ad Hoc Networks (VANETs) Using Randomly Generated Traffic

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ABSTRACT

Vehicular ad hoc networks (VANETs) have become the need of the future as all vehicles are going to have wireless communication capabilities in coming years. Extensive research is being conducted to make VANETs stable, reliable, intelligent, secure and quality of service (QoS) aware. Previously, there were many routing protocols which were developed and optimized for MANATs environment and caters for the needs of randomly moving nodes, where nodes have different constraints in terms of processing, transmission power, storage and battery power. But VANETs don't have such constraints as we have vehicles battery to be used for all these above mentioned, hence fast processing and better transmission techniques can be used, so there is need to rework on these routing protocols if we want them to use in VANETs. VANETs are going to be used mainly for two purposes i.e. for safety related applications and for comfort related applications. In either case, there is need to have less delay, less packet drop ratio, less jitter, better response timeetc. In this paper, we optimize route discovery related parameters of dynamic source routing (DSR) protocol in order to use it for densely deployed VANETs, where vehicles are moving with moderate speed i.e. 50km/s. Current researches shows that DSR is the best suitable option in case of congested VANETs situation, we, furthermore, explore the possibilities of optimization in route discovery parameters in order to achieve better QoS.

KEYWORD: VANETs, DSR, Route discovery, Moving Vehicles, QoS

1. INTRODUCTION

Vehicular ad hoc networks (VANETs) have vehicles as node which is mostly mobile [1], it is projected that many services will be provided by VANETs in coming years belonging to safety and comfort. VANETs have some different characteristics if we compare it with existing MANETs. Although both are mobile but in VANETs mobile nodes i.e. vehicles may move with very high speed, here prediction about trajectory of nodes is relatively easy as vehicles move in some organized way. [2] Discusses the mobility model of VANETs. Since movement of vehicles is quite different as those of MANETs node so existing models like random waypoint model cannot be used here in order to get good mobility prediction for simulations. The authors tried to make realistic models based on the actual movement of vehicles and then they used it for their simulations. In VANETs, there is more network disconnectivity and it is hard to estimate about the next network which a vehicle is going to attach with. [3] Made some statistical calculations to predict about the next network whom a vehicle is going to be part of. They used some probability techniques and showed that with their method it is relatively easy to predict the future network of association. As ad hoc networks are unique in their nature that there is no pre-established infrastructure for communication and network is created when needed [4]. So there may be many limitations in ad hoc network as compared with infrastructure based network like less transmission power, limited processing, no knowledge about the entire network conditions etc. In this paper, authors tried to do a survey based on the type of protocol and they showed that in which situation which protocol is better for wireless ad hoc networks. In this paper [5], authors used clustering technique to improve the routing of the existing VANETs. They used affinity propagation algorithm for their cluster. While making cluster, they also consider the speed of the vehicle in order to decide the cluster that vehicle should be part of. This work on clustering was inspired by the extensive research on the same on MAC layer. At the end they showed that this technique works well specially in the environment where vehicles have different moving speed. [6] Proposed new dynamic clustering scheme in which they used multi agents and cluster is formed on the fly. They showed that this technique is better with static clustering as we don't know in advance about the mobility and speed of the vehicles who form the cluster. So keeping in view the speed, stable and mobility pattern of the vehicles, a

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dynamic cluster is formed and it selects it head based on the stability, speed and the amount of time spent in that particular region. Then cluster head can advertise the mobility pattern of the cluster and other vehicles can also join this cluster having same pattern. In [7], authors proposed a new protocol that basically reduces the delay that is available in traditional cluster based protocols. Because it takes some time while cluster head is elected and then it advertises this information. After this the vehicles may be able to communicate. But in this new protocol authors claimed that overall delay is reduced and right after joining, the vehicles can transmit and receive the data. [8] Worked on medium access control (MAC), they proposed a technique having multi-priority and it will divide the incoming packets from upper layers into different categories and then according to priority, the most important traffic will be allowed for transmission. In this way, the overall delay for critical traffic is reduced by giving preference to important ones. Furthermore, they added that there will be no contention for ack of critical traffic, it will be delivered immediately. Finally they showed that this scheme improves the system performance, especially for the traffic of main concern. [9] Makes a mathematical analysis for mobile routing protocols in different environments and discusses the issues of QoS affected by mobility, it draws the graphical trajectory about mobility of nodes and QoS using different routing protocols. These analysis were carried out in dense environment. Finally it shows the results based on their experiments. In [10] authors did a comparative study about VANETs and WSNs networks and discusses the routing protocol issues in both of these two networks. They found that routing issues are different in VANETs as compared with WSNs, since node mobility pattern and speed is rather different in VANETs. So it is needed to work on enhancement of existing routing protocols in order to improve the QoS and security like features of VANETs. [11] Talks about efficiently using the available frequency spectrum and VANETs. It discusses that if spectrum is properly used and shared among the moving vehicles, it can also increase the QoS of the system, as there will be no issues of providing wireless access dynamically to the moving nodes. They talked that starving nodes can be given priority so that they can address their needs of QoS while moving with fast speed.

2. RELATED WORK

Due to the different nature of VANETs from MANETs, existing routing protocols cannot be as it is used in new VANET architecture rather it is required to propose extensions or device new routing protocols.[12] had discussion about position based routing protocols for VANETs environment. Since routing protocols from MANETs cannot be used without modification in new VANETs conditions where network partitioning is so usual and vehicles have fast mobility. So they proposed that location based routing protocol to cater for the needs of this new type of wireless ad hoc network. They presented the result that this position based routing is more suitable in highly dynamic network like VANETs. In [13], authors proposed a new contention based packet forwarding scheme to overcome the problems of link breakage and heavy broadcast of control messages. In this scheme, the forwarder is dynamically selected depending upon its stability and the number of routes it can reach to. They claimed that by using this method not only delay is reduced but also it reduces the control overhead. [14] Focused its work on reliability of the routing protocol as link failures happens more frequently in VANETs so availability of reliable links is of great importance. So the authors proposed a new routing protocol which addresses the issues of reliability and before selecting the vehicle as forwarder, it first checks it reliability and the stability of the routes it offers. If it doesn’t provide better and reliable route then it is not selected and data is forwarded to any other block. [15] In this paper authors suggested new routing protocol that uses hybrid technique for data forwarding, it includes geographical routing in traditional routing protocols. The important thing is that if no better route is available for data to be transmitted then it stores the data and wait for any good route to be discovered. And as soon as it gets the new better route, it transmits the data. At the end, authors claimed that it provides better routes to be searched and used and the overall probability of data delivery is increased. In [16], the authors tried to improve the performance of optimized link state routing protocol (OLSR) for high speed scenario. They worked to increase the duration of path links in order to ensure reliable routing. The decision about data forwarding is made on the basis of vehicles density and availability of valid routes. Finally, they showed that results that end-to-end delay, packet delivery ratio and parameters are improved using their method. [17] Used the method of multipath routing to improve overall performance of the VANETs. Since multipath routing strategies are already in use in different wireless networks so they applied this technique to vehicular network. But their focus is to enhance the routing when the network is separated i.e. node disjoint. They conducted many simulations and showed that with this technique the overall delay and packet delivery ratio is increased. [18] In this paper authors proposed new routing protocol which basically works on the principle of geographical routing. It collects the information from the vehicles moving on the same road and update its routing table, this is continuous work, since there may be failure of links and disconnectivity may be faced quite frequently. It caters for the mobility with the help of roadmap and geographically distributed vehicles take part in the routing process. They projected all necessary phases of routing protocol e.g. route discovery, data forwarding and later on maintenance of the failed routes. At the end, they showed results of simulations that this method works well in high speed VANETs environment. [19] Worked on a new routing protocol that uses concept of clustering and uses geographical routing in order to improve the routing and other packet delivery related performance on the VANETs system. Like traditional clustering techniques, it elects a cluster head based on the different parameters required to become a cluster head like its location, speed, reliability, number of routes offered and stability etc. Moreover, all vehicles will be storing the information about their neighbors as their neighbors are potential next hop router in the future. At the end, the authors presented the result with the help of simulations that this novel protocol works well in highly dynamic environment. In [20], a new architecture has been presented about routing in VANETs to address the challenges faced in this wireless domain. In this architecture, they used multiple protocol at different level and addressed the needs of routing at different speeds. This new routing protocol adopts the features of different protocols to provide good level of routing performance. They applied on the city level and showed that this hybrid protocol works in all situations being faced in VANETs.

3. PROPOSED WORK

We created vehicular ad hoc network for our work by using IEEE 802.11n standard having the frequency of 2.4GHz. The number of vehicles are 30 moving at the speed of 50km/s, as shown in figure 01. We tried to enhance the route discovery parameters of DSR protocol so that it could be used and give better results in congested vehicular ad hoc network. The parameters we used are, request table size (nodes), maximum request table Identifiers (identifiers), maximum request period (seconds) and initial request period. We took all these parameters and apply different values along with default one in order to get the best one for congested VANETs. For all scenarios, simulation time was 30 minutes and criteria for decision was based on result of following factors. End-to-end delay, end-to-end delay variations and number of packets dropped as these parameters play important role when we estimate QoS. To precisely record the result, we changed one parameter at a time and other all were kept unchanged and this practice was done for all the parameters under test. Finally random source and destination was selected for collection of result.

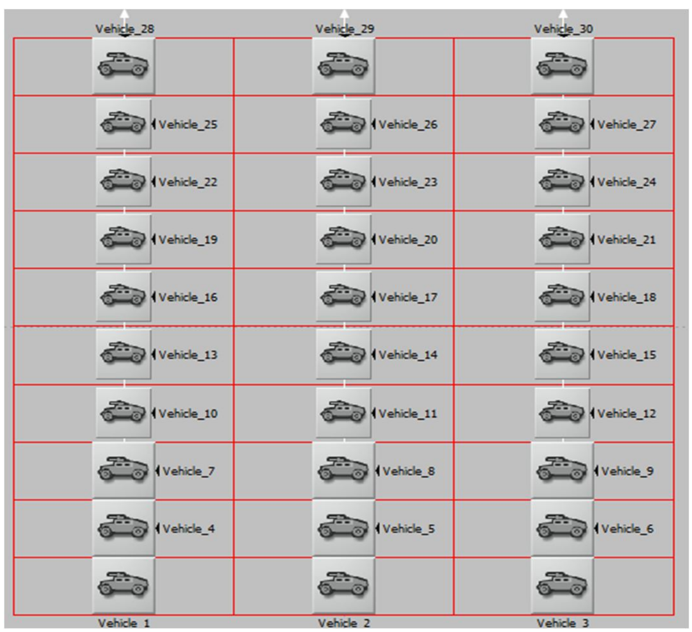

Fig. 01 formation of vehicular ad hoc network

A. Request Table Size (nodes)

In this scenario, we will change values of only table size and all other parameters will be kept as it is.

a) Request Table Size 20

We can see in figure 02 that when request table size is 20 the end-to-end delay is almost 0 and it is constant except from a few spikes which have maximum value of 0.19. But variation in end-to-end delay is little more as compared with end-to-end delay at the end of simulation as shown in figure 03. And of course, the number of packets dropped is 0, expressed in figure 04.

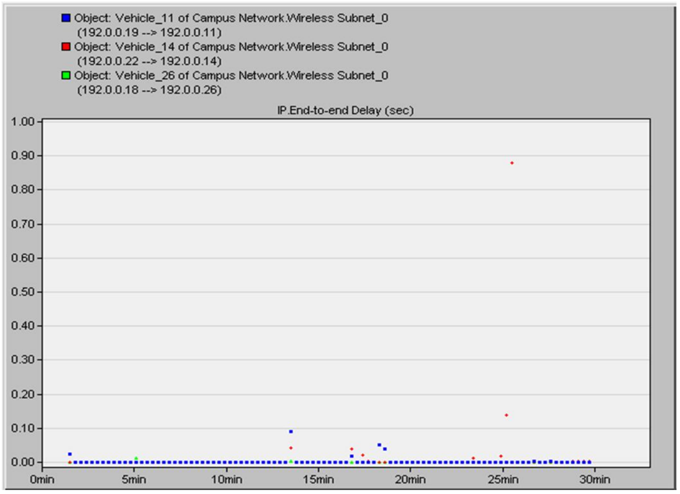

Fig. 02 End-to-end delay for request table size of 20

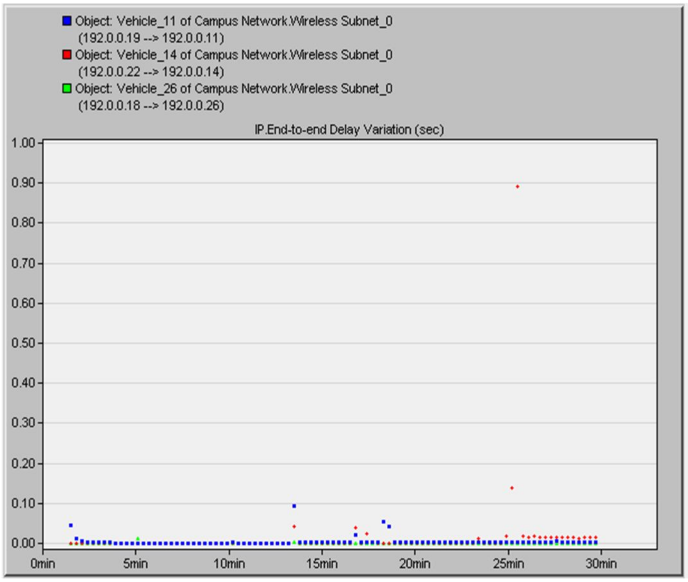

Fig. 03 Variation in end-to-end delay for request table size of 20

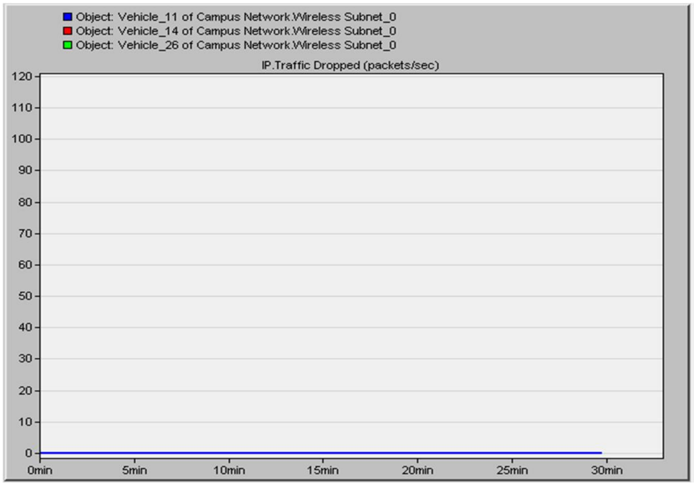

Fig. 04 Packets drop ratio for request table size of 20

b) Request Table Size 40

End-to-end delay is shown in figure 05, when we set request table size to 40. It is 0 and almost constant but there are some spikes up to 1.1 seconds. In figure 06, variations in end-to-end delay is exposed and in the beginning it is about 0.9 and obviously it is more than that of request size having value of 20. Figure 07 shows the number of packets dropped and there is no packet loss.

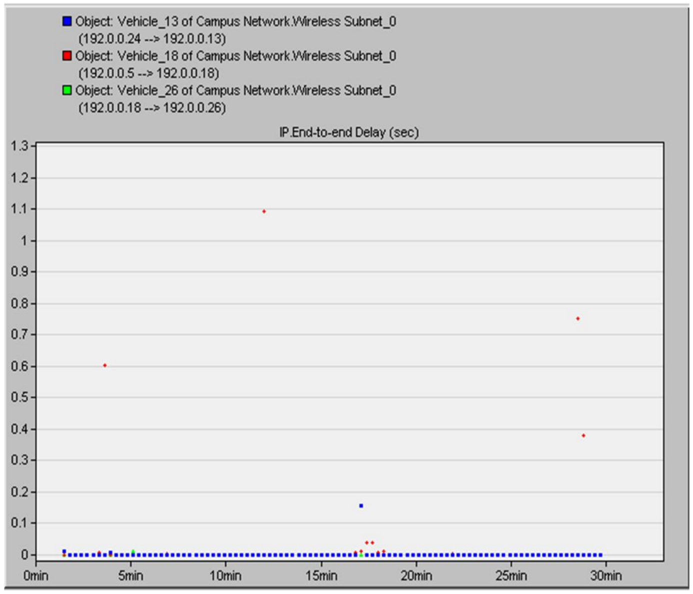

Fig. 05 End-to-end delay for request table size of 40

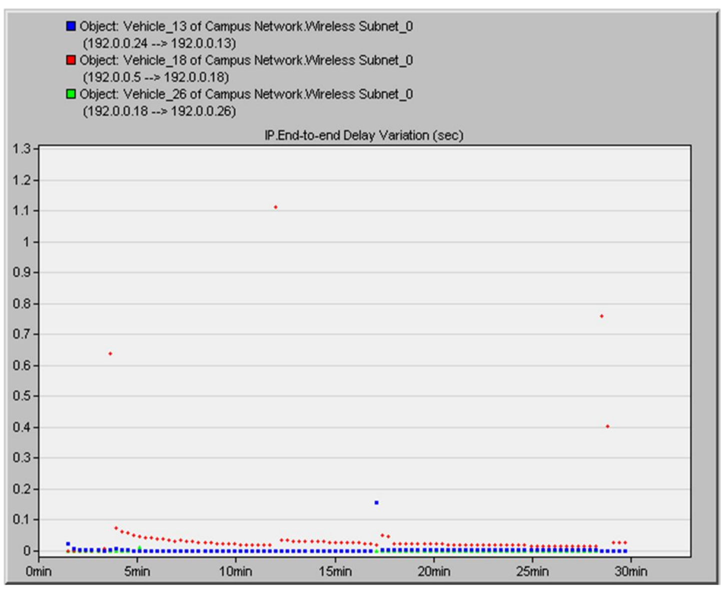

Fig. 06 Variation in end-to-end delay for request table size of 40

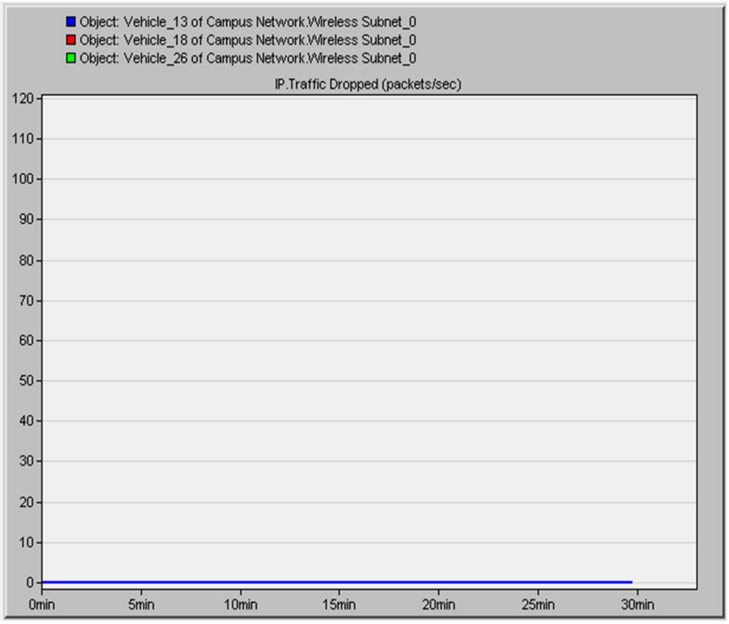

Fig. 07 Packets drop ratio for request table size of 40

c) Request Table Size 60

End-to-end delay using request table size of 60 is revealed in figure 08, it is 0 but there is some variation at the end, also it has some spikes up to maximum value of 2.6 seconds. Figure 09 exposes the variation in end-to-end delay and it's almost same like end-to-end delay i.e. there are some variations at the end. But packet drop ratio is 0 as shown in figure 10.

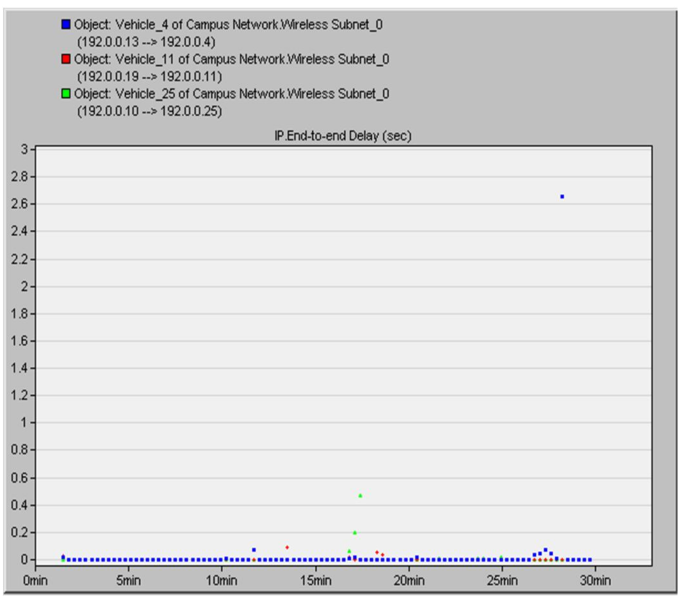

Fig. 08 End-to-end delay for request table size of 60

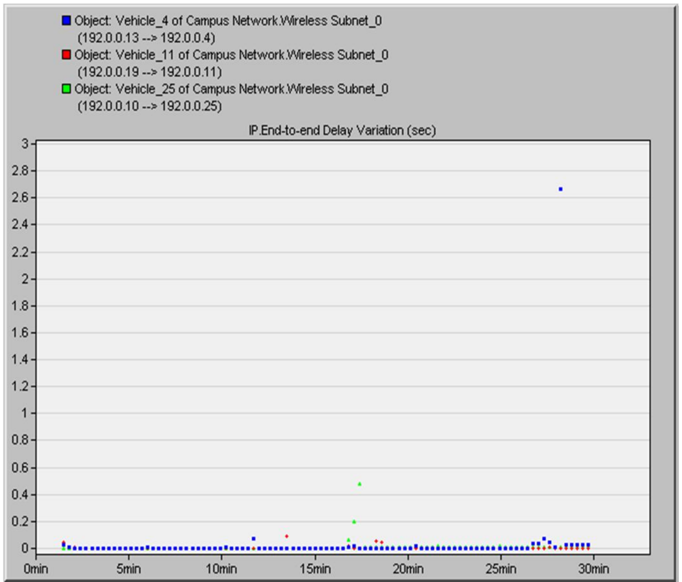

Fig. 09 Variation in end-to-end delay for request table size of 60

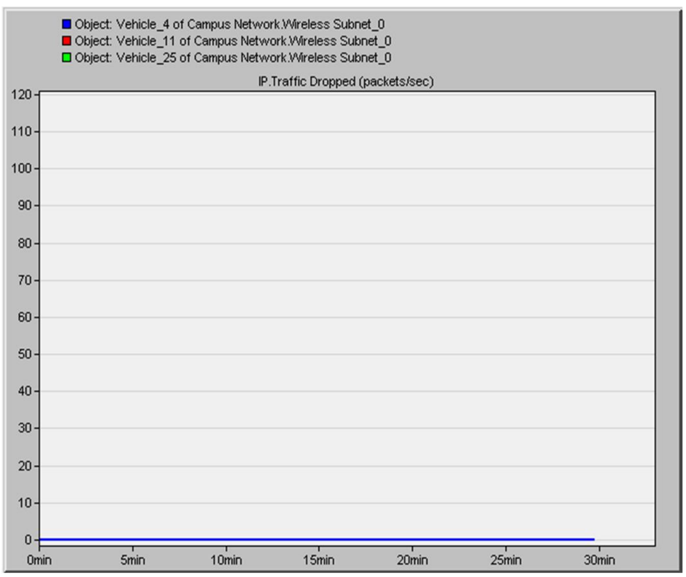

Fig. 10 Packets drop ratio for request table size of 60

C. Maximum Request Table Identifiers (identifiers)

In this scenario, we will change values of only maximum request table identifier and all other parameters will be kept as it is.

a. Maximum Request Table Identifiers size 5

Figure 11 shows the end-to-end delay when we set request table identifier size 5, again it is almost 0 with the exception of some spikes. But variation in end-to-end delay is increased, as in figure 12, up to 0.1 at the end of simulation. Packet drop ratio is 0 during entire simulation as shown in figure 13.

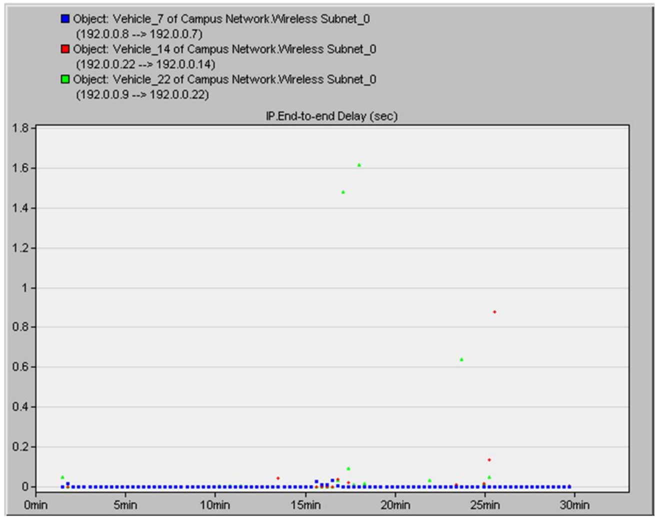

Fig. 11 End-to-end delay for maximum request table identifier size of 05

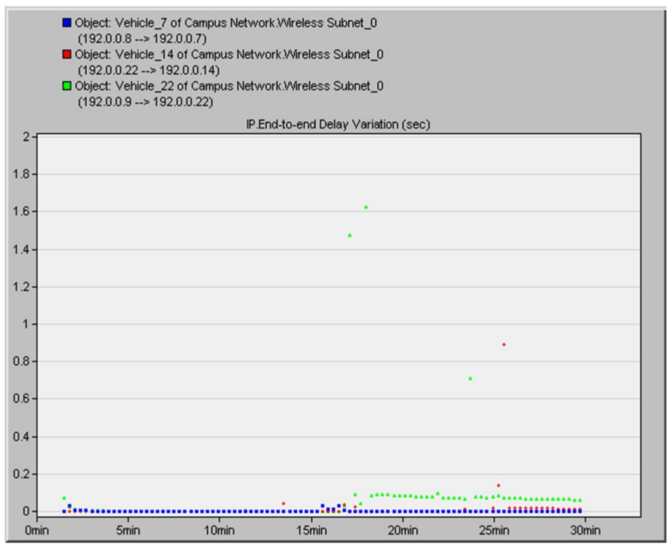

Fig. 12 Variation in end-to-end delay for maximum request table identifier size of 05

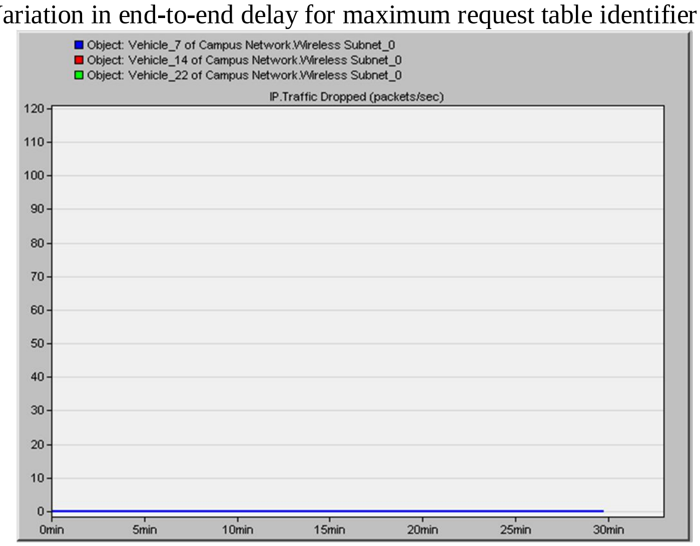

Fig. 13 Packets drop ratio for maximum request table identifier size of 05

b. Maximum Request Table Identifiers size 10

End-to-end delay using maximum request table identifier size of 10 is near 0 but there are some high values up to 2.5 seconds as expressed in figure 14. Variation in end-to-end delay is shown in figure 15 and it is clear it for some vehicles its value is more than .1 seconds and some spikes having values of up to 2.5 seconds. Number of packet lost ratio is 0 shown in figure 16.

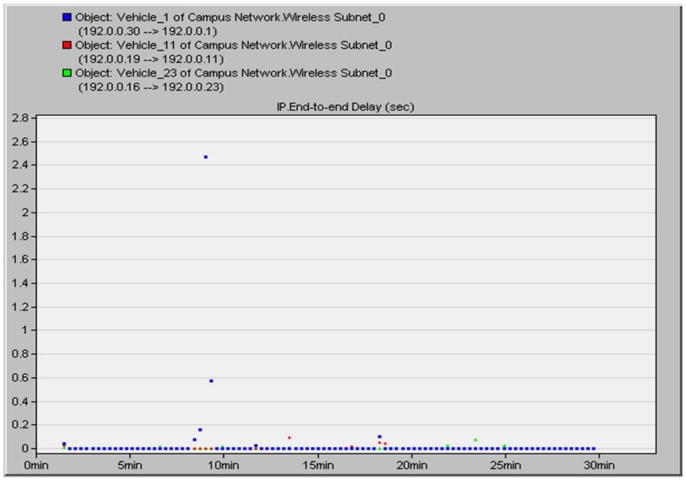

Fig. 14 End-to-end delay for maximum request table identifier size of 10

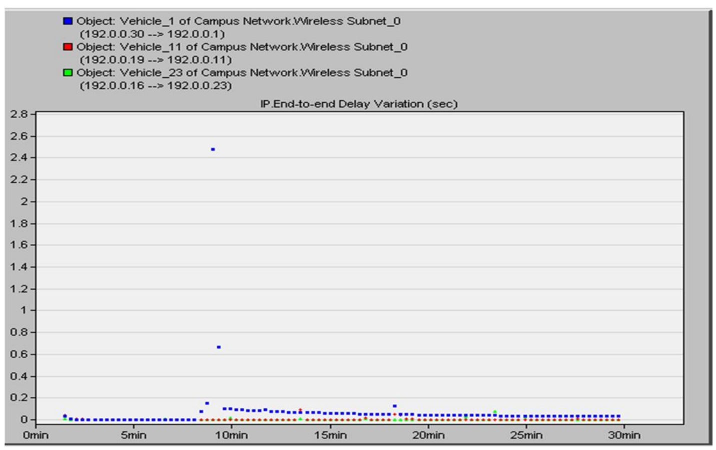

Fig. 15 Variation in end-to-end delay for maximum request table identifier size of 10

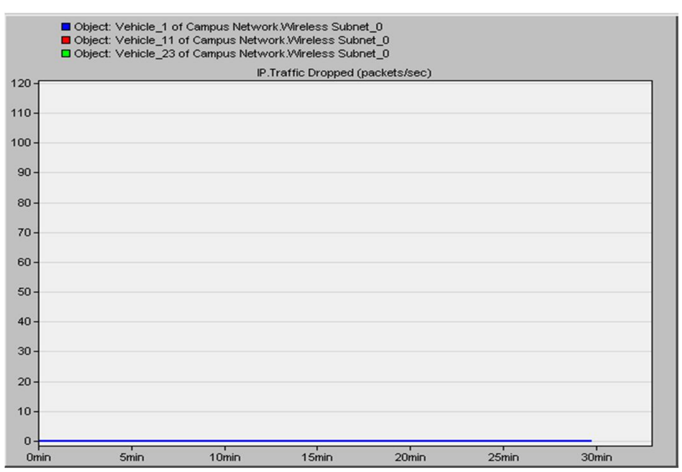

Fig. 16 Packets drop ratio for maximum request table identifier size of 10

c. Maximum Request Table Identifiers size 15

In figure 17, we can see the end-to-end delay that is about 0 and mostly constant apart form few glitches that is up to 7 seconds. Figure 18 shows the variation in end-to-end delay which is up to 0.3 that is quite high. And there is no packet loss as expressed in figure 19.

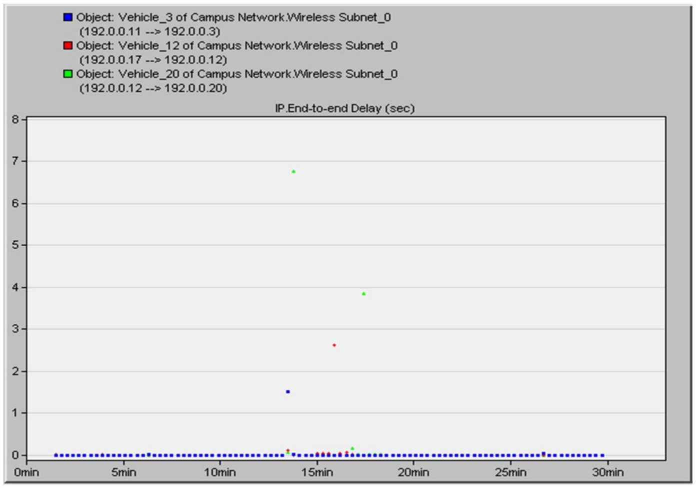

Fig. 17 End-to-end delay for maximum request table identifier size of 15

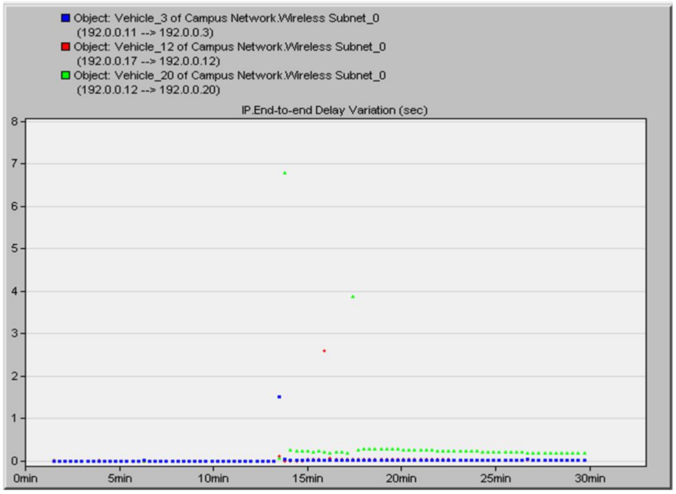

Fig. 18 Variation in end-to-end delay for maximum request table identifier size of 15

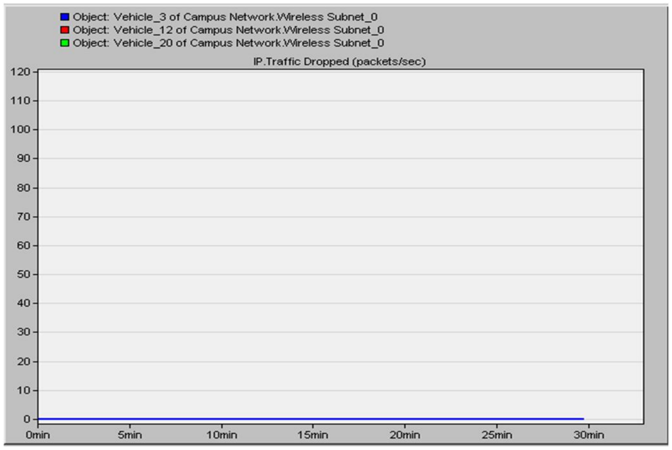

Fig. 19 Packets drop ratio for maximum request table identifier size of 15

D. Maximum Request Period

Here we only change the maximum request period during simulations and all other parameters will be kept constant. We will have 3 different variations of this parameter i.e. at 5, at 10 and at 15

a. Maximum Request Period of 5

In figure 20, we can see the end-to-end delay with maximum request period of 5 and it is almost 0 with the exception of few glitches up to 2.6 seconds. But variation in end-to-end is 0.1 at some times during execution of simulation and as usual there is no packet dropped as shown in figure 22.

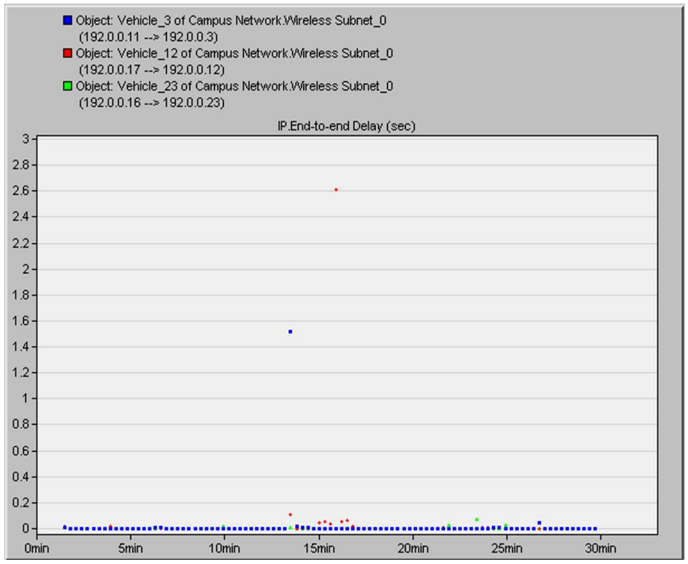

Fig. 20 End-to-end delay for maximum request period of 05

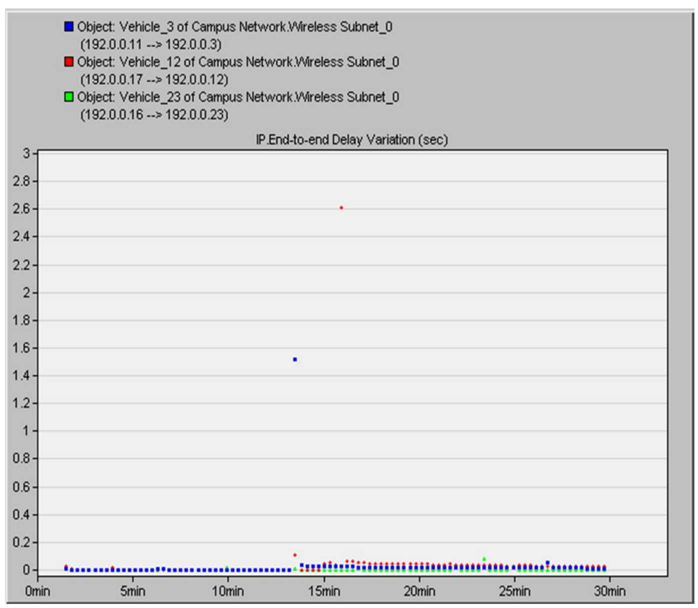

Fig. 21 Variation in end-to-end delay for maximum request period of 05

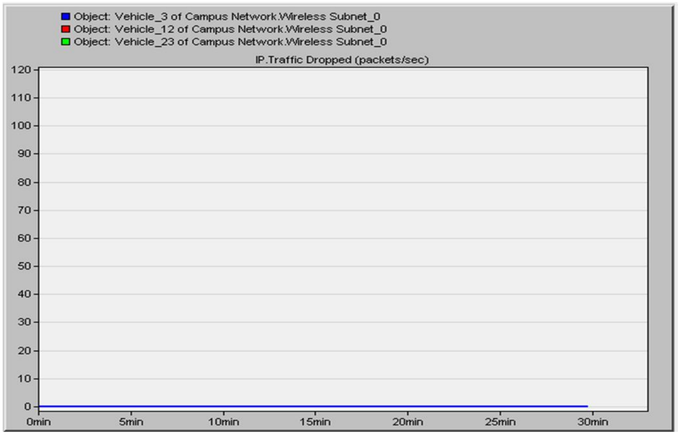

Fig. 22 Packets drop ratio for maximum request period of 05

b. Maximum Request Period of 10

End-to-end delay is near to 0 as revealed in figure 23 with the exception of some spikes up to maximum of 1.5 seconds. But the variation in shown in figure 24 is little high i.e. it is sometimes more than 0.1. Figure 25 shows the number of packets lost and definitely it is 0.

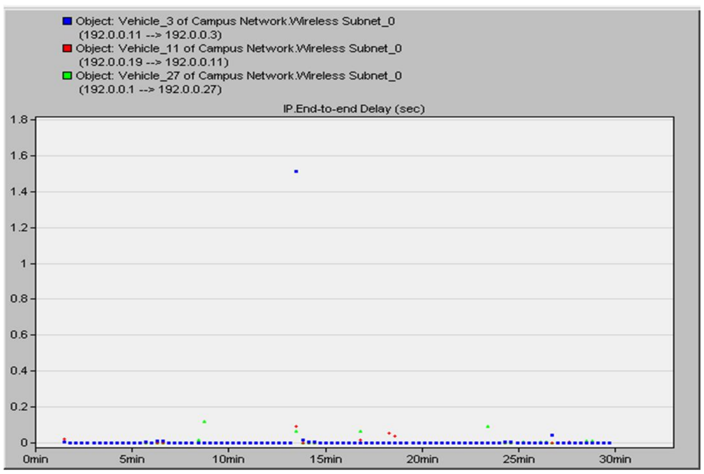

Fig. 23 End-to-end delay for maximum request period of 10

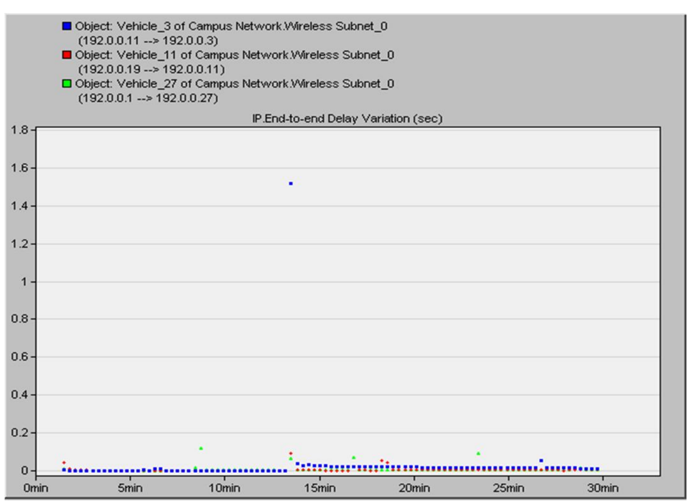

Fig. 24 Variation in end-to-end delay for maximum request period of 10

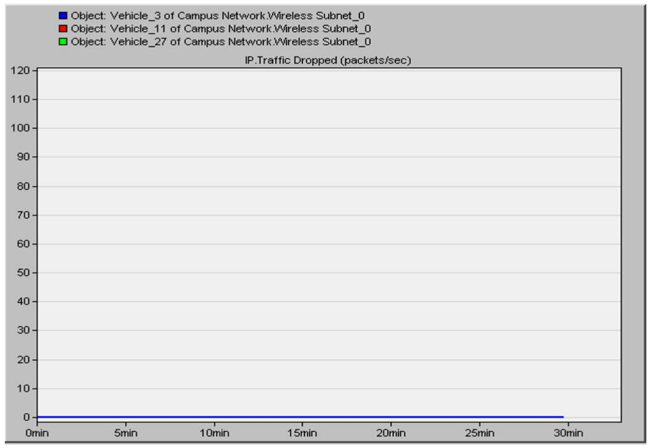

Fig. 25 Packets drop ratio for maximum request period of 10

c. Maximum Request Period of 15

In figure 26, it is obvious that end-to-end delay is slightly high on different places, also having glitches up to 2.5 seconds. Variation in end-to-end is shown in figure 27 and it is also higher i.e. up to 0.19 seconds. Some spikes are also there up to 2.5 seconds. As usual there is no packet dropped as expressed in figure 28.

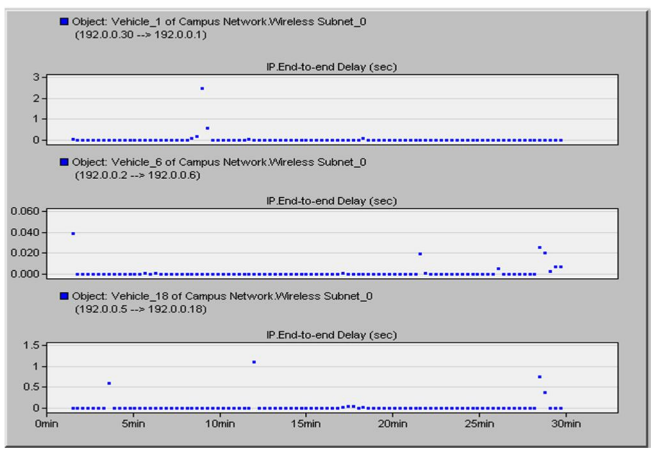

Fig. 26 End-to-end delay for maximum request period of 15

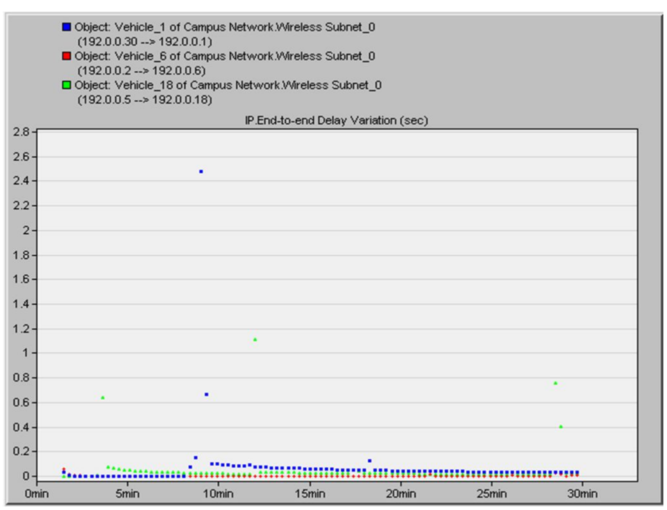

Fig. 27 Variation in end-to-end delay for maximum request period of 15

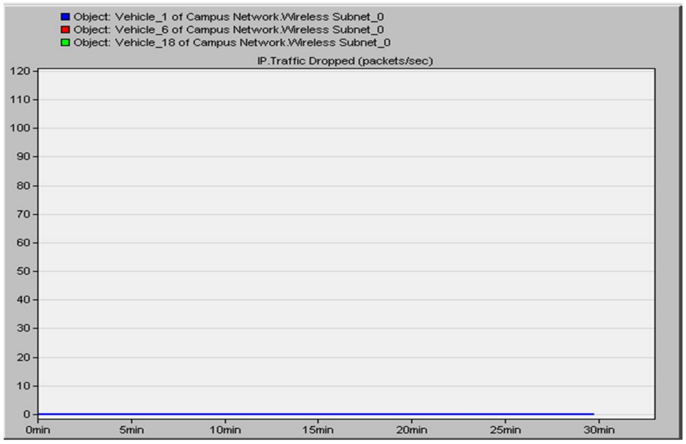

Fig. 28 Packets drop ratio for maximum request period of 15

E. Initial Request Period

Here we will only change initial request period and other parameters will be kept constant in order to be optimized.

a. **Initial Request Period0.25**

Figure 29 shows end-to-end delay which is nearly 0 except few spikes. Variation in end-to-end delay is discussed in figure 30 which is about 0.01, a really low value. In figure 31, packet lost ratio is shown and for sure it is 0.

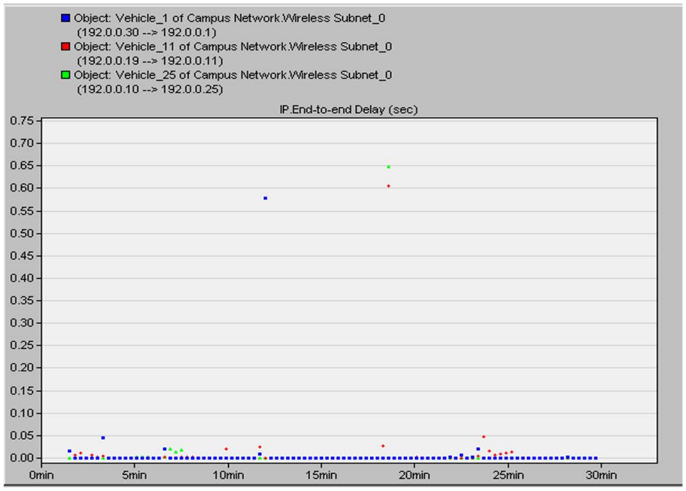

Fig. 29 End-to-end delay for initial request period of 0.25

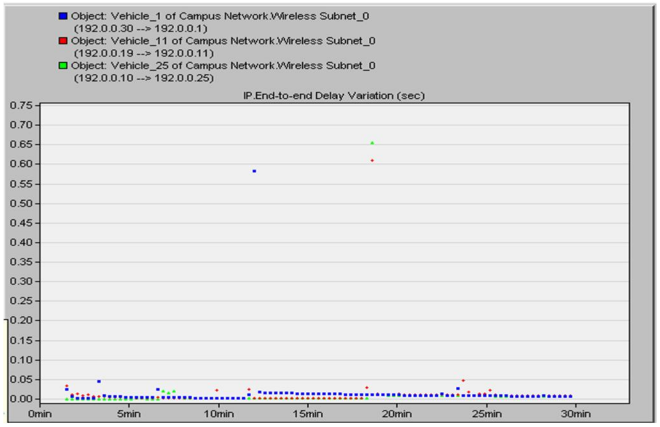

Fig. 30 Variation in end-to-end delay for initial request period of 0.25

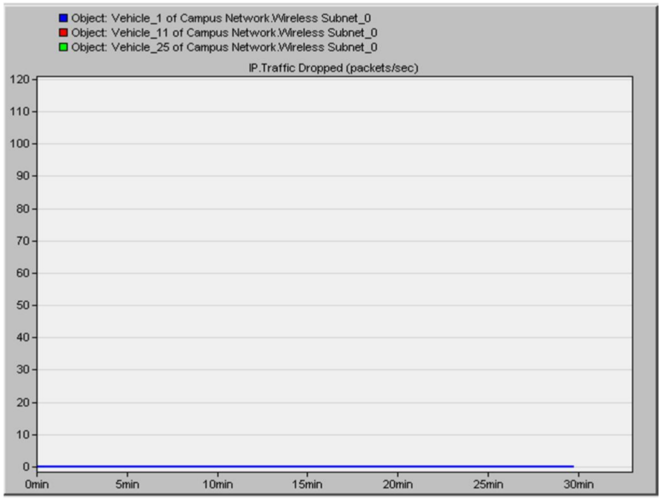

Fig. 31 Packets drop ratio for initial request period of 0.25

b. Initial Request Period0.5

We can see end-to-end with initial request period with 0.5 is nearly 0 but it has some glitches as exposed in figure 32. But variation in end-to-end delay is more i.e. up to 0.16 as shown in figure 33. And as usual packet lost ratio is 0 as in figure 34.

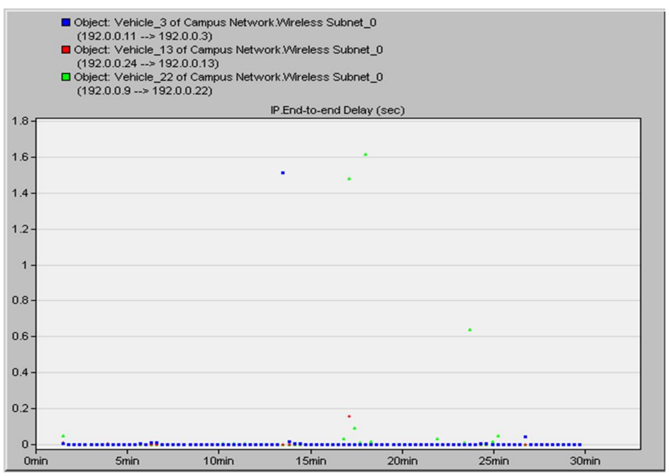

Fig. 32 End-to-end delay for initial request period of 0.5

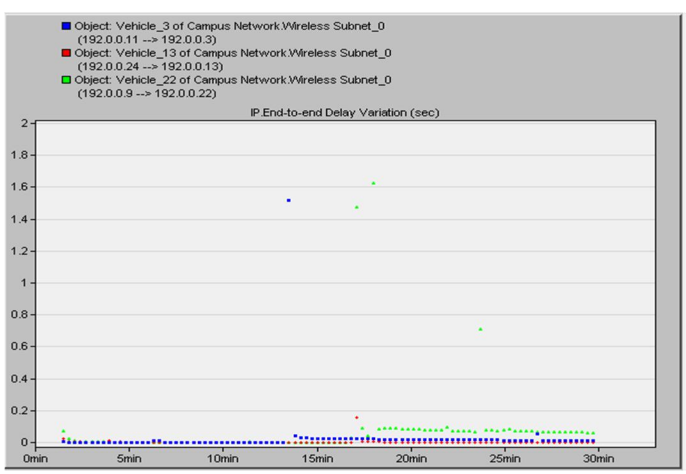

Fig. 33 Variation in end-to-end delay for initial request period of 0.5

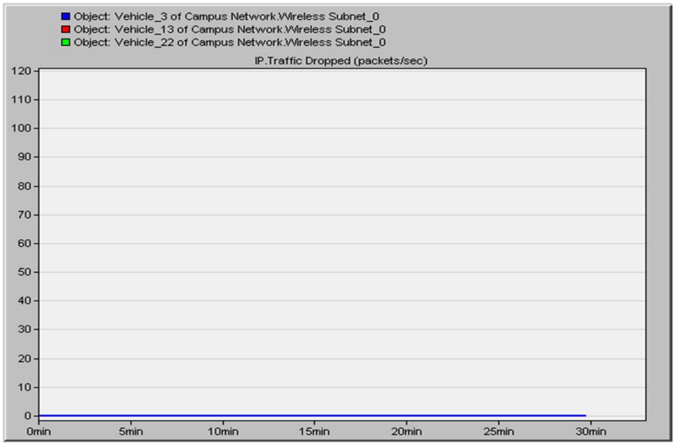

Fig. 34 Packets drop ratio for initial request period of 0.5

c. Initial Request Period0.75

End-to-end delay is almost 0 with initial request period of 0.75 as in figure 35 but variation in end-to-end delay is slightly higher i.e. up to0.18 along with some spikes as exposed in figure 36. And again packets dropped ratio is 0 as shown in figure 37.

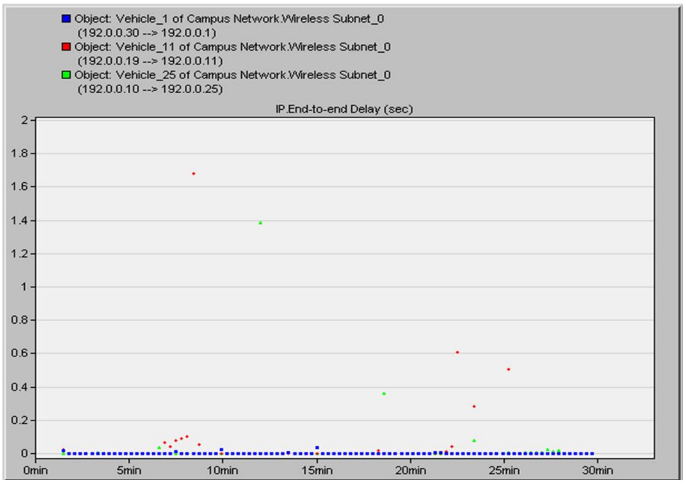

Fig. 35 End-to-end delay for initial request period of 0.75

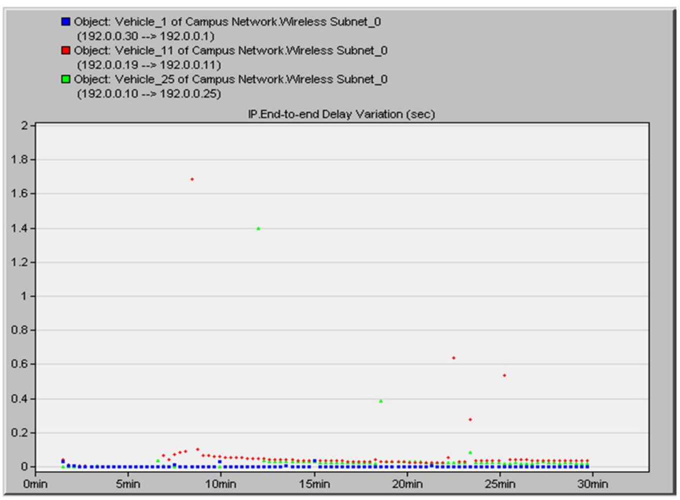

Fig. 36 Variation in end-to-end delay for initial request period of 0.75

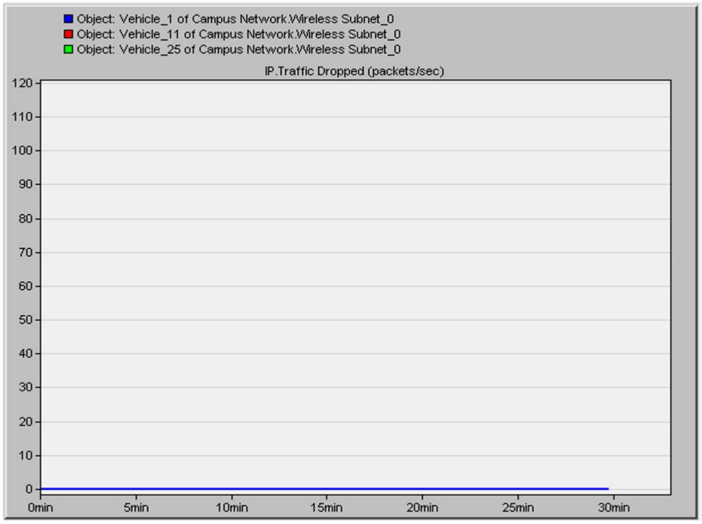

Fig. 37 Packets drop ratio for initial request period of 0.7

4. RESULTS

With these simulations, we can infer that in order to get optimum performance in VANETs using DSR, we need to change the value of different parameters. In this paper, we took 04 different parameters and checked the performance in terms of QoS using different values. The parameters were request table size, maximum request table identifier, maximum request period and initial request period. Our simulations shows that request table size with 20 gives the best results. Maximum request table identifier with 10 is best for DSR in congested VANETs. Maximum request period of 5 is suitable and initial request period of 0.25 is the best value.

5. CONCLUSION

We conclude from this research activity that with some modification existing MANETs routing protocol can be used in VANETs. So if we want to consider DSR for VANETs in densely deployed situation then above mentioned optimized values should be used, since in densely deployed VANETs vehicles are moving with slow speed i.e. in our case we considered speed of 50 km/h, we optimized the variables for this particular speed.

6. FUTRUE WORK

As we research work focused only congested situation where vehicles are moving with slightly slow speed. In order to make DSR usable for all other scenarios, more work is needed. Moreover, we catered for only 04 parameters, so other parameters should also be considered.

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