International Journal of Computer Science
ISSN:2348-6600
Oddity...Probe...Reviste...
Published by SK Research Group of Companies(SKRGC)

http://www.ijcsjournal.com Volume 3, Issue 1, No 2, 2015. ISSN: 2348-6600
Reference ID: IJCS-077 PAGE NO: 436-440.

QoS based clustering protocol in VANET Review

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***Abstract*—In this paper, problem of clustering in Vehicular Ad hoc Networks (VANETs) using Quality of Service Optimized Link State Routing (QOS-OLSR) protocol is addressed. The solution proposed is QOS based. The goal is to form stable clusters and maintain the stability during communication and link failures while satisfying the Quality of Service requirements. This is achieved by (1) considering the high mobility metrics while computing the QOS, (2) using Ant Colony Optimization for MPRs selection, and (3) using MPR recovery algorithm able to select alternatives and keep the networks connected in case of failures.**

***Index Terms*- VANET, QoS-OLSR, Clustering.**

I. INTRODUCTION

VANET [1] is a new technology that integrates the potentials of new generation wireless networks into vehicles.
It aims:

(i) Continuous connectivity for mobile users while they are on the road, which enables them to link with other users through home/office based networks.
(ii) Efficient wireless connection between vehicles without access to any fixed infrastructure.

VANET is also known as inter-vehicle communication (IVC). VANET devices such as on-board units are fixed in vehicles and function as the nodes to transmit and receive messages through wireless networks. These devices provides drivers and passengers with the latest information and alerting drivers about the conditions of roads, traffic and related aspects which are crucial to safety and to the regulation of flow of vehicles.
Factors affecting VANETS:

(i) Fast moving vehicles.
(ii) Active information transfer.
(iii) High speed of mobile nodes.
(iv) Identifying routes.

Position-based routing and geo-casting are more capable than other routing protocols for VANETS, just because of environmental limitations.

Few standards are similar to these of MANETs as both MANET and VANET don't depend on a permanent base for communication and information which is broadcasted.

The communication between the nodes and fixed infrastructure is said to be the vehicle to infrastructure (V2I) communication.

The communication between nodes only is said to be inter-vehicle or vehicle to vehicle communication.

They use wireless technologies such as, 3G cellular systems, LTE, LTE-Advance, IEEE 803.11 and IEEE 802.66e.

The information gathered from the sensors fixed in vehicles will be extremely useful in alerting other vehicles about emergencies, and will also assist the police in tracing criminals.

There is one more communication method which is the combination of vehicle to vehicle and vehicle to infrastructure called the hybrid. In hybrid architecture, the wireless networking devices are fixed in roadside communication units like cellular towers and vehicles along with some access points to form a smooth communication between the nodes.

This paper focuses on VANET QOS-OLSR protocol. It is a QOS based Clustering protocol for VANET. The foremost objective of routing protocol is to attain short communication time while using the amount of network resources. Many protocols which are designed for MANETs can be directly applied to VANETs. But the simulation results show that the performance of VANETs have been affected by following factors: fast moving vehicles, active information transfer and the associated high speed of mobile nodes, which are different from MANETs. Identifying and administering routes have always been the challenging tasks in VANET. Therefore, some new protocols have been designed especially for VANETs.

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VANET QOS-OLSR is one of the protocols which have been proposed to maintain the stability of the vehicular network. It is a cluster- based protocol, includes QOS-based clustering, MPRs. The QOS parameters such as Bandwidth, residual distance, velocity ratio and their results have been studied in this paper.

II. Literature Review

Several clustering and routing algorithms have been advanced to cope with Mobile and Vehicular ad-hoc networks. The main clustering algorithm for VANET has been proposed.

Clustering algorithms for VANET

Modified DMAC [2] was proposed on top of the original Basagni's Distributed and Mobility-Adaptive Clustering algorithm. Its basic idea is to increase the stability and avoid re-clustering of the group of vehicles moving in different direction. In this algorithm each node has to know its moving direction, current position and velocity.

Affinity propagation for vehicular network (APROVE) [3] uses the affinity propagation algorithm to perform a clustering that minimizes the distance and the mobility between cluster-heads and members. The affinity metric is composed of responsibility and availability factors.

In [4], the authors propose a clustering approach that groups vehicles of similar mobility patterns in one cluster. The mobility pattern is represented in terms of speed and direction. The objective of this approach is to increase the stability and extend the lifetime of the clusters.

In [5], multi-hop clustering is proposed that uses the relative mobility between multi-hop away nodes, beacon delay is used to calculate this metric. The cluster- head is elected according to the smallest aggregate mobility value. The re-clustering problem is also re-considered by postponing it for some time.

In [6], the authors use complex metric composed of traffic conditions, connected graphs and link quality. Before assigning a node to a cluster, a check on the node's reliability is done using the membership lifetime counter. This has the advantage of avoiding needless re-clustering.

QOS-based clustering protocols

Optimized link state routing (OLSR) [7] protocol has been designed to cope up with MANETs. The basic idea is to elect a cluster-head for each group of neighbor nodes and divide the network into clusters. These heads then selects the special kind of nodes called multipoint relay nodes (MPRs). The function of MPR is to reduce the overhead of flooding messages by reducing the duplicate transmissions within the same zone. QOLSR [8] was better than OLSR to consider the Quality of Service of the nodes during the election of heads and the selection of MPRs. In fact, QOLSR chooses the optimal path satisfying the QOS constraints. Although the QOLSR is unable to deal with Vehicular Ad hoc Networks since it considers exclusively the nodes' bandwidth ignoring thus some other important metrics such as mobility.

Now, the Quality of Service Optimized Link State Routing (QOS-OLSR) [9] is introduced. It is a cluster based protocol that aims to offer the prolong lifetime of network. This protocol considers in addition to the bandwidth, some metrics that may affect the network lifetime such as the residual energy, residual distance, and velocity ratio.

VANET QOS-OLSR protocol

In this, VANET QOS-OLSR protocol is proposed to maintain the stability of the vehicular network. Its three components have been explained, the QOS-based Clustering, the cheating preventing and the MPR recovery. The cluster head election algorithm selects a set of optimal cluster-heads. These elected cluster-head select a set of optimal MPR nodes responsible for transmitting the packets and connecting the clusters according to an authentic procedure. Then MPR recover algorithm deals with the link failures by selecting alternative MPRs.

Quality of Service metric model

In this paper, Vehicular Ad-hoc Network topology imposes new parameters to adopt in addition to bandwidth and connectivity namely the vehicle's mobility represented by residual distance and velocity. The bandwidth is considered to ensure the reliability, the connectivity is considered to increase the coverage of the cluster-heads and MPRs, while the velocity and distance parameters are considered to maintain the stability of the network.

III. RESULTS

In this part, a comparison study is presented between the proposed models in order to find the best model that will be compared with the other approaches

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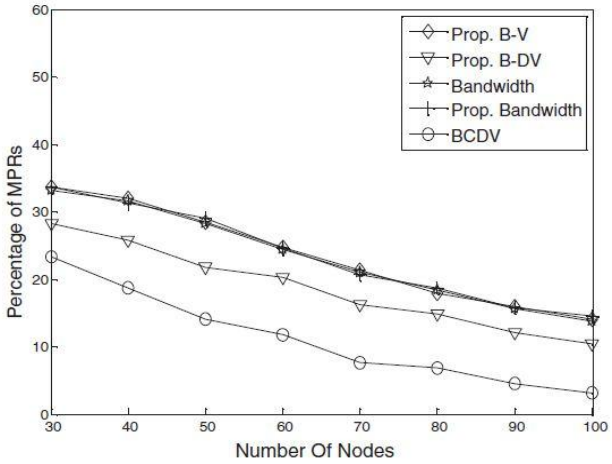

Figure 1. Percentage of MPR nodes *[10]* the BCDV model is able to decrease the percentage of MPRs by considering the connectivity factor that is able to increase the coverage of MPRs.

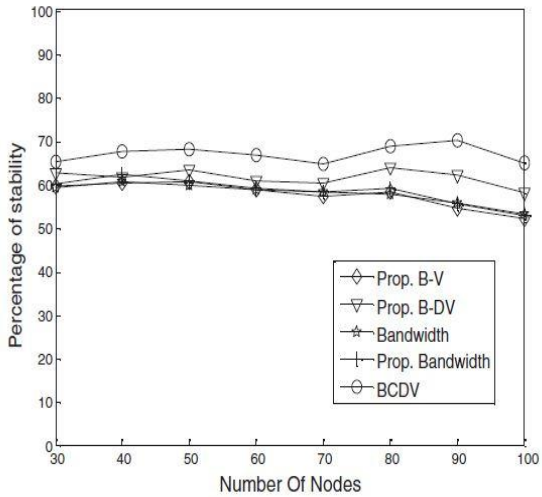

Figure 2. Percentage of stability *[10]* The BCDV model is able to increase the percentage of stability by considering the residual distance and velocity that can decrease the clusters' disconnections.

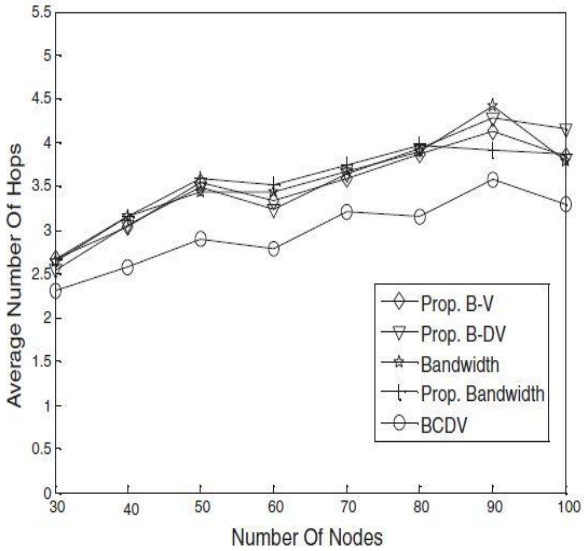

Figure 3. Average number of hops *[10]* The BCDV model is able to decrease the average number of hops by using the Ant Colony Optimization for MPRs selection and considering the route time when calculating the pheromone.

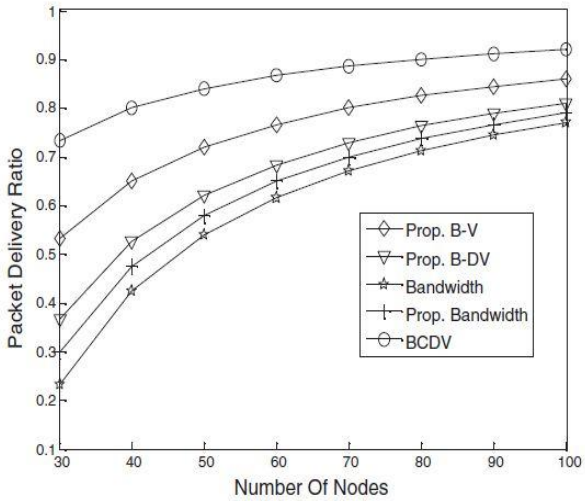

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Figure 4. Packet delivery Ratio *[10]* The BCDV model is able to increase the packet delivery ratio by increasing the stability and using Ant Colony Optimization for MPRs selection.

In this part, a detailed comparison between the cluster-based QOS-OLSR and the classical without clustering QOLSR. The VANET QOS-OLSR adopts the clustering concept so that each set of nodes elects their cluster-head which is in turn responsible for electing the appropriate set of MPRs used for communicating other clusters.

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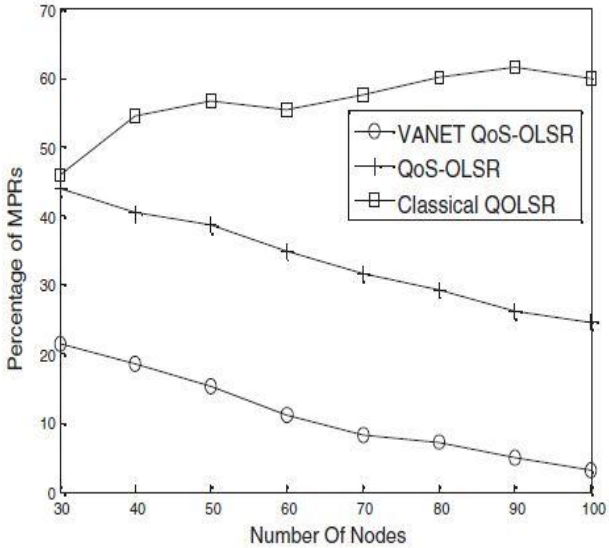

Figure 5. Percentage of MPR nodes *[10]* this shows that the cluster based model give a reduced percentage of MPR nodes by 20%.

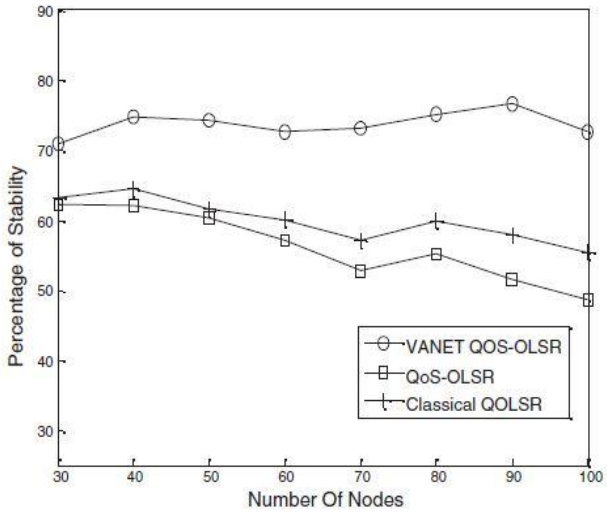

Figure 6. Percentage of stability *[10]* it reveals that VANET QOS-OLSR increases the percentage of cluster stability as the number of nodes increase.

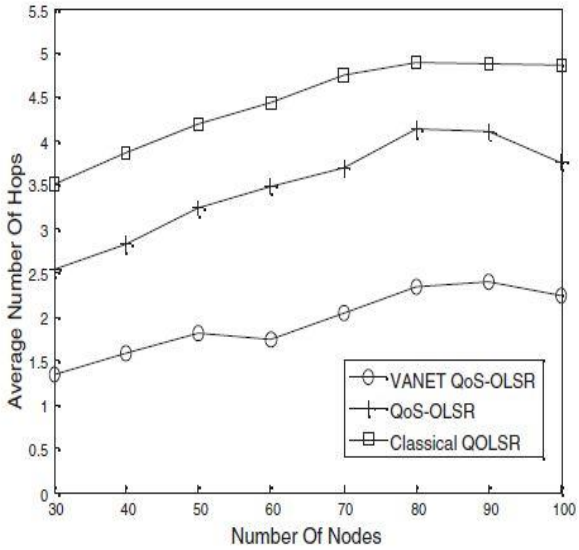

Figure 7. Average number of hops *[10]* it describes the average number of hops yielded by the three protocols (VANET QOS-OLSR, QOS-OLSR and QOLSR) after sending messages from ten random sources to ten random destinations. The shown result proves that the VANET QOS-OLSR model gives the less number of hops compared to other models.

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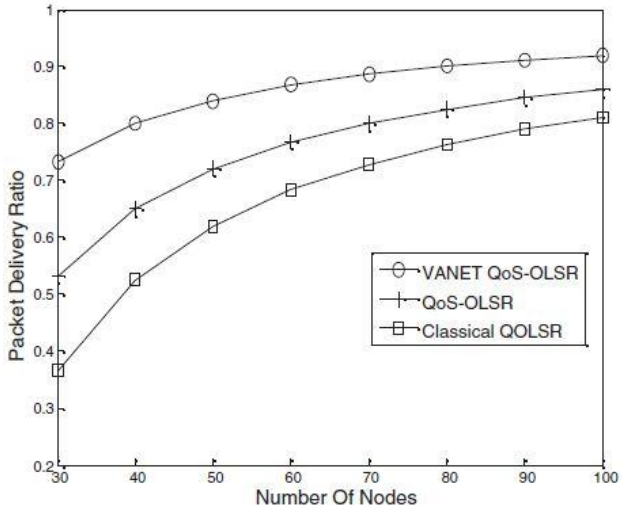

Figure 8. Packet delivery ratio *[10]* It reveals that VANET QOS-OLSR is able to increase this ratio. This is due to the fact that it is able to increase the connectivity, maintain the stability and decrease the end-to end delay compared to the other approaches.

IV. CONCLUSION

In this paper, we propose VANET QOS-OLSR protocol. It is designed to maintain the stability of the vehicular network while achieving the Quality of Service requirements. It is composed of three components (1) QOS-based clustering using ACO (2) cheating prevention algorithm (3) MPR recover algorithm for maintaining the stability of clusters velocity and distance metrics have been added. Performance analysis and simulation results prove that our protocol is able to extend the network lifetime, reduce the percentage of selected MPRs, increase the packet delivery ratio and decrease the path length.

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