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Research paper

Comparative Analysis of Clustering using AODV DSDV and CBRP

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Abstract

In a network whether wireless or wired, a set of protocols which are used to distribute the information through various routes between the nodes are said to be the routing protocols which serves as a majorly vital part of the computer networks. They specify the particular and specific path of information exchange by the sending and receiving of packets. Vehicular ad- hoc networks are quite emerging technologies of today's era presenting the provision of seamless and uninterrupted communication in the network of mobile nodes in dynamic environment. Routing itself proves to be quite a considerable and crucial challenge where the routing protocol named AODV performs its best by proving itself considerably more efficient. The stated paper focuses on the Performance comparison of the conventional protocols AODV and DSDV where AODV outperforms DSDV and offers better QoS but such conventional protocol proves to be inauspicious in VANET. This paper gives verification of better QoS of cluster based routing protocol CBR over the conventional routing protocols. The Simulation and comparison results have been carried out in Network Simulator NS-2 to briefly elaborate the impact of AODV DSDV and CBR routing protocols on the bases of Throughput, Normalized Routing Load, Control overheads, delay, Jitter and Packet drop ratio as performance metrics.

Keywords: *DSDV; AODV; VANET; CBR; QoS.*

1. Introduction

Since the 21st century has started, the vehicular ad hoc networks (VANETs) have woven their cobweb potentially and gained the dominance under the Mobile ad- hoc network (MANET) introducing it as the hot research topic. Though VANET shares similarities with MANET such as self-organizing nodes and the management of the information by itself, there exists some disparities also such as the VANET possess low bandwidth, dynamic topology, high dynamicity, short radio transmission range, frequent disconnections, sufficient storage and a communication environment including V2V and V2I interactions. Being cognizant of the dynamic topology of these networks with fast mobility and a big size network, it thus direly require the routing protocols for better efficiency where the better QoS is a major challenge to be achieved.These noteworthy characteristics of the vehicular ad- hoc networks makes the task of routing the information utterly challenging. In the VANETs, each mobile node is said to act as a host as well a router. In a defined communication range every node communicates with each other directly. For the purpose of communication with nodes that are outside of the communication range, there requires the intermediate nodes.

The objective of the paper is to compare the performance of AODV (Ad- hoc On Demand Distance Vector), DSDV (Destination- Sequenced Distance Vector) and CBR (Cluster Based Routing) Protocols on the bases of QoS parameters (Throughput, Control overheads, delay, Jitter, Normalized Routing Load and Packet drop ratio). The paper has been organized as follows, Section-2 discuss the routing protocols and their description. Section-3 explains the clustering and its need. Section-4 describes the protocols that we are using here along with its advantages, disadvantages and its usage and applications. Section-5 explains the various considered performance metrics on the bases of which the results have been carried out and discussed in Section-6 with detailed comparison of CBR protocol with the conventional routing protocols AODV and DSDV which shows the working of these routing protocols using NS-2.

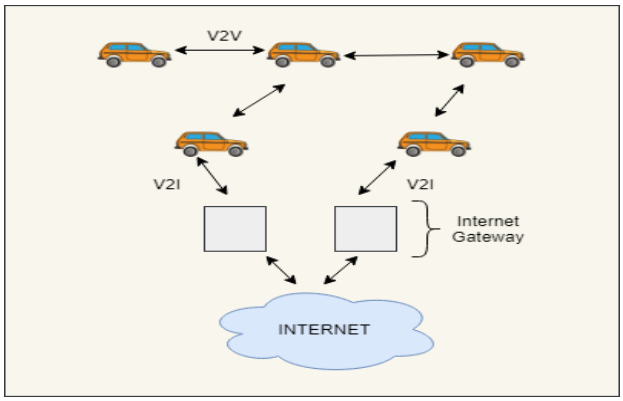

Fig. 1. VANET road scenario

2. Routing Protocols

Routing in VANET is quite a sturdy process due to the extraordinary and peculiar kind of the network offering high mobility of nodes and highly partitioned network with dynamically changing topology. The routing protocols are imperatively required so as to offer less network resource usage with the least communication. The Routing Protocols are responsible for routing the packets from one mobile node to the other in an efficient way. The Routing Protocols are: (a) Proactive (b) Reactive (c) Hybrid

Table 1: Routing Protocols

Proactive	Reactive	Hybrid
Table driven routing protocols	On- demand routing protocols	Combination of Proactive and Reactive
Every node owns individual routing table which is updated time to time	-Does not run the routing of path by itself - Does not require to update routing path	- Startup routing: Proactive - Use of network nodes with Reactive routing
High OH	Low OH but high latency	Improved OH
e.g. DSDV, OLSR	*e.g.* AODV, DSR	*e.g.* TORA, ZRP

The Routing Protocols for VANETs have been rigorously investigated by numerous researchers presenting the three leading functions as:

- Discovery of route
- Maintenance of route
- Selection of most dynamic route

In case of the VANET related routing protocols, we have different classification of the protocols as the topology is totally dynamic. Hence, the routing can be done with topology based, position based, geocast based, cluster based, broadcast based routing protocols. In our study, the used protocols are AODV, DSDV and CBR which have described in later section.

3. Clustering

In VANET, clustering is used as a method to club the mobile nodes to make a group of nodes with the help of clustering algorithms where the routing protocols are used for information dissemination to route the packets from one node to the other. It is responsible to offer an end to end communication between the nodes with the reliability across the whole the network. Hence, where the network uses routing protocols to route the packets, there clustering is used to stabilize the network by partitioning it and increasing the lifetime of the cluster. As we are using the AODV, DSDV and CBR routing protocols where the clustering is done when the process starts at the simulation period of 5ms.

Once the clusters are set up then process starts as:

• Dummy packets are sent to all the nodes of the cluster in order to calculate the trust value using the QoS parameters.

• The Cluster head (CH) nodes specifies the cluster distance range to nodes.

After attaining the CH as seen in Fig. 2 (a) , there three CHs are achieved as the no. of nodes have been divided into three clusters with their respective CH and the information exchange is done.

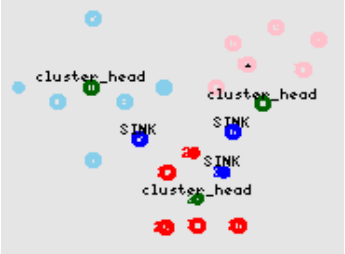

Fig.1 (a): Clustering

Since the three clusters have been achieved represented with green color, now the information is exchanged using the routing protocols as seen in the Fig. 2 (b)

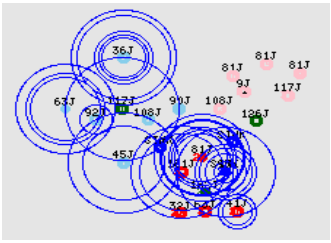

Fig. 2 (b): Routing

4. Selected Protocols

The three protocols have been implemented to analyze the QoS parameters which are AODV, DSDV and CBRP.

4.1 AODV

Ad- hoc On Demand Distance vector is the reactive routing protocol which is able to establish a proper route from the source node to the destination node whenever it is asked to send data packets on demand. The base for this algorithm is Bellman- Ford algorithm. The primary work done by AODV is the route discovery, and its maintenance. Route Request-Route Reply (RREEQ- RREP pair) packets are used for the purpose of discovery of the route. A routing table helps to find a route whenever a source node wishes for the communication with desired destination node. In the situation of n route available, the RREQ message is then broadcasted to all the other nodes i.e. the neighboring nodes. The information packaged along with the route request message contains necessary information.
It contains the address of source as well as the destination with the request identification number and sequence number. Similarly, the RREP message in return by the destination intermediate node

4.1.1 Merits of AODV

1. Being a reactive protocol, AODV can handle the dynamicity of nodes which gives it a better stage to perform in VANET.
2. The OH is less and can be used in both the unicast as well as the multi cast routing.
3. Intermittent HELLO message can be used to track the neighbors.
4. Repairable link breakages in dynamic course.

4.1.2 Demerits of AODV

1. Expiry time of the route is a bit tough to be measure whenever no data is transferred.
2. For the detection of broadcast of each node a broadcast medium is required.
3. Traffic is quite a major challenge due to the RREQ and RREP.
4. High processing time.

4.2 DSDV

Destination- Sequenced Distance Vector Routing Protocol is a table driven routing scheme which is proactive in nature based on Bellman- Ford algorithm. In every routing table entry providing all the destinations within the network is provided with sequence number. Periodically, the node transmits the routing protocols with immediate neighbors. It is not that suitable for VANETs due to the dynamicity of the vehicular environment due to the minute changes while the routing table updation.

4.2.1 Merits of DSDV

1. It provides the provision of all the loop free paths.
2. Incremental method of updation can be used to remove the issue of congestion.
3. Its routing table contains all the necessary information of sequence number as well as the hop count.

4.2.2 De- Merits of DSDV

1. It cannot be used for the multipath routing.
2.When it comes to a large network, it is difficult maintain the network because it is essential to update the routing information in routing table.
3. Congestion may occur as a challenge due to routing table updation method.

4.3 CBR

Cluster Based Routing Protocol divides the coverage area geographically into grids for the efficient transmission of the data packets. Grid contains the node which are said to be the clusters. It is basically based on the clusters as well as the position. A clusterhead is selected per cluster which performs the data transmission. CBR protocols perform really excellent in terms of QoS. It has high throughput which outperforms AODV and DSDV. CBRP is efficient in providing less delay and less dropped packets. It proves itself very efficient in minimizing the route discovery as well as the routing overheads with the help of clustering. It offers a very good packet delivery ratio.

4.3.1 Merits of CBR

1. Excellent scalability and efficiency.
2. Decreased Routing overheads
3. Better Throughput

4.3.2 De- Merits of CBR

1. Due to the source routing, overhead (OH) will increase if the cluster is very big.
2. Unidirectional links unsupported by 802.11 which works for bidirectional links.

5. Performance Metrics

The amount of the subjective information that is garnered from various routing protocols on the bases of which the performance can be compared can be utilized to look at the outcomes to investigate the best out of all these diverse routing protocols. Table I gives a comparative outlook of all the three considered routing protocols. A general description is given below:

5.1 Packet Delivery Ratio (PDR)

The ratio of received packets by the destination and the generated packets by the source is termed to be the Packet Delivery Ratio.

$$PDR = \frac{Number\ of\ packets\ received}{Number\ of\ packets\ sent} \quad (1)$$

5.2 Throughput

It is the rate of successful message delivery over a communication channel. We have calculated the aggregate throughput of AODV, DSDV and the CBRP in which throughput is the combined sum of all data rates being delivered to all the nodes.

$$Throughput = \frac{Total\ Number\ of\ received\ byte}{Total\ no.of\ transmissions} \quad (2)$$

5.3 Delay

Delay indicates the amount of time taken by the packets to reach to destination from the source.

$$Delay = \frac{\sum(arrival\ time - send\ time)}{no.of\ connections} \quad (3)$$

5.4 Normalized Routing Load (NRL)

It is the no. of transmitted routing packets for each data packet that has been delivered at destination.

6. Performance Metrics

After the simulation has been carried out in the network simulator (ns2) the performance of routing protocols have been bought up together to be compared to find the most efficient out of the three protocols. There are 22 nodes considered which are divided into a number of three clusters. Initially node 1 in the first cluster is chosen as the on the bases of highest trust value. Similarly the node 11 of cluster 2 is selected as the CH due to its highest trust value. A value of threshold is set and the node exceeding the threshold value is considered as the malicious node. The values of performance metrics are discussed in the Table 2 giving the values for throughput, jitter, overheads etc.

Table 2: Relative Comparison of Routing Protocols

PARAMETERS	AODV	DSDV	CBR
No. of packets send	642	671	717
No. of packets received	541	563	607
Packet Delivery Ratio	84.27	83.9	84.6
Control OH	1110	1089	1146
Normalized Routing OH	2.051	1.934	1.89
Delay	0.17	0.19	0.15
Throughput	249.9	192.38	256.6
Jitter	0.009	0.0086	0.0080
Packets Dropped	101	108	110
Dropping Ratio	15.6	16.09	15.33

As seen in the Fig. 3 the throughput of AODV is better than DSDV and CBR outperforms both. The results are confirmed by our conclusion that better the throughput leads to better performance. With the increase in time better throughput can be noticed.

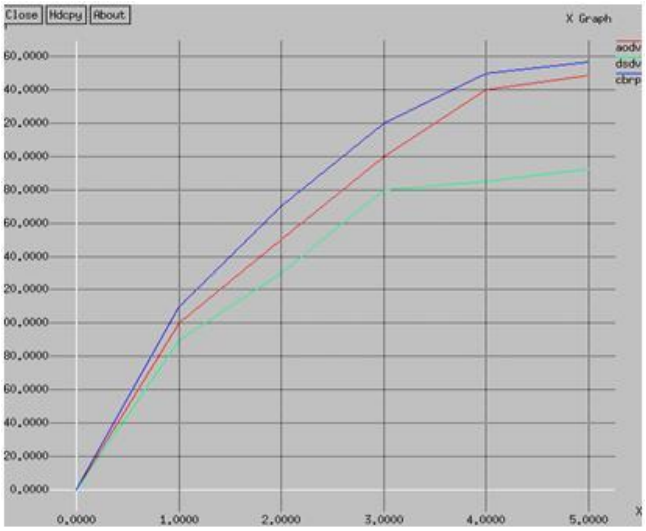

Fig.2: Throughput Performance Comparison of AODV, DSDV and CBR

Packet delivery ratio of CBR has been delivered fairly better than AODV and DSDV. The ratio is fairly decreasing with respect to time and hence the less number of packets are dropped in CBR. AODV provides the best medium PDR and CBR outperforms both.

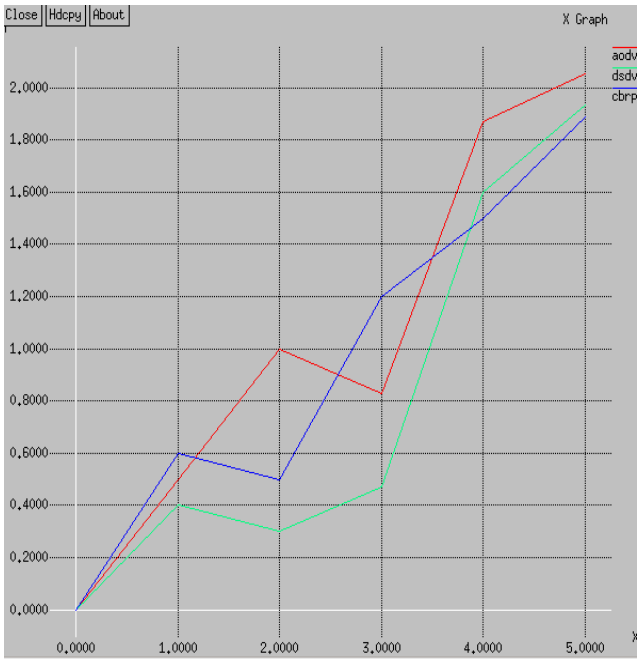

Fig. 4:PDR Performance Comparison of AODV, DSDV and CBR

The Normalized routing load in CBR is lower hence the performance of CBR is till the time best of AODV and DSDV. Here the routing OH are caused due to the data packets which waits in the buffer during a process. Since the conventional protocols causes a number of problems like exhausting extra bandwidth due to the beaconing periodically in AODV. DSDV can cause congestion and maintenance of big clusters. The curve of CBR as compared to AODV and DSDV gives a better curve.

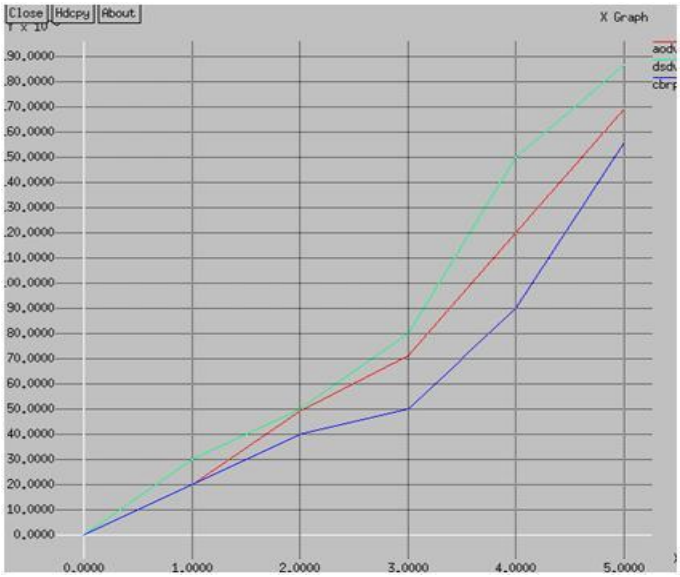

Fig. 6: Delay Performance Comparison of AODV, DSDV and CBR

The results analyzed in for delay as seen from curve in Fig. 6 shows that the delay is lesser in CBR as compared to conventional routing protocols. It reveals clearly that delay will be more with respect to time but the performance of CBR outperform others and gives a fair value.

7. Conclusion

This paper illustrates the comparative analysis of AODV, CBR and DSDV from where we have noticed a number of advantages of CBR especially in the PDR and Throughput. Lesser number of packets are dropped. CBR have low average routing overheads also high PDR. All and all the parameters satisfies and proves CBR all and all the better out of three with less jitter, low delays and overheads. The future work will focus on proposing a hybrid technique to increase the efficiency of the routing protocols so as to employ them to select an efficient clustering algorithm.

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