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CPDD: Clustering and Probabilistic based Data Dissemination in Vehicular Adhoc Networks

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Abstract

Objectives: To maintain Quality of Service (QOS) for data dissemination, prevent packet loss and high reachability. **Methods:** To achieve this, CPDD: Clustering and Probabilistic based Data Dissemination in Vehicular Adhoc Networks is proposed. The messages are disseminated between the clusters. The Performance metrics like throughput, jitter, Normalized Routing Load, Routing Overhead and packet loss ratio are analysed using NS2 and the results are compared for the varying number of nodes. **Findings:** The proposed approach has a low packet drop ratio and end-to-end delay compared to SECADD, SEAD and S1PD. The efficiency of the traffic system and the quality of driving are both improved by data dissemination through VANETs by using CPDD. The goal of an effective clustering method is to reduce the number of clusters while maintaining high communication over the vehicular network. **Novelty:** Establishing effective communication between two fast-moving vehicles is a major challenge in VANET. The challenge in designing a robust and reliable message dissemination technique is required for VANET safety applications. The results of the proposed model CPDD is compared for different numbers of nodes. The proposed work improves the QOS metrics with the Normalized Routing Load of 1.009%, Routing Overhead of 1.03 bits/sec, throughput of 205.5 bits/sec, end-to-end delay of 0.435 seconds and packet loss ratio of 20.02% for 50 nodes.

Keywords: Broadcasting; CPDD; Routing Overhead; Dissemination; Clustering; VANET

1 Introduction

One of the most important aspects of the Intelligent Transportation System is vehicular communication (ITS). Vehicles share aggregated sensor data with surrounding vehicles, such as position, velocity, and conditions. The Vehicular Adhoc Network (VANET), which is used to improve driver safety and network performance, is most concerned with data dissemination. The major goal of this study is to maintain data dissemination Quality of Service (QOS), avoid packet loss, and provide high reachability. CPDD:

Clustering and Probabilistic-based Data Dissemination in Vehicular Adhoc Networks is proposed to do this. The messages are dispersed throughout the clusters[1]. Routing the message is a major problem in safety and non-safety of VANET applications. The challenge in designing a robust and reliable message dissemination technique is a challenge because of the stringent QoS requirements of the VANET safety applications[2].

Vehicles and travel are a part of our everyday lives. We must travel for job, pleasure, and other reasons. The fault of the driver, the fault of the pedestrian, the defect in the road condition, the defect in the condition of the motor vehicle, and so on are the most common causes of road accidents[3]. We now live in a linked vehicle world. Vehicles are always connected to the internet. Mobility management, entertainment, driver assistance, and well-being are some of the application areas. The following are some of the unique aspects of VANET: The topology of a network changes frequently. Because of the rapid mobility of the nodes, the position of the node changes often[4]. Between the vehicles and the Road Side Units, there is a lot of information exchange via wireless channel. VANET can be used for one or more cities. Dedicated Short Range Communication (DSRC) and Wireless Access in Vehicular Environment are the wireless access technologies utilised in VANETs (WAVE)[5]. In 2003, Europe and Japan developed Dedicated Short Range Communication (DSRC) to support vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications[6]. The Challenges during data dissemination are scalability, security and trust, Quality of Service, Data Transmission in presence of Disconnection, High Mobility and Frequent Disconnections[7].

1.1 Literature review

Data dissemination refers to spreading the data or information over distributed networks[8]. Data dissemination in VANETs improves the efficiency of traffic system and quality of driving. It is tough for vehicles to communicate among themselves due to large number of vehicles on road[9]. It becomes very challenging task for vehicles to transmit information over the network[10].

Table 1. Data dissemination techniques

Approaches	**Applicability**	**Drawbacks**
V2I/I2V	Spread information about road conditions, enquire information about nearby restaurant, parking lot, etc.	Highly expensive, requires lot of infrastructure to be installed, latency issues.
V2V Forwarding	Flooding approach is good for delay sensitive application and suitable for sparse networks during low traffic conditions. Relaying is preferred for congested networks	Flooding is not suitable for dense networks. Reliability is difficult in relaying.
Opportunistic	Suitable for entertainment applications.	Server load increases with the increase in vehicle density, Flooding and storm problems occur.
Geographic	Less suitable for safety applications.	High latency, low success rate in message delivery and broadcast storm.
Cluster based	Reduces delay and storm issues.	High computational cost to connect the clusters with each other.
Peer to peer	Suitable for content dissemination. Does not cause message storm.	Decrease bandwidth and storage capacity per node quickly.
QOS based	Safety related application.	During data communications, QOS based clustering algorithms are required to maintain the stability of the clusters.
Delay based	Improves packet arrival ratio. Reduces retransmission of packets. Deals with broadcast storm problem.	If the protocol is not designed accurately, the timer Quantization effect may result in stopping the dissemination.
Probability based	Forward packets with certain probability to reduce information redundancy.	Higher density may lead to more communication redundant and the broadcast storm.

There are four categories of information need to be disseminated. They are as follows:

1.1.1 Safety information

Safety information have the highest priority. They are originated by vehicles or Road Side Units (RSU). Safety information are divided into eight categories such as Curve speed warning, Traffic signal violation warning, Emergency electronic brake lights, Pre-crash warning, left turn assistant, Lane change warning, Stop sign movements' assistance, cooperative forward collision warning[10].

1.1.2 Traffic information

Mobile nodes can be informed in advance about the road congestion. They can avoid traffic and select the best route. It is less critical than life safety information. It still has high priority when compared to content and infotainment information.

1.1.3 Infotainment

Infotainment information is the message about the entertainment. For example, Locating the nearest coffee shop, mall, fuel station, etc.

1.1.4 Content

Content data dissemination refers to the distribution of multimedia data such as audio, video clips, movies, etc[11].

1.2 Challenges in data dissemination

Some of the main issues during dissemination of data are as follows:

1.2.1 High mobility

Vehicles move with a very high speed and the topology changes. There is a frequent topology disconnection. The vehicle density is low during night in urban areas and both day and night in sub-urban areas. Vehicle density is high in urban areas during rush hours in a day.

1.2.2 Data delivery

When large number of vehicles requests same data at same time, data delivery becomes challenging. When vehicles operate in limited bandwidth, the network gets disconnected[11].

1.2.3 Data transmission over mesh nodes

All the nodes are not connected for long time and over the desired distance to ensure smooth flow of information. It is tough to transmit data over mesh nodes.

1.2.4 Data passing through different structures is tough

It is difficult to maintain different structures like tree, grid, and clusters for data dissemination. The problems may arise due to dense or sparse network at random points in the vehicular network zone. This will cause network disconnection and partition.

1.2.5 Data Collection

The data is collected from different sources before dissemination. As the vehicle speed is high, it becomes challenging to collect the information when the number of vehicles is more.

2 Methodology

Routing refers to finding optimal path between source and destination node and then sending message on that path so that message can reach its destination easily, quickly and on time. The main issue that needs to be solved in VANETs is how to exchange information in scalable fashion. The answer lies in Data Dissemination Protocols. In urban areas there are many numbers of intersection points and in large cities buildings can block communication among nearby vehicles though they are in transmission range of each other. So, it is important to forward information to those vehicles or RSU that are close to intersections so that the packets should not be lost due to obstacles such as buildings or tunnels[11].

2.1 Clustering based dissemination algorithms

Clustering is the process of organizing vehicles into groups based on some rules or criteria or some common characteristics. The nodes are divided into a number of similar groups. Under a cluster structure, mobile nodes may be assigned a different status or function, such as cluster head, cluster member or cluster gateway[4]. A cluster head (CH) is a special node responsible for assigning bandwidth and coordinating the cluster members of the cluster. In each cluster, there must be at least one cluster head (CH). Usually, nodes which have better features are elected as cluster head. Cluster member is the non-cluster head node called as ordinary node, which is without any inter-cluster links. Cluster gateway (GW) can access neighboring clusters and forward information between clusters[12].

In hybrid backbone-based cluster algorithm, the clusters are formed and the CH is selected by considering the vehicle mobility and number of links. Nodes with high degree of connectivity builds a backbone called as leadership. In mobility-based clustering scheme, the clusters are formed using Affinity Propagation algorithm in a distributed manner. Factors like average CH duration, average CM duration, average rate of CH changes and average number of clusters in the network are considered[13]. The node with the minimum weight value is elected as CH in Cluster based emergency data dissemination scheme. The Beacon based clustering algorithm increases cluster lifetime and reduces the node state. A node with less variance relative to its neighbors is a better choice for CH. Density Based Clustering algorithm (DBC) forms stable, long living cluster for reliable communication. The formation of the cluster is based on the factors like traffic conditions, density of connection graph and link quality. Direction based clustering technique increases cluster life time and minimizes the communication overhead. Efficient clustering algorithm is designed for efficient resource consumption[14]. The CH is selected based on neighborhood list of the vehicles, determining the priority of vehicles based on the distrust value, direction of the vehicle and entropy of vehicles. Position and direction information are used to form stable clusters in Stable Cluster based technique. Nodes having higher number of stable neighbors is selected as CH. Dynamic and Stable Clustering technique uses software agents to form dynamic and stable technique for clustering in VANET[15]. Cluster based Multi-channel MAC Protocol (CMCM) improves successful delivery rate of safety messages. It achieves real time traffic delivery. Distributed and Mobility-Adaptive Clustering (DMAC) can adopt to changes in the network topology caused by node mobility. It is suitable for any mobile environment. Vehicular Multi-hop algorithm for Stable Clustering (VMSaC) minimizes cluster overhead.CH duration and CM duration is maximized to provide stability. The summary of cluster-based dissemination algorithms is listed below[16–19].

Table 2. Clustering based dissemination algorithms

Algorithm Name	Description	Drawbacks
Cluster Based Medium Access Control Protocol (CBMAC)	Medium Access Protocol is used for data transmission. As every node sends data in the bandwidth assigned to it by Cluster Head, the use of MAC protocol enables collision free data transmission	Clusters are not stable. Waiting time for undecided node may be longer. One node is associated with different Cluster Head in different clusters. So, unnecessary messages are transmitted.
Clustered Gathering Protocol (CGP)	Cross layer protocol based on geographical and hierarchical data collection, aggregation and dissemination approach.	For CH selection, only geographic position of the node is considered. Clusters are not stable. Factors like velocity, node degree, and available resources are not used. QOS requirements of delay sensitive services are not fulfilled.
Affinity Propagation for Vehicular Networks (APROVE)	Clusters have high stability. It provides good clustering performance.	Acceleration, node degree, and bandwidth are not considered. QOS requirements of delay sensitive services are not fulfilled. Number of messages exchanged for cluster formation and CH selection are large.
Mobility Metrics Based Dynamic Clustering Algorithm (DCA)	Cluster stability is high. Average acceleration and average velocity metrics are used for cluster formation.	Node degree, and bandwidth are not considered in the cluster formation. Number of messages transferred for cluster formation is high.
Clustering Based Data Transmission Algorithm	It is a combination of CH selection algorithm and cluster switching algorithm. A cluster member in one cluster can request access to a new cluster if its transmission performance will be enhanced based on delay and throughput sensitive service.	If the cluster member increases, maintenance cost and cluster management also increase.
Mobility Based Metric for Clustering (MOBIC)	It uses mobility metric for cluster formation phase.	Cluster maintenance overhead may increase. It requires extra explicit message exchanges among mobile nodes for maintaining cluster structure.
Hierarchical Clustering Technique	CH is in the top of the hierarchy. Cluster Members (CM) are grouped into subsets of slave nodes and cluster relay nodes.	Overhead is high due to clustering hierarchy maintenance. It does not consider vehicles movement dynamicity.

Continued on next page

Table 2 continued

Directional Propagation Protocol (DPP)	It utilizes directionality of data and vehicles for packet propagation.	It can waste significant bandwidth due to uneven traffic density and imposed delays on packets propagation.
Opportunistic Packet relaying in disconnected vehicular Adhoc networks (OPERA)	It uses traffic directions to disseminate packets in an efficient way. It uses traffic incoming direction to disseminate a packet only if it overlaps another co-directional cluster on the road.	It is designed for undivided roads at which cars in both directions can communicate with each other.
Vehicle Assisted Data Delivery Protocol (VADD)	It follows carry and forward technique. When the routes do not exist, the nodes carry the packet and forward the packet to the new receiver that moves into its cluster or communication range.	Dynamic path selection should be continuously executed throughout the packet forwarding process.
Distributed Multi-hop Clustering algorithm based on Neighborhood Follow (DMCNF)	It follows proactive and shortest path methods. It focuses on how vehicular cloud nodes communicate with each other to improve efficiency.	High signaling overload.
Cluster based vehicular cloud system with learning-based resource management (COHORT)	It uses fuzzy logic in CH selection process. It groups the vehicles and cooperatively provide resource to the needy vehicles.	High signaling loads due to frequent broadcasting and updating of routing table information.

2.2 Proposed Work

To address the data dissemination challenge, CPDD: Clustering and Probabilistic based Data Dissemination in Vehicular Adhoc Networks is proposed. The vehicles have heterogeneous devices such as sensors, GPS, IPv4 addressing and IPv6 addressing. DSRC communication suites only for vehicles and RSU communication. When the RSU communicate with Gateway and with vehicular cloud using IPv4 and IPv6 addressing, compatibility issues occur. The problem is that the data has to be disseminated at the crossroads and intersections. The transmission range of RSU will be very poor at the crossroads and intersections. In order to overcome this issue, the parked car closest to the intersection could be the cluster head. The parked vehicles can be leveraged to play the role of the Road Side Unit. This CH can be used as the RSU representative for traffic message collection.

The purpose of clustering is to reduce overhead, to use network bandwidth properly, and to enhance message delivery, to improve high packet delivery and low delay. The good clustering algorithm focuses on minimizing the number of clusters without increasing the high communication over the vehicular network.

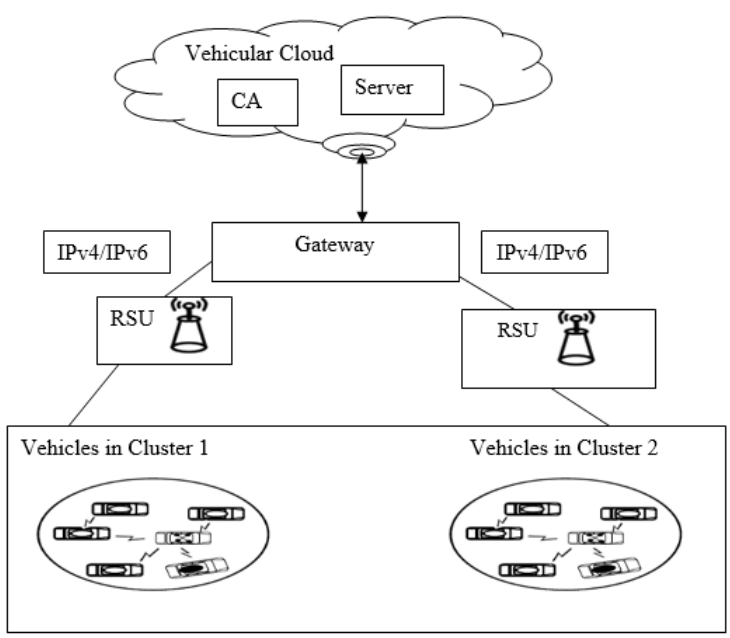

Fig 1. CPDD model for disseminating the message within the clusters

2.2.1 Node Initialization

The node does not belong to any cluster is in non-clustered state. It executes node initialization phase. Two nodes are considered to be stable neighbors when they are within the transmission range of each other. Only vehicles that are moving in same direction and same road ID will be considered to form a cluster. A message from neighbor node moving in different direction is ignored.

2.2.2 Cluster Formation

Group of nearby vehicles traveling in the same direction from a cluster. Cluster Head act as representative for intra-cluster communications among the cluster members within its transmission range. The assumptions are Transmission range is 300 meters, One Cluster distance = 1km and speed is 60-120 km/hr.

2.2.3 Parameters

Vs-Vehicle speed, Db-Data to be broad-casted, TV–Trust value, N–Node, Msg–Message, C–Cluster, P-Probability, PV-Parked Vehicle, CM-Cluster Member, CH-Cluster Head, RP-Rebroadcast Probability, S-Speed, TR-Transmission range, TG-Time Gap

Algorithm 1: Cluster Formation
Input: Vehicle speed, Direction, Hello message, Road ID, Node Id, Number of neighboring nodes
Output: Cluster Formation
1: Begin
2: If (Ni,Nj.......Nn) travel in same Direction D,
//cluster formation based on relative speed and direction
3: Ni ← confirmation Msg to Nj
// Transmission of HELLO message
4: Nj replies authenticated msg to Ni
// session is initialized
5: Else
6: Discard the message
7: End if
8: Initialize vehicle location.
9: Calculate distance D between vehicle Ni and Nj= $\sqrt{(p1-p2)^2+(q1-q2)^2}$
// p1, p2 –Current Position of vehicle
q1, q2 – Position of vehicle from which distance is calculated
10: if(Ni,Nj ← travel in similar distance)
11: assign (Ni, Nj) ←C1 //Join Cluster 1
12: else
13: assign Nj ← C2 //Join next Cluster
14: End if
15: End

2.2.4 Selection of Cluster Head

CH coordinates the task among the cluster members and it is responsible for managing the cluster structure. CH should be stable for long period to increase cluster stability. If the vehicle velocity increases, the network topology will be more dynamic and the average CH duration decreases. It is tough for CHs to maintain its stability.

Algorithm 2: Selection of Cluster Head
Input: Cluster members of cluster, Node Id, Trust value
Output: Selection of stable and trustworthy cluster
1:Begin
2: for all (Ni, Nj,........Nx) do
Call Trust Value (TV)
// TV is continuous value ranging from [0.0-1.0]
TV =1 highest level of trust
TV=0 Distrusted
TV=0.5 neither fully trusted or distrusted

3: if (TV<=0.5)
4: Declare as malicious node
5: Not allow the node to take part in CH selection
6: end if
7:else if (TV ← 0.6 -1)
8:CM ←CH
9: CH ← Db msg to CM
10:end if
11: Else if ((CM1......CMn)TV ←1)
//based on neighborhood selection if one or more CM has trust value as 1
// compare CM nodes
12: CH ← Node near RSU
13: PV ← RSU candidate
//At intersection, Parked Car closest to intersection act as RSU candidate
14: End if
15: End
Trust Value is derived as
TV=1/TG
$TG = D_{avg} / Ve_{avg}$
D_{avg} – Average distance between 2 vehicles
Ve_{avg} – Average velocity of vehicles

2.2.5 Cluster secret key agreement

Secret-key cryptography is used for more efficient intracluster information exchanges. Public Key cryptography is based on Public Key Infrastructure where the certificates are issued by a Certificate Authority (CA). Public/Private Key pair is assigned to each node and the public key certificates are authenticated by CA. Merkle Hash Tree (MHT) is used to distribute the information about the revoked certificate within the vehicular network to notify other nodes (vehicles) regarding the revoked misbehaving vehicles[20].

Algorithm 3: Cluster secret key agreement
1: Begin
// Assign private and public key
2: Pvtk -> x ∈ Z*p // private key
3: Pubk=nx∈G2 // public key
4: Key validation -> call Hash function (H1,H2)
// Revocation using MHT if malicious user have valid key
5: MHT-> Check for keys
6: If (key exist)
7: Assign new key
8: Update and distribute
9: Else
10: Certificate cancellation to the Vehicle
11: Warning msg-> RSU to RSU and Vehicles
12: Assign new Pvtk
13: Update and Distribute

Consider a bilinear map c: G1*G2 ->G3. G1, G2, G3 are cyclic groups, G1=<m> and G2=<n> with same prime order p[4]. ê (m, n) ≠1 and for any a, b ∈Z and all m ∈ G1, n ∈ G2, ê (ma, nb) = ê (mn) ab. c: G1*G2 ->G3 which can efficiently compute ê (m, n) for any m, n ∈ G1. If m is a generator of G1 and n is a generator of G2, then e (m, n) is a generator of G3.

$H1 : \{0,1\}^* > G1$

$H2 : \{0,1\}^* \times G1 - > Z^*p$

2.2.6 Cluster maintenance

Cluster maintenance phase is necessary where the validity of cluster is checked. This phase is used to maintain the cluster in a stable state. It should minimize message exchange as well as resource consumption. Due to the dynamic nature of VANET, joining and leaving the cluster happen frequently.

Algorithm 4: Cluster Maintenance
Input: Existing clusters and cluster members
Output: New cluster
1: Begin
2: if (Ni, Nj.......Nn) cannot reach CH then
3: call Selection of Cluster Head Algorithm
4: end if
5: if CH cannot reach CM then
6: CM ← remove
7: Monitor (Ni, Nj.......Nn)
8: end if
9: if two clusters are too close for a certain time then
9: Join two clusters into single cluster
10: call (Selection of Cluster Head Algorithm)
11: Select CH
12: End if
13: if the nodes are out of transmission range
14: Nodes leave the cluster
15: if CM receives signal from CH then
16: Join the cluster with the signal of CH which is stronger
17: end if
18: end
Three events that affect the cluster stability are as follows:

1. Joining the cluster
2. Leaving the cluster
3. Merging the clusters

2.2.7 Cluster node connectivity and cluster leaving

If two vehicles are neighbors and the distance is less than the communication range, the node connectivity exists. When the Cluster Head did not receive a periodic message from its Cluster Member in a particular time period, it is assumed that CM is disconnected and leaves the vehicular cluster.

Algorithm 5: Cluster node connectivity and cluster leaving
1: Begin
2: if (receiver node!=CH)
3: call Rebroadcasting Probability (RP)
//calculate RP
4: RP= Distance between CH and current forwarder/ T
5: If (Distance of CH and current forwarder)<T
6: Connectivity exists
7:end if
8:end if
9:if(d<=CR)
10: Db ← msg
11: else
12: Nodes are disconnected
//Remove the nodes from the cluster

// Nodes leave the cluster
13:End if
14: End

3 Results and Discussion

Slotted 1-Persistence Dissemination Protocol (S1PD) yields significant decrease in the number of redundant broadcast. In S1PD, the transmission range is divided into various areas designated as "slots". Incoming packet format contains source vehicle ID and a local packet ID. The packet header contains the GPS coordinates of the vehicle and Broadcasting Node ID.Each vehicle contains a data buffer to store original data packets received or generated by the local application running on the transmitter vehicular node. Whenever the packet reaches the vehicle, it checks whether the message ID is known by Cluster Head (CH). The received redundant message is discarded after the redundancy ratio parameter is updated. The disadvantage is that S1PD suffer from Timeslot Boundary sychronization problem. A Simple and Efficient Adaptive Data Dissemination Protocol (SEAD) is a hybrid protocol that combines delay and probability based dissemination schemes. It depends on distance, direction and vehicle's density. There is no beacon exchange. SEAD has high packet delivery ratio and acceptable delay. It can also reduce bandwidth consumption. Simple and Efficient Cluster Head Adaptive Data Dissemination Protocol (SECADD) tackles the broadcast storm problem by reducing excessive broadcasts. The nodes relay the packets with the help of intermediate nodes. No beaconing exchange is required. The QOS parameters considered are throughput, Jitter, Normalized Routing Load, Routing Overhead and Packet loss ratio for varying number of nodes.

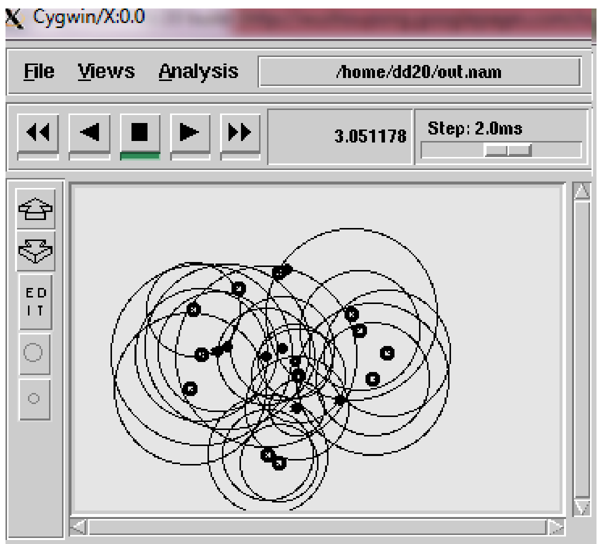

Fig 2. Data Dissemination of nodes

The above resultant graph exhibits data dissemination with 20 nodes.

3.1 Jitter

The variation in the delay of packets received is jitter. The delay time between each packet can vary due to congestion in the network.

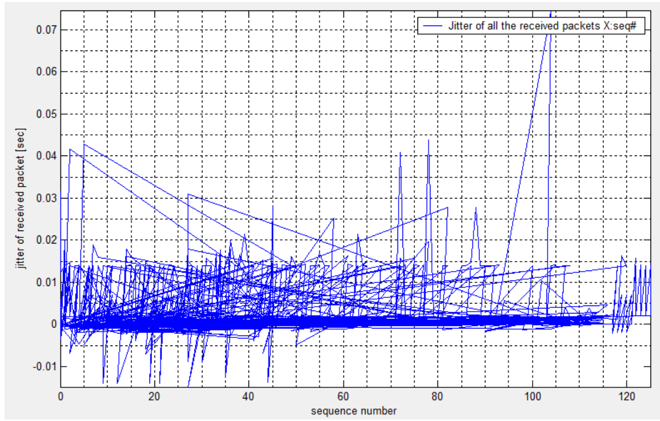

Fig 3. Jitter for 20 nodes

Figure 3 depict the jitter for 20 nodes. The main goal of QOS is to provide controlled amount of Jitter.

3.2 Throughput

Throughput refers to the total number of packet reception at the destination out of total number of packets that are transmitted. It is calculated in bytes per second or data packets per second.

Throughput (bytes/sec) = Total number of received packets at destination* packet size /Total simulation time.

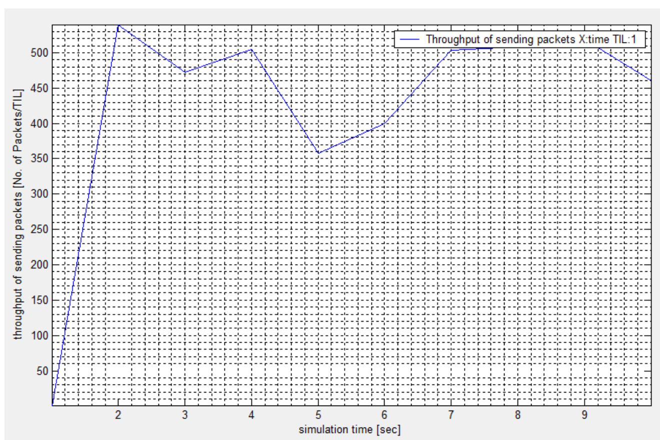

Fig 4. Throughput for 20 nodes

From the above result and analysis, it is found that the throughput parameter has major impact in QoS. It is about 205.5 bits/sec for 50 nodes. Throughput indicates the average number of successfully delivered data packets on a vehicular communication network or a network node.

3.3 Normalized Routing Load

Normalized Routing Load (NRL) is the fraction of all routing control packets sent by all the nodes over the number of data packets received at the destination node. For 50 nodes the NRL is 1.009%.

NRL value should be less for better network performance. NRL can be calculated as follows.

NRL= Total number of routing packets sent/ Total data packets received

NRL tells how efficient the routing protocol is. If the fraction is bigger, the protocol efficiency is less.

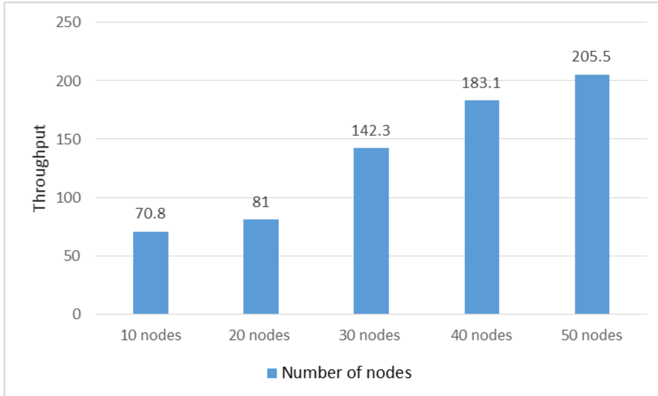

Fig 5. Throughput analysis

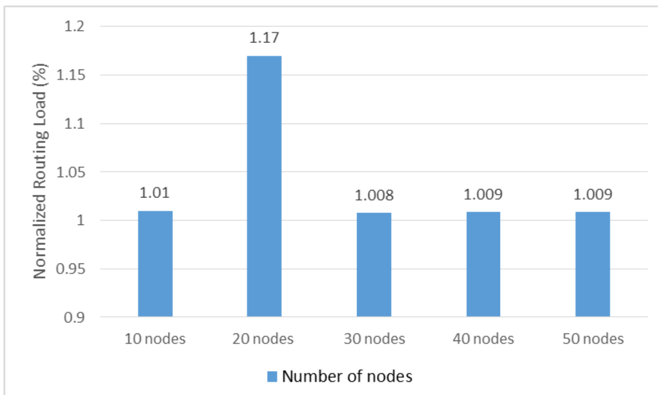

Fig 6. Normalized Routing Load

3.4 Routing Overhead

Routing Overhead is calculated by dividing the total number of routing packets sent and routing packets forwarded by the total number of data packets that are received. A good routing protocol should have less routing overhead. Figure 7 shows the Routing Overhead for varying number of nodes. It is 1.03 bits/sec for 50 nodes.

Routing Overhead= Routing packets sent+ routing packets forwarded/ Total number of data packets received

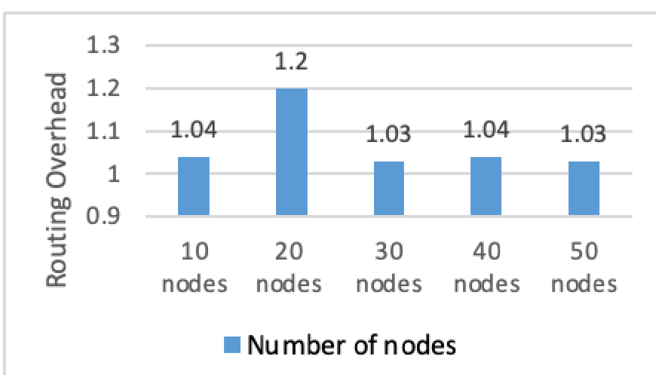

Fig 7. Routing Overhead

3.5 Packet loss ratio

Packet loss usually occurs when one or more packets being transmitted across the network fail to reach the destination.

Packet loss ratio= Total number of packets dropped/ Total number of packets sent *100

Packet Loss % = (Packets Sent – Packets Received) / Packets Sent

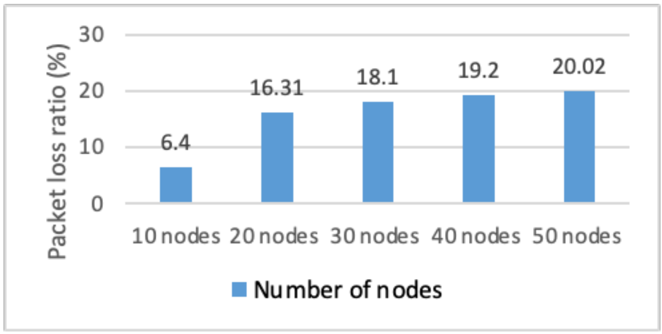

Fig 8. Packet loss ratio

The packet loss ratio is very less for the above obtained results which leads to better networking performance. The packet loss percentage is 20.02 for 50 nodes.

3.6 Transmission Delay

The transmission delay is the important metric for the reliability of safety data dissemination in VANET, Proposed work outperforms than other protocols approach on time is taken by vehicle to rebroadcast the message and received at the destination node.

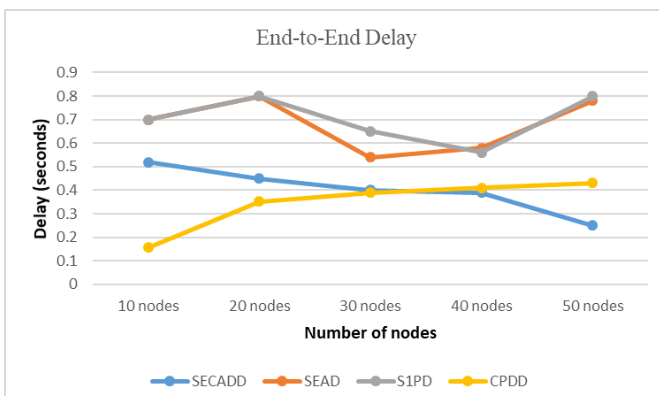

Fig 9. Transmission Delay

Figure 9 presents the end-to-end delay comparison performance between protocols. End-to-End delay should be less for better network performance.

3.7 Packet Drop Rate

The proposed approach has a low packet drop ratio compared to SECADD, SEAD and S1PD.

Packet Drop Rate = No. of packet lost/ Number of packets sent *100

This observation shows that the proposed work alleviates the broadcasting storm impact by reducing the network collision and contention. S1PD has a better drop ratio compared to SECADD.

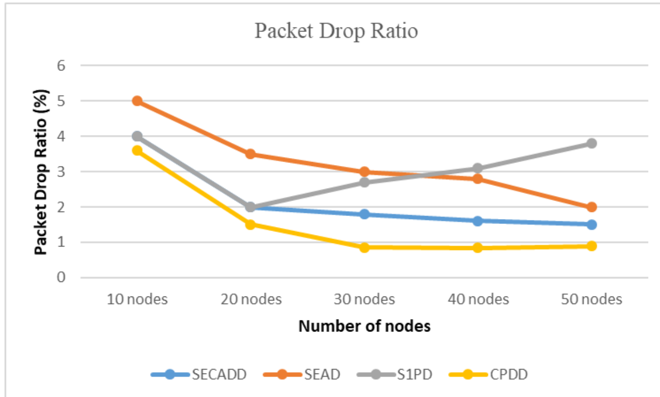

Fig 10. Packet Drop Ratio

4 Conclusion

The efficiency of the traffic system and the quality of driving are both improved by data dissemination through VANETs. Due to the unstable network topology, frequent fragmentation, and large number of vehicles on the road, data dissemination in vehicular networking environments is a difficult issue. Vehicles face a difficult problem when it comes to transmitting data across the network. In VANETs, the main problem to be solved is how to communicate information in a scalable manner. In this paper, we propose CPDD: Clustering and Probabilistic based Data Dissemination in Vehicular Adhoc Networks. The proposed work improves the QOS metrics with the Normalized Routing Load of 1.009%, Routing Overhead of 1.03 bits/sec, throughput of 205.5 bits/sec, end-to-end delay of 0.435 seconds and packet loss ratio of 20.02% for 50 nodes. In the future, the solution is to replace humans with robots on wheels. The future cars are built by sensing the environment, making decisions based on environment and carry out the decisions.

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