QOS BASED VEHICLE SELECTION AND CO-OPERATIVE DATA TRANSFER FOR VEHICULAR AD HOC NETWORKS

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Abstract— utilizing the benefits of Directed Short Range Communication (DSRC) VANET gets deployed as a means of assisting driving personnel. The information necessitated from the base infrastructure or any Road Side Units (RSU) gets disseminated and gets intermittent owing to vehicular mobility. Consistently wavering link stability and curtailed bandwidth utilization accounts for a feeble data transmission among vehicles travelling on a highway. Hence, the concept of data downloading and offloading gets introduced. The data being requested from the RSU gets downloaded to fulfill user need in projected in various aspects given as entertainment, mapping resource etc. The data requested sometime necessitates a huge occupancy of memory space as well as bandwidth for accomplishing a robust transmission. VANET starves a lot to fulfil such criterion amidst of consistent mobility. This leads to information loss and information abuse too. Hence, to overcome all these issues, this paper proposes a robust QoS based Cooperative Data Transfer (QoS-CDT) methodology. The neighborhood discovery procedure evolves on the basis of trust factor, memory possessed, geographical location, energy available and the bandwidth necessitated by that node for transferring the information requested. A caching protocol involves in managing the memory space residing in the cache of intermediate nodes along with authorization of trust provided by a Certification Authority (CA). Thus the devised QoS-CDT enriches its capability in outperforming other prevailing methodologies in terms of throughput, routing control overhead, Packet Delivery Ratio (PDR) and transmission delay.

Keywords — Cooperative downloading, IEEE 802.11 Ext, Popularity measure, Quality of Service (QoS), Trust authentication, Vehicular Ad hoc Network (VANET).

I. INTRODUCTION

Inevitable portion of life in current scenario attracts human for leading a life on the go without any sort of lag. In spite spending superfluous time for search of a route, much of online solutions assist at the time of driving. But in case of encountering some other mishap, the safety must be ensured in prior. This task must be accomplished irrespective of any liability towards available infrastructure (1). Such an expediency is achievable by means of exploiting VANET in highways to assist driver in a suburban or even in an urban highway. This networking sophistication is capable of offering diverse set of services for driving personnel. Unlike ordinary networking activity realized within a network that comprise of systems organized in a static manner, the vehicles tend to migrate from one location to the other either in a constant or a varying velocity inferred. Hence, the overall topology of a networking strategy availed here is mentioned as ever-altering and unreliable (2).

The most exotic challenge prevailing is to accomplish a prominent communication between any vehicles (V2V) or between a predefined infrastructure and a vehicle (V2I) in the Vehicular Ad hoc Networks (VANET). At present a robust growth is necessitated in VANET that realizes an inevitable existence on highways in accordance with an automated situation handling scenario. Vehicular networking paves path for many sort of aspects given as safety applications, traffic management applications, automated software updates as well as the entertainment based video streaming or any route mappings to explore for a particular location. All these usefulness are obtainable only with realization a robust communication. The key issues prevailing within the network prompts from the point of mobility of vehicle in accordance with its relative speed, wavering link stability, vehicular network with sparse density, partial utility of exhibited infrastructure (3). The availability of vehicular nodes is not assured and that ultimately recognizes a failure. So, the retransmission of information for a particular vehicle is also unfeasible. Hence, the information to be accomplished is processed via cooperative data transfer mechanism. It is made feasible by means of employing a complete utilization of VANET that

is deployed. The communication devices installed within vehicles that are capable of getting connected to internet is highly feeble to obtain a robust connectivity in accordance with the mobility exposed (4). It is too hard to accomplish a task of realizing an enhanced downloading capability in a real-time scenario. It is very hard because of the limited expiry time inferred with the packet that is sent and so it gets lost or failed before reaching destination (5).

Completely wavering nature of VANET environment is primarily managed with varied information disseminating approach. Random channel access protocol deployed in VANET suffered from many sort of practical issues like frequent collision in data transmission that is totally unavoidable. In addition to that, the processing of transmission request projected by vehicles is also deliberated in an arbitrary manner (6). Hence, the accomplishment of a reliable and completely secure mode of transmitting information from a pre-deployed infrastructure through an optimal multi-hop path to the requesting node becomes unfeasible. Subsequently, the QoS constraint involved VANET gets diminished in terms of routing delay, packet loss, mitigated channel bandwidth occupancy etc., Many other methodologies like k-shortest paths, look-ahead feature strategy and other QoS based routing algorithms are employed to fulfill the necessity of acquiring information through in between nodes from an internet source. Look ahead mechanism employed necessitated a pre-defined number of execution time for obtaining an optimal path. Such an activity is impracticable in VANET owing to its mobility. Interpretation in intermediate single point failures surges the failure criterion. Many other swarm intelligent based techniques ultimately suits only up to the range of voice packets and not a complete video streaming task that certainly incurred much of complexity (7) (8). The process of discovering an optimal path becomes highly infeasible in a VANET scenario (9) (10). Moreover, the security of that information also gets lacked through incorporation of information abuse performed on data by intermediary nodes. As a means of resolving all these issues and to accomplish a robust information dissemination through efficacious caching procedure Quality of Service based Cooperative Data Transfer (QoS-CDT) is proposed in this paper. The novel technical contributions of proposed approach are listed as follows:

- Nodes discovered as neighbors are registered with CA that ultimately authorize those nodes on the basis of trust factor involved. Hence, the security criterion is assured
- The coverage assessment on nodes ensures the availability of nodes by means of assessing the geographical location and link stability.

- Data downloaded is offloaded through a robust caching protocol that proficiently manages the memory space of the buffers of intermediate nodes in order to accommodate the data requested.

The paper organized as follows: The detailed description of the related works regarding data transformation from source to requester node are discussed in section II. The implementation process of Quality of Service based Cooperative Data Transfer (Qos-CDT) mechanism for proficient memory management and caching is described in section III. The comparative analysis of proposed Qos-CDT with existing methods provided in section IV. Finally, section V gets concluded by exhibiting the proficiency of QoS-CDT approach.

II. RELATED WORK

In this section, the review of various data dissemination, communication strategies and the interference cancellation schemes are presented with their merits and demerits. *Hao, et al.*(11) fabricated a downloading framework for VANET that was capable of offering a cooperative download of information in a secured manner through Road Side Units (RSU) on their pass over. A proficient data accomplishment was achieved by means of downloading when a vehicle is within the coverage area defined by RSU and collectively share with each other even after the sometime when they were in out of RSU's reach. Even though the endorsed protocol capable of working on the basis of location sharing along with assurance towards security, the overall proficiency in obtaining data was mitigated owing to the complicated mobility of vehicles. *Gerla, et al.*(12) analyzed various methodologies existing as state of art methodologies and protocols capable of assisting in information propagation through VANET. Intricacies realized in information dissemination were mobility, limited access to internet resources and accomplishing a cooperative approach transferring data.

Abbas, et al. (13) devised an effectual mechanism for alleviating the adverse influence created in accordance with the shadowing effect implied on vehicles travelling over high way and was signified as shadow fading model. However, it was realized that the Line Of Sight (LOS) inferred a delay loss in addition than a normal scenario. *Luan, et al.*(14) assessed the throughput of Distributed Coordinated Function (DCF) in accordance with the mobility recognized in vehicles through deployment of an effectual analytical model in a drive-thru internet based setup. Though it was capable of managing an utmost mobility in vehicles, the speed revealed in transferring the information from one vehicle to the other is highly depreciated and consequently the throughput was diminished. *Khabazian, et al.* (15) envisaged a dual fold

priority classes for examining the proper propagation of safety control messages within VANET through formulation of an analytical model. 2-Dimensional Markov modelling was utilized to schedule periodic messages with a minimized priority through articulation of a joint distribution prototype for a proficient information propagation in a highway. Messages with a high prioritization were propagated abruptly without any sort of delay involved but the key issue rely on cache burden involved within vehicular nodes of VANET. The rupturing nature of link stability between nodes caused the information packets to become held within the queue before it was received by a particular node.

Zhang, et al. (16) recognized an inventive two different interference based resource allocating prototype constructed on the basis of graph theory for disseminating information between distinct vehicles of VANET. Though the devised prototype was proficient enough to accomplish a robust distribution of resources, it was obtaining only a meagre performance for nodes existing in a communication mode deployed in an orthogonal way. *Patra, et al.* (17) devised an Intelligent Transportation System (ITS) that would assist drivers while overtaking in driving by means of providing a visualized video feed of the current scenario available through a typical architecture specified as EYES. Even though the proficiency of ITS was enhanced in providing timely driver assistance, without any sort of delay incurred in transferring the video feed, the limitation was observed with the physical location positioning of a vehicle in spite of robust infrastructure found.

Bi, et al. (18) evaluated a robust emergency message disseminating protocol in order to omit redundancy in message sending procedure to the destination and also to mitigate the transmission delay involved in transferring the emergency information involved through Urban Multi-hop Broadcast Protocol (UMBP). The proficiency of the formulated mechanism was realized by means of mitigating the propagation delay involved. However, the approach was incapable of managing the cache burden involved after collecting the information that was downloaded from a source.

Wu, et al. (19) recommended a mechanism for reassigning the message held by current data carrier to another mediating carrier vehicle using a cluster based forwarding approach that was formulated by collating both fuzzy logic and reinforcement learning based protocol in prior to the migration of former one. Though the suggested approach was capable of providing proficient transformation for a long time period, the utilized fuzzy rule based approach escalated the overall computational complexity involved when there were many number of vehicles involved. Furthermore, the overall bandwidth occupied for processing message transformation was also high.

Fogue, et al.(20) introduced an efficacious alert propagation mechanism specified individually for the VANETs and was designated as Profile-driven Adaptive Warning Dissemination Scheme (PAWDS) by means of employing a mapping methodology that was capable of positioning the vehicles appropriately. Though it was capable of alerting the vehicles in even in a highly dense vehicular environment, it was unable to cope with a real-time environmental scenario with diminished vehicular density. *He, et al.*(21) deliberated an effectual dissemination approach specified in particular for two-dimensional VANET scenario by means of utilizing Minimum Delay Routing Algorithm that incorporated geo-cast routing methodology. The information was propagated on the basis of vehicle traversing direction in order to comply with the assured message delivery within a previously opted path. Messages that were integrated to resolve the epidemic situation were transmitted with a proficiency in a mitigated expectation delay however, the packet loss avoidance was not definitely assured in a real-time scenario. An acute congestion occurred when the individual packet size got enlarged.

Eiza, et al. (22) established a situation-aware complete approach for discovering reasonably achievable routes defined in specific for a multi-constrained approach along with employment of Ant Colony mechanism and was confined as Situation-Aware Multiconstrained QoS (SAMQ) routing approach. A reliable and unwavering information diffusion was accomplished on employing this strategy irrespective of multiple routes available at any specific instance within the network. On the other hand, it was incapable of resolving routes in a large scale network in accordance with coping an utmost mobility of vehicles. *Luo, et al.*(23) formulated an integral file dissemination approach in highways for VANET by employing Cluster-based File Transfer (CFT) technique through evaluation of intervening distance available between resource as well as destination vehicles. The CFT recognized was capable of accomplishing a robust information dissemination in a collaborated manner accompanied with an enhanced cluster size assisted in huge sharing of files. Conversely, it was unable to mage the minimized traffic density in VANET that consequently escalated the entire cluster size necessitated for processing.

Liu, et al.(24) endorsed a cooperative downloading strategy through deployment of a Digital Fountain Code (DFC) approach that was capable of accomplishing a robust data transferring proficiency in order to attain the necessitated QoS requirement. Though it was capable of realizing a mitigated packet loss rate the packet loss inferred was significantly considerable. *Lai, et al.*(25) articulated a cooperative and reliable forwarding methodology through deployment of Camenisch-Lysyanskaya signature

mechanism for download and offload data packets on performing some sort of mediated virtual checks. The devised Secure Incentive Reliable Cooperative (SIRC) methodology was capable of achieved a reliable information propagation scheme through manipulation of symmetric cryptosystem and skillfully obtained an enhanced downloading rate supplemented with a communication overhead. In accordance with those information obtained with proficiency of prevailing approaches, the limitations inferred were,

- Incapability in assessing the reliability of a node in prior to information transfer
- Implicit cache burden either with the resource vehicle or destination vehicle by means of disseminating information through an untrusted node
- Realization of bandwidth insufficiency to deal with a proficient data offloading procedure for vehicles that move on in a consistent manner.

III. Quality of Service Based Cooperative Data Transder

This section discusses the implementation details of the proposed Quality of Service based Cooperative Data Transfer (QoS-CDT) for accomplishing a robust driver assisting system through implication of real-world traces in accordance with vehicular mobility. The workflow of the proposed QoS-CDT is shown in Fig. 1. The proposed VANET architecture formulation mechanism initially prompts for vehicle selection by means of sending request message to the neighboring nodes on the basis of neighboring table maintained in prior. Frequently altering topology thus formed is completely disclosed to a Certification Authority (CA) as a means of evaluating varied necessary criteria such as energy, trust score and bandwidth occupancy. After getting registered with CA the request being projected for want of particular file is taken for next stage to discover the route to obtain particular data. The route discovering procedure is guided with utilization of a forwarding table that subsequently opts for estimation of data rate for the particular node involved in that specific path. On the basis of data rate that is forecasted the feasible path is opted. Since, the data rate of the processing node should be in par with that of the requesting node. If it is not up to the necessitated rate then another node is opted from the forwarding table. After obtaining the feasibility regarding data rate transformation, the nodes are assessed for its authentication. The nodes are authenticated based on the trust criterion possessed by CA for distinct nodes. On realizing a completely trusted node, the master node checks for the necessity of offload for that particular requesting node. If the receiving capacity prevailing within that node suffices for holding the entire data slot in a single instant, then the information gets transferred completely at a single stroke. If not the information gets split up into chunks of data and gets traversed to receiving node (Rec) after getting stored within the local storage (cache). Those chunks are transferred with several nodes that holds good with channel band width available, mobility and trust assessed. This sort of procedure is reiterated until all the information is completely sent to the stipulated receiving node.
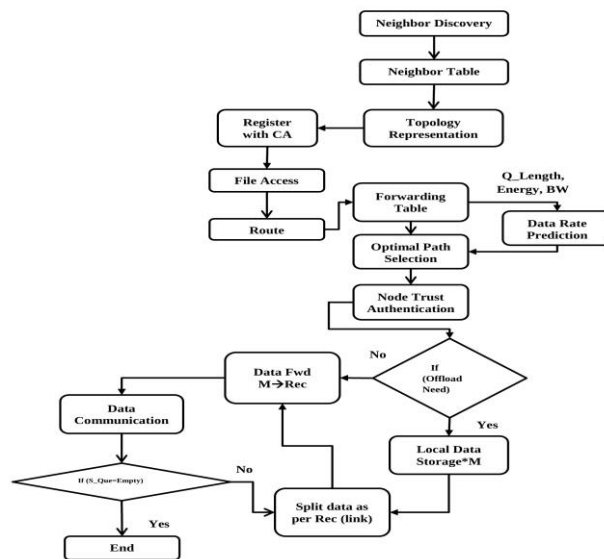

Fig.1 Workflow of Proposed QoS-CDT

A. Vehicle Selection

Formulated networking architecture of the devised VANET scenario is organized with inclusion of Road Side Unit (RSU) and a sophisticated networking infrastructure. This sort of formulation induces two diverse set of communication given as Vehicle-to-Vehicle (V2V) as well as Vehicle-to-Infrastructure (V2I). In order to accomplish the overall networking scenario, the basic criteria to be served is to select an apt vehicle for communication. The set of vehicles that suffices QoS constraints are chosen from the neighboring table residing in the infrastructure or RSU and hence, the offloading task is quite easier to handle with. Differed set of candidate vehicles are collated to articulate the basic vehicle sets and is given as,

$$VS = \{v_1, v_2, \ldots, v_n\} \tag{1}$$

Where,

n gets signified as 1, 2,…

The vehicle set is selected from every single row of candidate set group and that is given as,

$$v_i \epsilon \, VS \tag{2}$$

These candidate vehicles are chosen on the basis of similar QoS values (l) that assists in obtaining a better offloading functionality. Candidate vehicle set is defined as,

$$v_i = \{v_{i1}, v_{i2}, \ldots, v_{il}\} \tag{3}$$

Where,

$$l = (1,2,3 \ldots)$$

After opting for a vehicle set with similar QoS values, the attribute vector is computed for realizing the offloading by means of aggregating those QoS functionalities. Those attribute vector values meant for offloading is given as,

$$QoV = \{q_1(VS), q_2(VS), \ldots, q_r(VS)\} \tag{4}$$

Where,

r=range of attribute values involved with distinct vehicles

Those QoS values of every single vehicle v_{ij} gets deliberated as,

$$Qov_{ij} = \{q_1(v_{ij}), q_2(v_{ij}), \ldots, q_r(v_{ij})\} \tag{5}$$

The packet loss rate inferred with every vehicle along with its QoS values are sum up as,

$$q(V) = \sum_{i=1}^{n} q(v_i) \tag{6}$$

The density of traffic scenario recognized within the network holds the responsibility for escalation of QoS value inculcated within. Hence, the traffic involved inside the network is completely assessed via QoS value aggregation that is deliberated in terms of packet loss rate along with the delay constraint involved in rendering packets to destination. Every vehicle is liable with a constraint of mobile data traffic comprised by a vehicle associated with a mobility. Those functionalities related with mobile data traffic are given as,

$$f(v_{ij}) = \sum_{k=1}^{r} \frac{Q_{i,k}^{max} - q_k(v_{ij})}{Q_{i,k}^{max} - Q_{i,k}^{min}} \cdot tr \tag{7}$$

$$F(V) = \sum_{k=1}^{r} \frac{Q_k^{max} - q_k(V)}{Q_k^{max} - Q_k^{min}} \cdot tr \tag{8}$$

Here,

tr indicates the relation inferred between those QoS values with that of traffic associated

$Q_{i,k}^{max}$ –ranges within an interval of $0 < k < r$ that deliberated for the utmost value involved in candidate vehicle that corresponds for offloading task.

$Q_{i,k}^{min}$ – signifies the minimal value involved in vehicles for offloading mobile traffic data.

This attribute vector calculation typically assists in computing individual traffic involved with every vehicle through a mapping functionality employed among the QoS values (Qv_{ij}) against the entire set of QoS values accumulated in prior given as $f(v_{ij})$. The prevailing network setup is completely exploited to serve the communication request in particular to deal with offloading task. Similar set of operations are restated for every single offloading performed within the network.

B. Popularity Estimation

At an instance when a particular node is sufficient enough to deal with whole information at a single instance in terms of buffer space, the caching procedure is not necessitated. If there exists any sort inadequacy prevailing in archiving space, then the process of caching is to be employed and hence, the requisite for computing the popularity of information gets insisted in a wide manner. Space insufficiency in the cache gets resolved by means of deleting some information prioritized on the basis of popularity indulged within every single data inferred. Popularity measure gets assessed for every data in accordance with the time concluded for expiry of data concerned along with the requesting frequency from which it is demanded. The frequency within which a data concerned is demanded within u_e is worked out through $P(I)$. The popularity of a data concerned is assessed through a Poisson distribution and is evaluated as,

$$P(I) = 1 - e^{-\rho_I(u_e - u_c)} \tag{9}$$

Where,

u_e- designates the time at which the data concerned gets expires

u_c – signifies the current time in which the request is being processed

ρ_I- implies the arrival rate inferred in accordance with requesting frequency. Where,

$$\rho_I = {}^a/u_c - u_s \tag{10}$$

The chance of repetitive demanding associated with a data is deliberated by analyzing the managing infrastructure.

C. Neighbor Discovery

The information that is demanded by the receiving node is accomplished from the source by means of incorporating some of the chosen set of intermediate nodes. Those intermediary nodes are perfectly opted with two diverse set of routing strategy that implies data accomplishment via offloading scenarios. Those schemes trail a prefixed schematic means given as,

- Robust caching is selected initially
- Subsequently forwarding the cached information to the requesting user from those cached archive

All sorts of requesting nodes are suffced by means of exploiting a set cover approach. This approach certainly slot in only a minimal number of nodes to disseminate the cached data to the demanding requester nodes. The coverage property of a node gets defined by means of plotting the belongingness of a particular node to a confined set of nodes. The association prevailing in between nodes are revealed to outline possibility of covering tendency of every distinct nodes involved in transmitting data requested within the overall time inferred for its expiry. The mathematical association between caching user that is actually defined using the transmission probability mentioned as $\beta - neighbor$ that typically reveals the association among the requesting node to that of the source node. It is made feasible by means of manipulating a dedicated multi-path methodology that completely utilizes the $\alpha - path\ set$.

For constructing multipath scenario between the source node and the requesting node, the elementary node set defined for fabricating the neighbor set is specified. Any sort of vehicular node v_k certainly belongs to a neighbor set of nodes and is defined as,

$$N(v_k) \subseteq V \qquad (11)$$

A candidate set of nodes v_x are primarily alleviated and these confined neighbor set of nodes are obtained in the established network scenario depending upon the concept of $\forall\ v_k \in v_l$. Relying upon this concept completely preserves the generality of a path being specified. An ultimate path that is capable of linking all sorts of nodes existing in different node sets v_k as well as v_l gets confined by defining a path set as,

$$P\ (v_k \rightarrow v_l) \qquad (12)$$

For those set of nodes v_l and v_k the $\alpha - path\ set$ gets concluded by means of assessing the weights of a path defined as follows,

$$P_\alpha\ (v_k \rightarrow v_x) = \{z : z \in P(v_k \rightarrow v_l) \wedge p_z\ (T) \geq \alpha\}$$
$$(13)$$

The $\beta - neighbor$ condition of a node gets resolved for finalizing a neighborhood node to abide by the constraint given as,

$$1 - \prod_{\forall z \in P_\alpha(v_k \rightarrow v_l)} [1 - p_z] \geq \beta \qquad (14)$$

Furthermore, the set covering property of a node gets defined by assessing the entire set of requesting node that are responsible for demanding the similar information. The requesting nodes are confined as,

$$G = \{g_1, g_2, \ldots, g_b\} \qquad (15)$$

The covering matrix $(m \times n)$ for a requested information is defined on the basis of overall number of vehicles given in as $|V| = n$. Typically, the covering matrix gets defined as,

$$c_{ij} = \begin{cases} 1; & g_i \in N\ (v_l) \\ 0; & Otherwise \end{cases} \qquad (16)$$

Where,

g- defines the requesting node of a neighbor node v_l. This subsequently implies the covering property of that particular requesting node for that data item. Moreover, the overall number of nodes is mitigated for accomplishing the task of caching for satisfying the need of those requesting nodes. The entire number of nodes utilized for caching ultimately gets diminished through implementation of caching and cooperative downloading task with a time complexity of $O(n)$. Hence, here the time complexity depends only on the density of nodes and not on the message complexity.

D. Caching Procedure

The data being cached in a master node is delivered to other requesting node through other intermediate nodes. The data being requested from the infrastructure connected to internet is collected and stored in a master node. The master node holds the responsibility of managing the data to get passed through the in-between nodes that completely suits the need of data availability. The suitability of node is assessed on the basis of trust factor enrolled within every vehicle. The trust of a node is deliberated in accordance with the mobility, link stability, energy constraint and bandwidth necessitated to send and receive the data. The trust factor is completely ensured and later that particular node is considered for disseminating the cached data.

$$T = E + TR - M \qquad (17)$$

Where,

T indicates the trust

E designates the overall energy prevailing within nodes

TR refers to the trust rate possessed by that particular node

M signifies the mobility model of that node

QoS based Cooperative Downloading Protocol
Input: Vehicle Set
Output: Offloaded data for the best vehicle set
Step-1: Extract adjacent list of requester nodes *Step-2:* Initialize α and β for the cell operator *Step-3:* // Check (13) for α computation

If (13) holds good for current node and requester node

    add path to $\alpha - Pathset$
  Else
    remove current node
  End if
Step-4:
  If (req $r_i \geq \beta$)
    Add r_i to $N\left(v_j\right)$
  Else
    Switch to Step-3
Step-5: Build Covering matrix based on (16)
Step-6: Compute Popularity and trust
Step-7:
  If (c_{ij} != enough space)
    Remove data from buffer based on popularity
  Else
    Rebuild the matrix
Step-8: Push the data into the cache
Step-9: **If** (r do not receive complete data)
      Reiterate Step 3 to Step 8
      Obtain remaining data
      End If

The vehicle set articulated through initial neighborhood discovery is preserved for transmission of single video data that is requested by a requester node. Primarily, the vehicles positioned adjacent to the requester node is considered for receiving stipulated data on the basis of trust evaluation. A request is sent from the requesting node after assessing the neighborhood table possessed by the infrastructure. After analyzing the topological representation of vehicles, those vehicles existing at the vicinity are registered with the certification authority (CA). The CA holds responsibility of authorizing the nodes involved transmitting information. The trust is evaluated using (17). After assessing the trust factor, the CA authorizes particular node is included in the transmission. The trust criterion also comprises of the link stability of the node that is the disconnection of that node in previous transmissions. If the node gets disconnected in prior to the completion of a transmission, it is signified as an untrusted node and its trust factor is diminished. This trust degradation is abruptly updated to those neighbors, so that any sort of future transmission through that node is avoided. After ensuring the trust, the data being cached into the master node is assessed and the space available in the intermediate node is compared with it. If the space suffices of holding the complete data I a single instant, the data cached is completely pushed into that node. If not then further caching is legalized among other trusted neighboring nodes.

At this juncture, the coverage property of the node is assessed for finding the neighborhood nodes prevailing within the reach. After assessing that coverage property, the coverage matrix is articulated with neighboring nodes in accordance with the path set incurred. Both the $\alpha - Pathset$ as well as $\beta - neighborhood$ is assessed. The nodes out of that coverage reach is completely removed from the neighborhood collection of nodes. Those nodes collected in the neighborhood are also registered with CA and its trust factor is evaluated. After evaluating the trust, the space available in cache is checked. If the space is inadequate, then the data is removed from buffer of that node on the basis of popularity. Data with a minimum amount of popularity is curbed out from the entire information that is accessed long back and is do not get access in near future. Such kind of information is popped out of that node and the information currently needed is pushed into that buffer space. Hence, the data to be sent is cached in various cooperative nodes and assist in reaching the destination node. The similar procedure is reiterated until all the entire set of information reaches the requesting node.

IV. PERFORMANCE ANALYSIS

This section illustrates the experimental posture for the VANET environment deployed and the proficiency assessment of the varied prevailing methodologies like Vehicular routing setup based on Ant Colony Optimization (VACO), Mobility-Aware Ant Colony Optimization Routing DYMO (MAR-DYMO) and Situation-Aware Multiconstrained Quality-of-Service (SAMQ). Proficiency is considered by analyzing various parameters given as Packet Delivery Ratio (PDR), routing control overhead, throughput and transmission delay. The entire networking scenario is constructed in IEEE 802.11Ext standard and AODV / DSRC protocol is utilized for transmitting video streams in between the requested vehicle and source vehicle with an assistance of NS2 simulator. Table 2 shows the simulation parameter involved in the created networking scenario.

TABLE 2 SIMULATION PARAMETER SETTINGS

Parameter	Value
Topology Area	1500m * 400m
Number of Nodes	50,100
Speed of Vehicles(m/s)	5,10,20,30,40
Road Length(m)	1000
Number of Lanes	3
Road Direction	Two-Way
Simulation Time(Sec)	200
Type of Service	Video Stream
Packet Size of CBR	500
Packet Generation Rate	0.05
Transmission Rate(UMTS)	384Kbps
Transmission Rate(WLAN)	5Mbps

MAC Protocol	802.11Ext
Routing Protocol	AODV/DSRC

A. Packet Delivery Ratio

The proportion computed between total number of packets that is transported to the requested end point in a successful manner is specified as the Packet Delivery Ratio (PDR). For the simulated scenario deliberated here, the proposed QoS-CDT approach exposes a consistent performance of when compared with other prevalent methodologies found for all increasing speed of vehicle involved in communication as shown in Fig. 3. The consistent performance escalation is observed with devised approach because of the data semantic relationship assessment done in prior to data transformation between nodes. The methodologies taken for comparison are Vehicular routing setup based on Ant Colony Optimization (VACO), Mobility-Aware Ant Colony Optimization Routing DYMO (MAR-DYMO) and Situation-Aware Multiconstrained Quality-of-Service (SAMQ) (22).
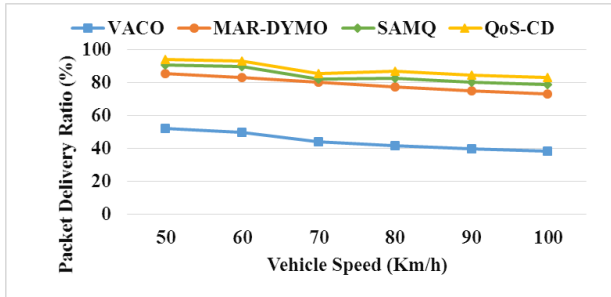

Fig. 3 Packet Delivery Ratio Vs Vehicle Speed

For the minimized vehicle speed of 50 Km/h, the PDR acquired for SAMQ approach that sounds better among all other existing mechanisms is 90.648% and for that of the proposed QoS-CDT is 93.934 %. This is actually a 2.91% enhanced than other mechanism. For the utmost speed being recognized in vehicles that is 100 km/h the PDR inferred is 78.667% for SAMQ and 82.843% for QoS-CDT respectively. This exposes a 5.04% betterment than prevalent methodologies available. Vehicle density analysis is performed between the proposed QoS-CDT against prevalent techniques available in accordance with the increasing number of vehicles. In this scenario also the devised QoS-CDT approach exposed a consistently increasing performance than SAMQ approach for minimized and maximized number of vehicle availability with a precise enhancement of 0.1% and 0.3% respectively as shown in Fig. 4.
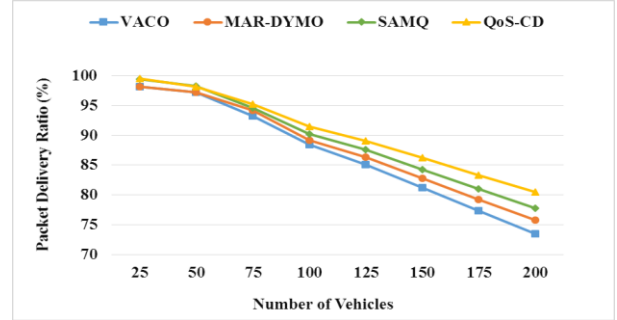

Fig.4 Vehicle Density Analysis Vs Number of Vehicles

The devised QoS-CDT exhibited an advanced performance than prevailing SAMQ approach because of the prior relationship defining of memory space within the cache along with the trust authentication procedure employed by CA. Thus, for 25 and 200 number of vehicles SAMQ methodology expressed 99.42 and 77.723% of PDR. Similarly, QoS-CDT exposed 77.723 and 80.476 for 200 number of vehicles respectively.

B. Throughput

The computation between count of productively transferred packets within a stipulated amount of time gets confined as throughput value. The throughput performance exposed by QoS-CDT approach is consistently high than other existing approaches because of the robust co-operative downloading scenario and it is exposed in Fig. 4. Owing to this aspect, the data that is necessitated and requested are completely obtained without any sort of lag in transmission within a limited amount of time irrespective of vehicle's mobility.
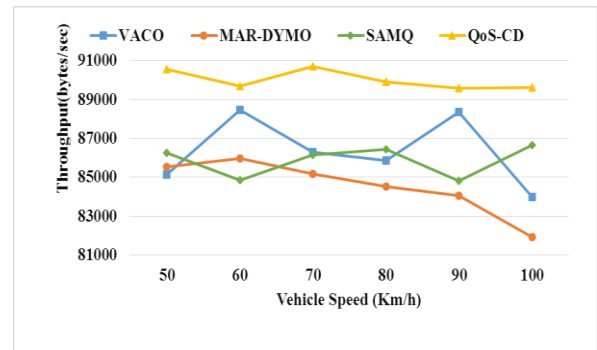

Fig. 4 Throughput analysis Vs Vehicle Speed

The variants of throughput for prevalent techniques like VACO, MAR-DYMO, SAMQ are compared against the endorsed QoS-CDT approach for differing speed of vehicles involved in communication. The maximum speed of vehicle that accounted for 100 Km/h permitted a throughput of 89612 Bytes/sec for QoS-CDT and 86662 Bytes/ sec for SAMQ methodology. The minimum speed of

vehicle with 50 Km/h exhibited a throughput value of 86271 in SAMQ and 90574 in QoS-CDT methodologies respectively. Hence, the overall enhancement observed in throughput analysis is 4.25 and 3.29 % respectively.

C. Routing Control Overhead

The typical variations exhibited with respect to the vehicle speed inferred in terms of routing control overhead is illustrated in Fig. 5.
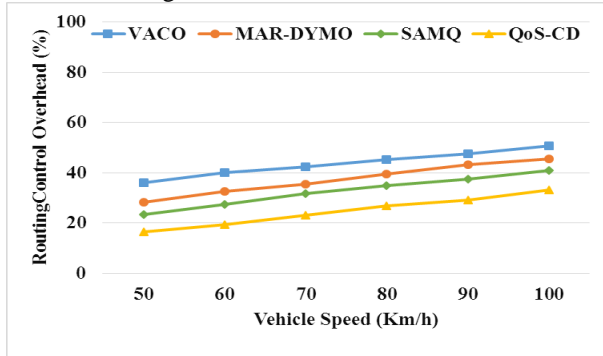

Fig. 5 Routing Control Overhead analysis Vs Vehicle Speed

The suggested QoS-CDT approach presented a consistent minimized routing control overhead in accordance with varying vehicle speed ranging from 50 Km/h to 100 Km/ h. Such a robust performance is revealed from the proposed approach is because of the prior data removal from the cache buffer by means of assessing the semantics prevailing in between the vehicular nodes existing in the networking scenario. The vehicle travelling with minimum amount of speed in 50 Km/h exposed a control overhead of 23.199% and for a maximum speed of 100 Km/h the control overhead experienced is 16.406% for the SAMQ methodology. For the endorsed QoS-CDT approach the routing control overhead realized for both minimum and maximum speeds of the vehicle are 40.791 and 33.005 % respectively, which is 29.28 and 19.08% mitigated than SAMQ respectively.

The vehicle density analysis for the routing control overhead for varying number of vehicles for the generated networking scenario is illustrated in Fig. 6.
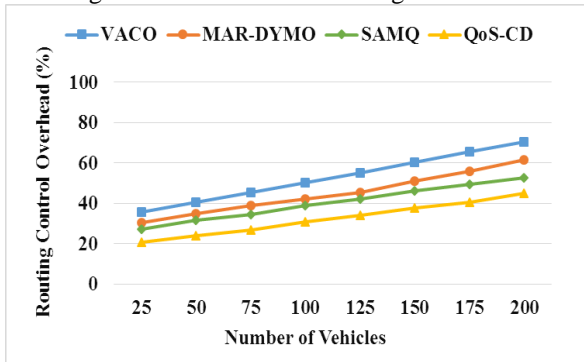

Fig. 6 Vehicle density- Routing Control Overhead analysis Ve Number of Vehicles

The routing control overhead for varying number of vehicles is analyzed among various prevailing methodologies like VACO, MAR-DYMO, SAMQ against the devised QoS-CDT approach. Routing control overhead is highly mitigated with the QoS-CDT mechanism even with the increasing number of vehicles due to unwavering co-operative data transfer strategy employed within the nodes assured in prior for trust by the CA. For minimum and maximum number of vehicles, the routing control overhead exposed by SAMQ methodology is 27.345 and 52.874 % respectively. On the other hand, QoS-CDT exposed a routing control overhead of 20.91 and 45.168 % for respectively, which is 23.53 and 14.57 % minimized than the SAMQ approach.

D. Transmission Delay

The fraction of time inferred by the packet to reach destination in spite of transmission done from the source node gets characterized as transmission delay. Varying vehicle speed exhibited differing transmission delay and is depicted in Fig. 6.
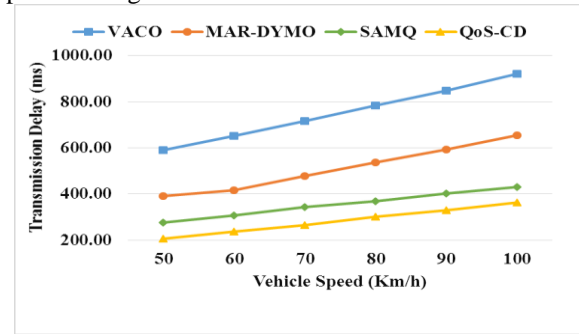

Fig. 6 Transmission Delay analysis Vs Vehicle Speed

Transmission delay inferred with several prevalent techniques like VACO, MAR-DYMO and SAMQ is compared against the devised QoS-CDT approach. An enhanced performance is exposed by QoS-CDT mechanism owing to its prior data removal criterion from a cache for assessing the semantic association between the nodes accompanied with a robust cooperative data transfer. The minimal vehicle speed kept for observation is 50 Km/h and the maximum vehicle speed considered is 100 Km/h respectively. The SAMQ approach exposed a 276.94 ms ans429.66 ms respectively for minimum and maximum speed. While, the QoS-CDT method exposed 205.54 and 363.89 ms, which is 71.4 and 14.60 % lesser.

V. CONCLUSION

The issues prevailing in broadcasting information among vehicles in VANET is exhibited and the way out for obtaining a solution is dealt through the endorsed QoS-CDT approach. This mechanism assisted in transforming information among both V2V and V2I is accomplished in a robust way in terms of efficient memory handling and trust authentication. Consistently wavering link stability and curtailed bandwidth utilization accounted for a feeble data transmission among vehicles travelling on a highway. Hence, the concept of data downloading and offloading is introduced. The data that is requested from the RSU is downloaded in order to fulfill user need projected in various aspects given as entertainment, mapping resource etc. Wavering mobility of vehicles curbed the proficiency in obtaining the information from the source node to the destination. Hence, in this proposed QoS-CDT neighborhood discovery procedure evolves on the basis of trust factor, memory possessed, geographical location, energy available and the bandwidth necessitated by that node for transferring the information requested. A caching protocol is employed to manage the memory space residing in the cache of intermediate nodes along with authorization of trust provided by a Certification Authority (CA). Thus the devised QoS-CDT enriches its capability in outperforming other prevailing methodologies in terms of throughput, routing control overhead, Packet Delivery Ratio (PDR) and transmission delay. The information transmitted from a source node is transformed to the requester within a minimized transmission delay of 71.4 % and 14.6 % for a maximum as well as minimum amount of speed inferred with vehicles.

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