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A Geocast Based Routing for Cooperative Video Streaming Over Vehicular Networks

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Abstract—A typical Mobile Ad Hoc Network, in which automobiles serve as hubs, is the Vehicular Ad Hoc Network (VANET). The VANETs have numerous applications such as traffic warning distribution, live data communication technologies, video stream services, file share services etc. Due to the high mobility and complex evolving topology, an appropriate routing protocol is mandatory to ensure secure and efficient connectivity between vehicles. The multimedia streaming service on VANET is a challenging task due to the highly mobile environment. Also, concerning multimedia streaming networks, each vehicle's data download volume is minimal due to limited network connectivity. It takes far more period to stream a high-definition video using a single cellular 3G/3.5G interface. This work considers a shared video streaming situation where a vehicle fleet exchanges its network resources on their journey. This paper analyses the feasibility for applying the Geo-TORA routing protocol in Multimedia streaming-based VANET. The protocol consists of a geo cast service for sending messages to everyone in a specified geographical region. This protocol effectiveness is assessed using the metric routing overhead, geo cast packets' precision, and end to end delay. The study shows that Geo TORA has significant improvement in this scenario, compared to the Temporally Ordered Routing Algorithm (TORA) protocol considering the metrics mentioned above.

Index Terms—DSRC, CVS, TORA, Geo-TORA, VANET.

I. Introduction

Without the intervention of centralized or pre-established infrastructure/authority, the increasing need for wireless connectivity and modern wireless devices' specifications aims to explore self-organizing, self-adjusting networks. The networks are called Ad hoc networks with the absence of any consolidated or well before system. Ad hoc networks are a set of mobile nodes that are self-governing. One category of Handheld Ad Hoc Networks is Vehicular Ad Hoc Networks (VANET). Rather explicitly, a VANET comprises of on-board units (OBUs) mounted on the vehicles to enable V2V contact, and roadside units (RSUs) built along its sides of the urban motorways within which vehicles interact constitutes communication between vehicle and infrastructure (V2I). VANET allows motorists to connect and collaborate via vehicle-tovehicle contact to prevent any dire situation, e.g., Roadside collisions, traffic congestion, speed control, rescue vehicle unfettered access, and hidden barriers, etc. In addition to safety solutions, VANET also provides road users with comfort applications. Weather data, mobile e-commerce, Internet service, and other multimedia applications, for instance.

It is possible to split the ad hoc routing algorithm into two classes. Proactive, i.e. table-driven routing protocols where the network device establishes a routing table to distribute packets of data and needs to associate to other members in the fleet. Such nodes record the number of hops needed to reach each endpoint in the forwarding table. The hop count defines the routing element that the target node [1] generates. Each station stream and alters its routing table from time to time to maintain stability.

On the other hand, reactive is an on-demand oriented routing protocol that eliminates overhead coordination as routes are decided on a demand-based level. The protocol consists of two primary Route Discovery and Route Management roles. The role of Route Exploration is accountable for exploring new routes.

II. THE CO-OPERATIVE STREAMING IN VANETs

When members of the family or groups of people plan to go out for a journey together, a community of people will create a fleet-based automobile network and share their internet bandwidth throughout their journey. The required streaming video can be gathered from the Web using its 3G/3.5G cellular connection if a person in a car needs to have a streaming service during the ride. However, the 3G/3.5G link's bandwidth will not be adequate to achieve exemplary service efficiency (QoS). Even if the vehicle uses a 4G or WiFi network to retrieve the media files, the connectivity offered by this link might not be sufficient for the initial concerns [2]. The applicant asks that other squad members collaboratively import the video and that the other representatives of the same squad import portions of the video sequences and provide them to the applicant through DSRC.

The case consists of a requester, a forwarder, and helpers. The requester needs the video streaming service; the forwarders are the ones who further the data segments stream hop by hop through the network based on DSRC [2]. The helpers are the ones who not just to forward the parts of video streams but also download data using their cellular interface.

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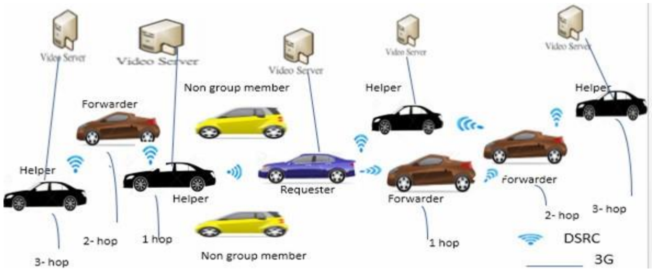


Fig. 1: The co-operative streaming scenario in vehicular Networks [3]

The key focus is to make efficient use of spectrum by spectrum sharing mechanisms with adjacent VANET members. Whenever a forwarder wishes to transfer a file, it only selects the closest those as a helper with the lesser hop count gap of its neighbours in the previous works and plans to choose helpers as the next forwarder. For downloading and forwarding, they will not pick an optimized routing option.

In our study, we reviewed a practical Temporally Ordered Routing Algorithm (TORA) that is extremely adaptable, competent, and scalable, based on the Link Reversal Routing (LRR) protocol [4]. It may build the path to a specific destination via this TORA, preserve the path in connection loss, and remove the route whether there are inaccurate routes. Geo -TORA proposed in [5] is indeed the protocol's name since it is adapted from the routing algorithm TORA. In this paper, the application of Geo TORA for cooperative video streaming over VANETs has been discussed. .Geo casting mechanism [6] allows delivery of packets from source vehicle to other vehicles within the geographical region. Section II discusses the background info on cooperative streaming over VANETs, and the suggested solution is explored in Section III. Finally, in Section IV, the simulation and effects are presented.

III. Related Works

Jiang D, And L. Delgrossi discusses the research problem in the cooperative streaming video over VANETs and the technology of wireless access in-vehicle environment (wave) [7], a layered design for devices that usesIEEE802.11. The standardization approach for the IEEE802.11 wave originates from the dedicated short-range communication allocation in the united states, DSRC spectrum band, and the attempt to define the technology in the DSRC band for use [7]. It is vital for the successful discovery of neighbouring nodes to use the Adhoc wireless network. Access at a random system of exploration, such as birthday protocol [8], neighbourhood detection using directional antennas that enable nodes to be defined in each one be arbitrarily in a transmitted or listening state. Time slot, each node has an opportunity to hear at least once in a reasonable period for the neighbour [9]. A large number of the time slot is needed to discover the neighbour node. To overcome this problem a link of on-off signalling, CDMA is used, each of which a signature is assigned to the node and transmits the signature when they transmit the beacon from the centre node simultaneously.

Using a swarming modal can be supplemented with a small world, and self-driven autonomous car phenomenon in simulations, a maintenance scheme of the car fleet is studied to calculate the coherent machine efficiency. In the routing operation, it is not possible to successfully implement the current routing protocol in MANETS to VANETs. The predictable protocol for routing is due to this referred to as used before predicting a link breakage. The VADD protocol [10] approach a definition for carrying and forward data delivery where the packet is born by moving vehicle and forward the packet before it passes into a new car's vicinity.

Peer-peer networking is an efficient data system for in specific a distribution for streaming. Swarming is the peerpeering mechanism of content delivery that shares resources among a co-operating peers mesh. The SPAWN protocol [11] consists of discovering peers, an option of peers, and material discovery of content and delivery. A protocol knows as collaborative streaming mobile [12] to distribute mobile multimedia content in a peer fashion. The video is accessed by mobile devices in a WMAN stream broadcast and share the data received via WLAN [13]. This scheme uses the mechanism of time slicing to save power. The aggregation scheme for bandwidth will calculate the usable bandwidth to support the applicant and then choose suitable helpers from these participants. To attain the case Greedy approach, pick appropriate members as helpers.

A video compression algorithm, H.264 SVC (scalable video coding) is for cost and performance and efficient video file transmission over low bandwidth networks. An extension to the H.264 codec specification is H.264Scv which handles multiplatform and adaptive delivery streaming from a single file. So, svc video streaming is designed with a minimum base layer and additional layers of(multiple)enhancement. H.264svc is an encoded video bitstream composed for a multiple network abstract layer (NAL) unit, developing natural packetization entities [14-15]. The requester downloads the lower, the base layer. The enhancement layer can enhance resolution, spatial resolution, frame rate, or video quality. It is possible to download lower layers by helpers.

IV. Materials and Methods

An efficient, scalable and highly adaptive distributed on demand, the source-initiated algorithm for routing, Temporally Ordered Routing Algorithm (TORA) is used. It adopts QRYRPY mechanism and the G.B. algorithm's partial link reversal mechanism. TORA's main feature is its response to connection failures. TORA's primary aim is to restrict the spread of control messages in the highly dynamic mobile computing environment [4]. It offers several routes and quickly sets routes to one destination, and overhead contact also reduced where possible by locating the algorithm reaction to topological changes.

The protocols TORA and Geo TORA for CVS Over VANETs is analysed by authors. Geo TORA also involves flooding [5]. However, within a small area, it is limited to nodes. This integration of TORA and floods will considerably decrease the overhead and ensure relatively high accuracy of regional distribution [5]. In conventional multicasting, a host is inserted explicitly into the multicast community. On the other hand, if the host belongs to the geo cast area, the host becomes an independent geo cast group member. Each Node is GPS enabled. The geo cast group is then said to be the set of nodes in the geo cast area.

A. TORA PROTOCOL

TORA has three main tasks:

1) Route Creation.
2) Route Maintenance.
3) Route Destruction.

TORA aims to create such an acyclic directed graph (DAG) rooted at the target. TORA uses three types of messages,

1) The route formation QUERY message.
2) The messages of UPD for route construction and route maintenance.
3) The CLR message for disabling a route.

A node's height value consists of five components (τ, *oid*, *r*, δ and *i*).τ is the moment at which reference level was established, the new reference level is *Oid* and *r* is a single bit value. , determines the height value concerning the reference standard. i have individually recognized node identifier. The destination's height is always zero.

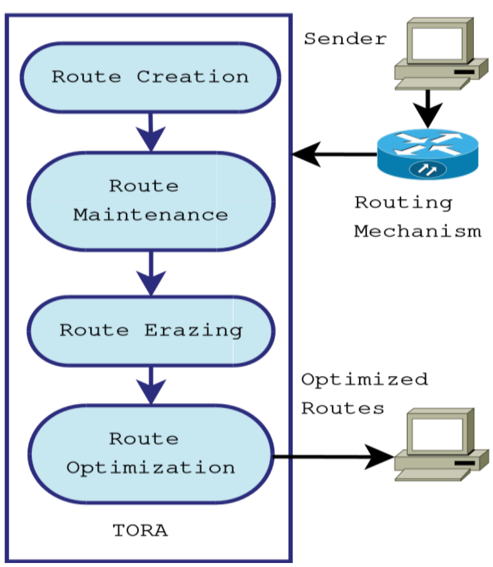


Fig. 2: Block Diagram [3], [5]

The sender requests packets from other network nodes and evaluates the algorithm. The specified routing system receives the sender's request, and the TORA algorithm in routing mechanism will be accessed. TORA offers four types of network operations for efficient routing. First one, Route creation generates a route in the network. Second, this approach is used for route management to preserve routes without malicious nodes and attacks.

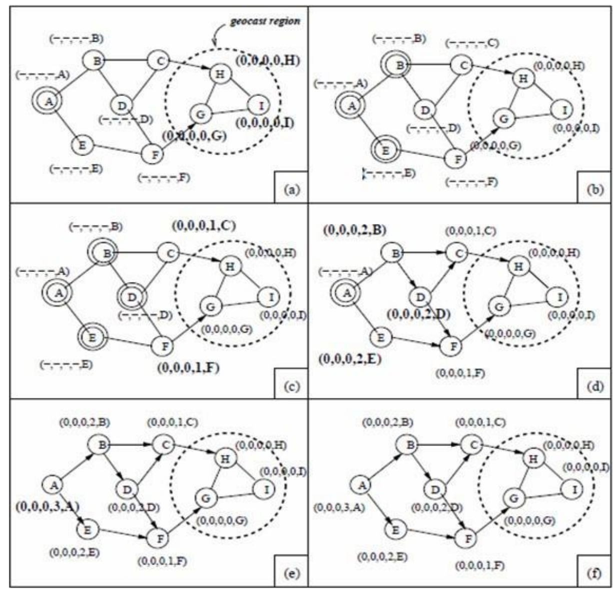


Fig. 3: Geo cast Route Creation in Geo-TORA [5]

Third, it was used to erase unwanted or malicious routes by route erasure. The last one is path optimization, which is used to optimize network paths. TORA's route creation, route maintenance and route destruction are depicted in [3].

B. GEO-TORA PROTOCOL

Geo-TORA is derived from TORA. A single guided acyclic graph (DAG) [5] is maintained by Geo-TORA, identical DAG to TORA. The only difference is that all nodes in the geocast region are ZERO in height, unlike TORA, where there is ZERO height for just one node (the destination). Initially, Geo-TORA routes' creation and maintenance are addressed by delivering geo-cast messages using Geo-TORA.

1) ROUTE CREATION AND MAINTENANCE IN GEO-TORA: A cluster head would have to route to the specified geo cast area to achieve geocast community packets. GeoTORA uses a route construction method similar to TORA, but with the difference described above to initially set routes). The methodology of route formation in geo cast is shown in Fig 3.

The dotted circle in Fig 3 represents the geo-cast area within the geo-cast region, with nodes *G*, *H* and *I*. The system's initial value is described in Fig 6. (a). Inside the geo cast area, as nodes *G*, *H* and *I* are, they place their elevation to *ZERO*. In particular, node *I* set its height to be (-,-,-,-, *I*). Nodes *C* and *F* (where the height is *NULL*) are connected to nodes H and G, respectively since *NULL* height is assumed to be more critical than any height other than *NULL* [5].

The QRY packet for Node *A* reaches nodes *B* and *E* and, in essence, forwards packets to their peers and sets the appropriate local route flag. (Consult Fig. 3(b)). Nodes *C* and *D* obtain QRY messages from node *B*. Nodes *C* and *F* have outbound connections to the geocast group members in Fig 3(c), but node *D* does not have outbound links, geocast group. As a result, only node D forwards packets to its members and sets the correct flag for the path. Nodes *C* and *F* change their height from *NULL* to $(0,0,0,1,C)$ and $(0,0,0,1,F)$ respectively when receiving QRY messages. The algorithmic evolution is seen from the outside in Fig. 3(f). A *DAG* formed, which have each member of the geo-cast community as a destination.

In Geo-TORA, there have been two occasions where the DAG is changed, i.e. when: (a) a connection malfunction happens, or (b) whenever a node joins or exits the geo cast area. Fig 4 demonstrates how the DAG in Geo-TORA is altered in reaction to communication failures. Fig 4(a) shows that node D does not take maintenance action as a consequence of link abrasion (*D,F*), as node *D* always has a downstream link (*D,C*). Node *C* is left with little outward ties since node *C* splits with node H in Fig 4(b). By generating a new reference point, node *C* then adjusts its height, indicating that node C lost all downstream ties at time 1. As seen in Fig 4(c), the modified height of Node *C* is $(1,C,0,0,C)$. As node C lifts its height, node D selects a height $(1,C.0.\ -1,D)$ and sends its neighbours a UPD; node D has no outgoing links. Due to the updated height selected by the *C* and *D* nodes, Node B loses its outgoing connection. Consequently, node *B* reduces its height to $(1,C,0,-2,B)$ below the existing height of Node *D*. Nevertheless, node A already has another outgoing connection (*A,E*), so there is no need for further intervention. Fig 4(C) displays the final condition of the *DAG*.

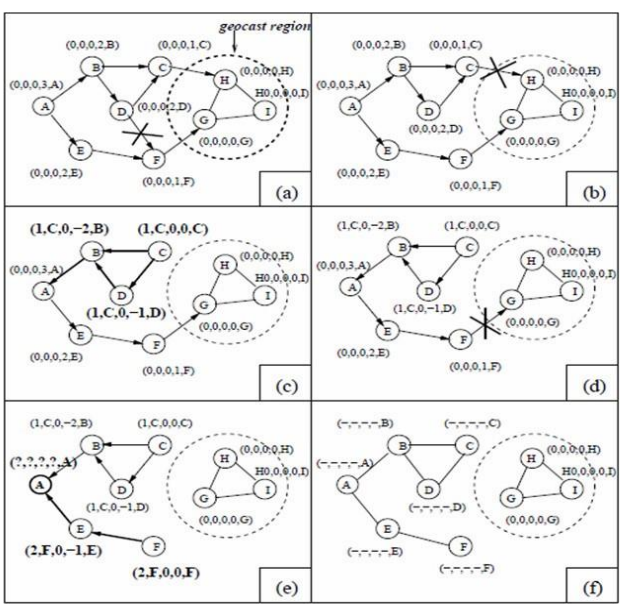


Fig. 4: Geo cast Route Maintenance in Geo TORA: Three different scenarios of link failure [5]

The node F and G link failure at time two are seen in Fig4(d). Due to the link loss at nodes *F* and *G*, nodes *F* and *E* opt for a new height. In Fig 4, the updated height of node E is seen (e). Node *A* does not have any outbound relations left. When it gets a UPD, node *A* recognizes it. Node E message comprising node *E*'s latest height, all its outgoing links are broken; hence, node *A* is separated from the geo-cast group. As a result, the mechanism of route erasure is begun. Fig 4(f) displays the network status after the route deletion phase has been completed.

Fig 5 illustrates how Geo TORA deals with shifts in geocast party membership [5].

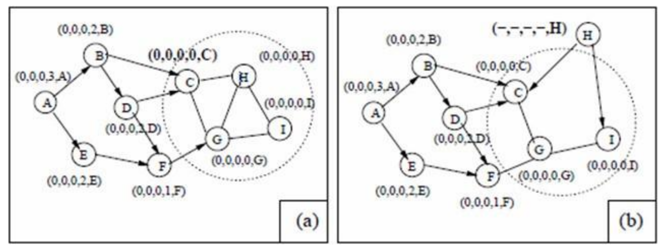


Fig. 5: Route Maintenance in Geo-TORA for handling dynamic change of geo cast group [5]

C. GEO-TORA FOR CVS OVER VANETS

The Protocol Geo-TORA can be used for cooperative video streaming over Vehicular Networks. Apart from MANETs, VANETs have high mobility and dynamic changing topology. The procedures for route creation and route maintenance in VANETs is somewhat similar to MANETs. Geo casting mechanism allows delivery of packets from source vehicle to other vehicles within the geographical region. Several geo casting protocols has been designed focusing on different scenarios and applications. Fig 6 shows typical video streaming within a geographical region.

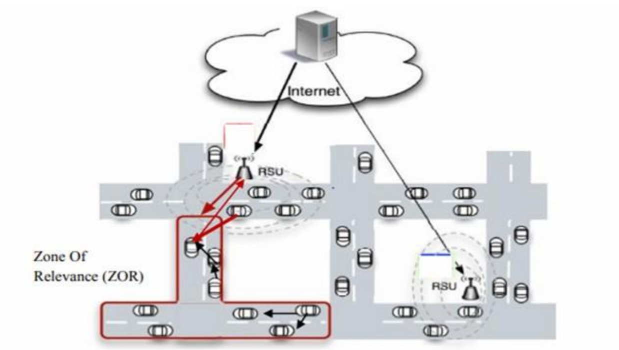
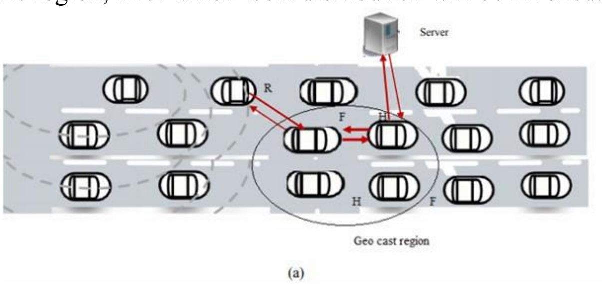


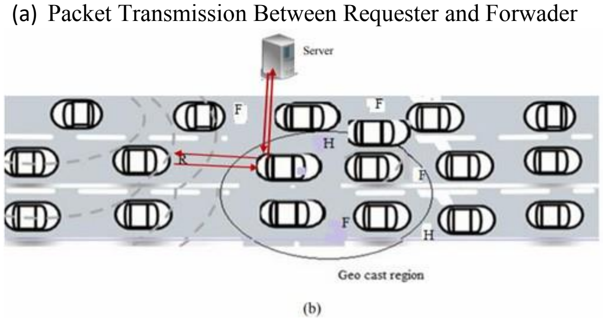
Fig. 6: Typical video streaming within a geographical region

Cooperative video streaming scenario over VANETs consists of the requester, helper and forwarder. By using effective routing algorithm TORA, routing problem is solved.

Geo TORA protocol is used to minimize the routing overhead and maintain high accuracy for geo cast packets delivery. Route creation and route maintenance in Geo TORA is confined to a geo cast region. The primary purpose of a geo casting protocol is to disseminate certain information to determine the target area. If the source is outside the target zone, there should be a mechanism to reach at least one node in the region, after which local distribution will be invoked.



(a) Packet Transmission Between Requester and Forwader



(b) Packet Transmission Between Requester and Helper

Fig. 7: Geo cast routing for CVS

In Fig 7a, the cooperative video streaming scenario in which the source node, i.e., a requester who needs video streaming service sends requests to the forwarder is shown. The forwarder and helper are in geo cast region, and the source node sends data packets to nodes in geo cast region. The geo cast region nodes, i.e., forwarder flooded the packet within the geo cast region. The packet reaches the other node, i.e., helper in the geo cast region. The route creation and route maintenance procedure are similar to Geo TORA in MANETs. The helper sends data packets to server and server downloads the video and forwards to helper in geo cast region. The helper forwards the packets to forwarder and forwarder to requester

In Fig 7b, the concept of dynamically changing topology of VANETs is depicted. Due to high mobility and dynamic changing topology, the requester, helper, and forwarder may change. The above figure shows helpers and forwarders move off from geo cast region, and other nodes enter the geo cast region. In this case, the requester node changes its position. The requester sends packets to the nodes in the geo cast region. Here, the helper node in the geo cast region receives the packet and requests the server to download the video. The server downloads and sends to helper in the geo cast region and helper forwards to the requester. The route creation and the reaction to the link failures are similar to TORA. The main objective for selecting Geo-TORA for CVS over VANETs is to minimize routing overhead, reduce end to end delay and maintain high accuracy for the delivery of geo cast packets.

V. RESULTS AND DISCUSSION

The Cooperative Video Streaming Scenario (CVS) consists of 40 mobile nodes used in this simulation distributed randomly over a square region of 2000×1500 m^2. The data packet size is 512bytes. Network Simulator (NS-2) is used here.

TABLE I: Simulation Parameters

Parameter	Value
Field size	2000×1500
Number of mobile nodes	40
Propagation Type	Two ray ground
Routing Protocol	AODV and TORA
Channel	Wireless channel
Simulation time	35 sec

A. PERFORMANCE ANALYSIS

The protocol's performance is compared with the current geo cast delivery method, overhead routing, and end latency in this portion. Geo cast delivery accuracy is defined as the number of group members who receive the geo cast packet and the number of group members when the geo cast delivery was initiated in the geo cast area. Fig 8 shows the accuracy of geo

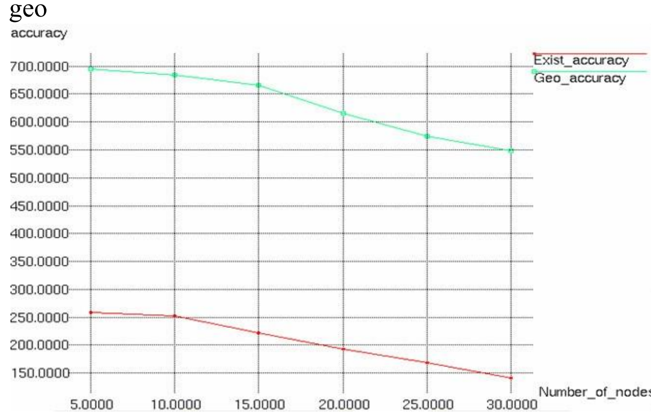


Fig. 8: Accuracy of Geo cast Delivery

cast packet is more in Geo TORA than the existing method. In terms of the number of geo cast packets obtained by the nodes, the overhead is calculated. Geo-TORA's overhead consists of data packets and control packets (QRY, UPD, and CLR) for route formation and maintenance. This Fig 9 indicates the performance comparison of the existing method. Geo TORA's routing overhead is less than the existing method because the data and control packets are localized in a geographical region. The routing overhead of Geo-TORA is less than TORA. Fig 10 compares the end-to-end delay of the Geo-TORA algorithm, TORA and existing method.

TORA's reduces the delay in data transmission by about 40% than that of the existing method, and the Geo TORA algorithm reduces delay by 70% compared to the existing method. The delay of data transmission in TORA is in between the existing method and Geo-TORA.

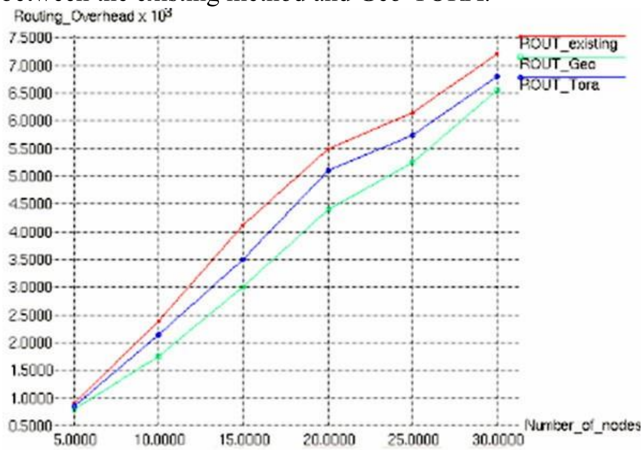


Fig. 9: Routing overhead

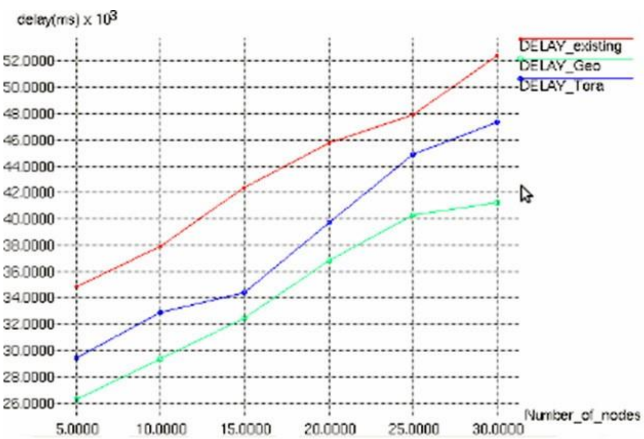


Fig. 10: End-to-End Delay of Geo TORA

VI. CONCLUSION

The demand for people to be connected and transfer information when they are mobile is growing. Cooperative video streaming over VANETs provide better bandwidth utilization among neighbouring peers. The protocol TORA for Video Streaming in Hybrid Vehicular Networks provides an efficient routing path for achieving better video streaming performance. TORA is an on-demand routing protocol which can be used effectively in a congested network. However, considering the network overhead and delay the TORA have few shortcomings to apply in cooperative video streaming based VANETs. The protocol named Geo TORA which is derived from the TORA routing protocol based on location-based multicast routing. The protocol Geo TORA analysis in VANETs reveals that it can reduce the delivery overhead significantly and end to end delay by 40%. The Geo-TORA based network provides reasonably high accuracy also. The application of more dynamic routing protocol in the cooperative video streaming network is a good direction for future research due to the sudden surge of vehicular connectivity technology. The analysis of Geo-TORA in autonomous vehicle fleet for route identification will be another interesting direction for research.

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