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Hybrid Algorithm for Distribution of Nodes Using Vanets Networks

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Abstract:
Today wireless services are the most preferred services in the world and the ultimate goal become to communicate any type of information with anyone, at any time, from anywhere, with no need for conductors or wires. Based on the capacity the cellular networks are improving year by year. Nowadays 5G networks are most widely used by many mobile operators to increase performance in terms of increased data rate, reduced latency, and provide the best quality of service. In this paper, a dynamic data transfer protocol in VANETs is developed to transfer the data without any fluctuations or data loss. The main focus of this approach is to provide the data transfer service with high speed and maintain intelligent routing to reach the destination without any loss. Every node in the algorithm maintains the buffer storage to transfer the data in peak hours. This is the combination of Packet data convergence protocol (PDCP) and the dynamic routing protocol to provide Quality of Service (QoS) in wireless 5G networks. Providing network connectivity to mobile users is a key requirement for cellular wireless networks. User mobility impacts network performance as well as user-perceived service quality. The performance of the proposed approach is measured by using Packet Delivery Ratio (PDR), Packet Loss (PL), Throughput, and network delay.

Keywords: Small Cells (SCs), hybrid algorithm, 5g networks, throughput.

Introduction

Vehicular Ad-Hoc Networks (VANETs) are a specialized subset of Mobile Ad-Hoc Networks (MANETs) that enable vehicles to communicate with each other (Vehicle-to-Vehicle, V2V) and with roadside infrastructure (Vehicle-to-Infrastructure, V2I). This communication network facilitates applications such as traffic management, safety warnings, and infotainment services, significantly enhancing road safety and driving efficiency. With the advent of 5G networks, VANETs are poised to experience a transformative evolution. 5G offers ultra-low latency, higher bandwidth, massive connectivity, and enhanced reliability, which are essential for the performance of VANET applications, especially in critical scenarios like autonomous driving and real-time traffic updates. The integration of VANETs with 5G is a cornerstone of the Intelligent Transportation Systems (ITS), paving the way for Vehicle-to-Everything (V2X) communication, which includes V2V, V2I, Vehicle-to-Pedestrian (V2P), and Vehicle-to-Network (V2N).

The future of wireless networking is a network architecture in which information can be shared which is accessible everywhere and at any time to the whole world. 5G is the future generation wireless communication networks that are provided high data transfer rate (it's GBPS) with low latency rate, increase the capacity of base station, and rapid improvement in users based on the Quality of Service (QoS) compare with the 4G LTE networks. This network can increase the performance of the smart devices and can shows the huge impact on wireless networks in coming future. Many advantages are identified by using this 5G wireless networks such as long transmission data transfer, very low data transfer delay (around 5ms) and components with high mobility speed (~500 kmph) [1][2].

5G is a good opportunity to provide this combined framework. The previous 1G-4G systems depend on so-called orthogonal multiple access. Such orthogonal multiple accesses will be difficult to support for future IoT applications. 5G is a good opportunity to provide this combined framework. 5G is a good opportunity to provide this combined framework. The development of 5th Generation (5G) wireless technology promises the bandwidth rate which has never been experienced before.5G promises to have more speed, more capacity and low cost per bit. It is providing large broadcasting capacity up to Gigabit which supporting almost 65,000 connections at a time. It is also very securing than 4G and improves bi-directional bandwidth shaping. 5G mobile system model is an all-IP based model which ensures wireless and mobile networks interoperability. Due to an all-IP model it is ensured that all information and services are carried by a single network transport rather than different ones for each services and information. This helps to increase the density of network and increase the bandwidth of the network. 5G architecture consists of a user terminal and a number of independent, autonomous RAT (Radio Access technologies). In this paper, two types of protocols are combined to maintain the QoS in 5G networks.

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Literature Survey

Based on the benefits of the handover process, in [3], Qiu et. al. proposed a unique innovative method to implement the virtualized network functions and fog computing cases. The research indicates the benefits of virtualizing the network functions. These benefits play an important role to enhance the flexibility and the robustness of the network. The study was carried out by utilizing fog-computing based APs and X2- based handover design.

[4] that is written by Yang et. al., addresses the usage of wireless communication networking for the case of everyday situations. A handover operation for specific cases is presented in the study. The cases about that UE has weak connections with eNBs because of the surrounding buildings and the distances. These obstacles are handled by forwarding the signals from a relay station. By this way, coverage area and communication range increases, which eliminates the interference signal. Arshad et al., [5] discusses about enhancement of spectral efficiency and resource allocation operations in a case involved multiple subscribers, in [5]. It is stated that, spectral efficiency can be improved by considering the BS footprints. The handover operation is utilized to increase the 5G network performance. Also, it is stated that handover rate is a significant element that has notable impacts on the network performance and it is needed to be considered appropriately. Moreover, the difficulties suffered while operating handover process in 5G networks are stated and discussed explicitly. A method that minimizes the unnecessary handover rate is proposed in the article, which is stated as topology aware handover approach. This proposed method is verified for single and two-tier networks for downlink connections. In [6], Barua et. al., proposes a new way to yield better networking performance by utilizing D2D communication method. The proposed D2D method does not need any BS for communication between the UEs. Since mobility management processes are real challenging tasks in D2D communications, a few methods are stated to handle these tasks. The new approach proposes to utilize Time Division Duplex in LTE-A systems. By this way, it becomes possible to implement wellknown power control algorithms for Time Division Duplex. However, latency, complexity, and the power issues still go on as important challenges. Wu et al., [7], studies on optimization of the handover parameters in small-cell deployed 5G multi-tier cellular networks. Initially, the article states that present methods used for enhancing QoS are based on former information and the network procedures. And, in case of insufficient information, the mentioned currently used methods are unsuccessful to fulfill the QoS and performance requirements. In purpose of handling this problem, dynamic fuzzy Q-Learning algorithm is proposed as a novel and unique method that ensures continuous D2D communication, lower latency, and lower signaling overhead. Choi et al., [8], stated that, one of the main purposes for architectures is to provide seamless mobility management service by corelating the core network with multiple APs properly. In the paper, approach of MAPDU (Multiple Access Protocol Data Unit) session to manage the data communication in 5G cellular network, and a dynamic mobility management process between various APs are presented. The dynamic anchoring MM method is proposed with End Marker to ensure the connection while UE is moving. Calabuig et al., [9] states that traditional mobility and resource management methods like increasing spectral efficiency are inapplicable in 5G networks due to the high capacity. They analyze the most promising methods that are defined in METIS project. They utilize context information in their structure to provide a reliable and power efficient mobility management service. Although the proposed solutions seem to enhance mostly resource management, the combination of the methods provides robustness to unplanned cell deployments, mobility for users and cells.

Ad hoc On-Demand Distance Vector (AODV)

AODV stands for Ad hoc On-Demand Distance Vector. AODV is a reactive (or on-demand) MANET routing protocol, it only keeps routes that have a demand in the network. For reaching destinations, AODV holds a routing table with the next hop. If no packets are sent on a path, they will time out after a while. It only consists of information about its neighbor nodes so re-transferring the data frames might take more time. In this paper, the proposed model is the combination of Packet data convergence protocol (PDCP) and AODV. PDCP is the 5G network layer which is used in 5G networks. PDCP layer provides services to the upper layers that are, RRC or SDAP and takes few services and inputs from the Radio Link Control (RLC) layer, Medium Access Layer (MAC) layer, and Physical (PHY) layer.

The functionality of AODV, along with routing tables of every node, two counters including Sequence Number(SEQ NO) and broadcast ID are maintained also.

The destination IP is already known to which data is to be transferred from source. Thus, the destination Sequence Number(SEQ NO) helps to determine an updated path from source to destination.

Along with these counters, Route Request (RREQ) and Route Response(RRESP) packets are used in which RREQ is responsible for discovering of route from source to destination and RRESP sends back the route information response to its source.

Functionality of Hybrid Algorithm

Hybrid is the dynamic and geographic routing approach that selects the nodes dynamically. The selection of paths can be done by analyzing the traffic and density of the vehicles in the junctions to select reliable routes in the network. The maps are used to find the actual positions of the nearest junctions. Based on the score given by the density of vehicles in traffic and distance among the metric curves are used to selects the next destination, then the junction is selected. This works better on dense traffic platforms. The efficient selection of path is selected based on the packet travels. Every node in the network gives the information to the server (gateway) if it goes to its communication range. The gateway develops a various set of paths among itself and each node.

The algorithm is focused on various factors such as route discovery, route recovery, dynamic routing and maintaining the constant power at all the vehicles. The hybrid develops the route by using the request of the route from the base stations (BS). The BS gives the route reply by using the messages. To find the efficient route, the distances between two vehicles are to be calculated. Distance factor plays the main role to measure the distance among the nearest vehicles are measure by using Euclidean distance is represented in (1).

$Dist=\sqrt{((a1\text{-}a2)+ (b1\text{-}b2))}$ (1)

Equation-1 (a1, b1) represents the neighbor nodes, and (a2, b2) represents the spatial region of the destination node. The data is sent to the destination node from source to find the accurate route. Various factors shows the huge impact on finding the route such as constant, lifespan and availability of buffer are measured. These factors are merged with reply packets to other general information. Hybrid is adopted with fitness function improves the more constant route, this results in increasing data PDR. This will also reduce the packet loss and more routes are added.

Algorithm Steps:

Find_Route from Source to target and update Route Table
Input:
Sor, Source ID
Dst, Destination ID
Rot, Route Table
Output: Routing updated model
(1) Create Mapping To R
(2) For each S in network do
(3) {
(4) Generate Request Packet
(5) Set rq_des to D
(6) Set rq_src to S
(7) Set rq_type to RREQ
(8) Increase BROADCAST_ID
(9) Broadcast Request Packet
(10) }
(11) Update R with new Path(s) detected
(12) Return;

Experimental Results

NS3 is a network simulator for discrete event simulation. It is free software under the GNU GPLv2 license. This tool is directed to research applications, as well as for educational purposes [11, 12]. NS3 has the flexibility and speed of simulation scenarios due to the using C ++ as a master programming language. At the same time, it supports the Python language, which gives a lower learning curve for new users using this simulator. Each of these programming languages allows describing the behavior of telecommunication systems.

The NS3 gives the opportunity to developers to build models of any topology and complexity. Along with this, a simulator gives an opportunity to implement, modify and supplement both existing models and modules with the user's own developments. Disadvantages of the NS3 are missing of a fully supported IDE and also missing a built-in graphical interface. However, there are ready-made third-party implementations for visualizing the behavior of models.

Table 1: Simulation Parameters

Parameter	Value
Simulation	NS3
Simulation Time	300 Seconds
Simulation region	1500 m x 1500 m
Total No of Nodes	300-500
Required RAM for System	32 GB
Transmission Range	500 m
Transmission Power	1.4 W

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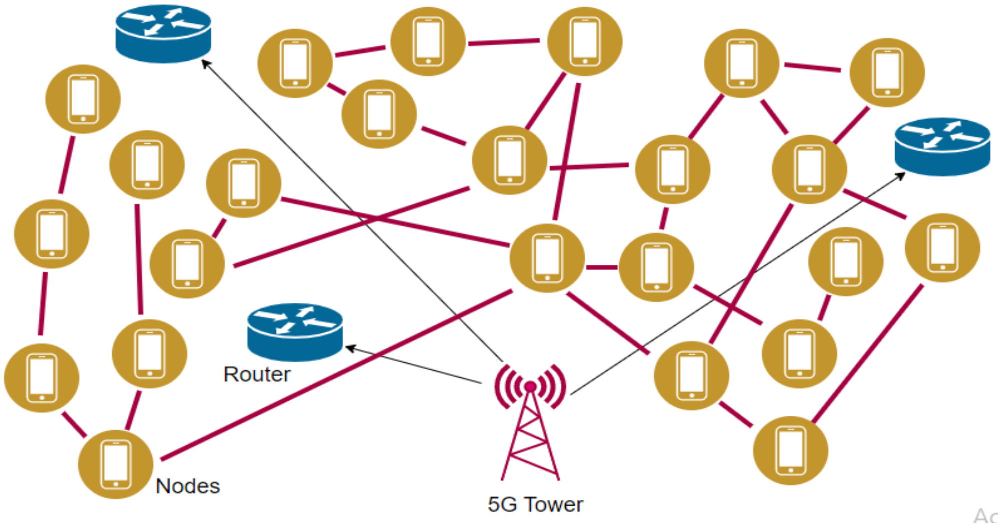

Figure 2: 5G Network Architecture

Performance Metrics

The performance and efficiency of the proposed method are shown in comparison with AODV and DSDV. The metrics such as PDR, PL, throughput, delay, are considered.

Packet Delivery Ratio (PDR)

The packet Delivery Ratio is mainly concentrated on the number of packets successfully delivered to the destination location. The value of PDR is computed with the below expression:

$$\mathbf{PDR} = \frac{\sum_{a=1}^{k} \mathbf{PR}}{\sum_{a=1}^{k} \mathbf{PO}}$$

Where the term $\boldsymbol{PR}$ denotes the number of packets successfully reached the destination and $\boldsymbol{PO}$ denotes the number of packets originated from the sending node. The comparison of the PDR of the proposed method with two other existing methods is depicted.

Packet Loss (PL)

Packet Loss (PL) is calculated by finding the proportion of the number of packets that originated and the number of packets not received in the destination node. It can the computed by the following expression:

$$\mathbf{PL} = \left(\sum_{a=1}^{k} \mathbf{PO} - \sum_{a=1}^{k} \mathbf{PNR}\right) * \mathbf{100}$$

Where PNR denotes the number of packets received at the destination. The comparison of PL of the proposed method with two other existing methods is depicted.

Throughput

This element plays a vital role in the 5G wireless networks. It is defined as the transmission rate of a packet from the origination to the destination. This component delivers the effect of several measures like collisions, traffic, and mobility. It is an efficient method for calculating the channel capacity of the network and it is calculated in terms of bits per second (Bit/s). The comparison of the throughput proposed method with two other existing methods is depicted in figure-10.

$$\text{Throughput} = \text{PR} * 8/\text{Data transission period (bps)}$$

Delay

Delay is the duration of time taken for a packet to travel from source to destination across the network. It is computed by:

$$\mathrm{D}_{\mathrm{end-end}} = \mathrm{N}\left(\mathrm{d}_{\mathrm{trans}} + \mathrm{d}_{\mathrm{proc}} + \mathrm{d}_{\mathrm{prop}}\right)$$

Where the term $D_{end-end}$ denotes the end-to-end delay, d_{trans} denotes the transmission delay, d_{prop} denotes the propagation delay and d_{proc} indicates the procedure delay. In this case, buffering delay is neglected. The comparison of the delay of the proposed method with two other existing methods is depicted.

Table 1: Performance of Table for Network with 50 Nodes

Algorithms	**PDR**	**Packet loss**	**Throughput**	**Network Delay** (Milli Seconds)
Existing System	80.34%	12 Packets	84.34%	22.12 MS
Hybrid Algorithm	96.98%	8 Packets	94.21%	14.23 MS

Table 2: Performance of Table for Network with 100 Nodes

Algorithms	**PDR**	**Packet loss**	**Throughput**	**Network Delay** (Milli Seconds)
Existing System	83.34%	25 Packets	83.55%	44.34 MS
Hybrid Algorithm	96.98%	12 Packets	95.43%	23.45 MS

Table 3: Performance of Table for Network with 150 Nodes

Algorithms	**PDR**	**Packet loss**	**Throughput**	**Network Delay** (Milli Seconds)
Existing System	84.78%	33 Packets	86.45%	56,23 MS
Hybrid Algorithm	97.34%	17 Packets	96.78%	29.67 MS

Conclusion

In the last decades, there has been a rapid increase in demand for wireless communication that cellular communication is seen the major part of. And, the latest cases in communication need throughput with the best performance. Because of the innovative differences in 5G technology, it becomes inapplicable to utilize previous traditional mobility management strategies that are used in LTE systems. Therefore, in order to handle the mobility issues in 5G wireless networks, various techniques have been developed. In this study, a comprehensive survey about mobility management in 5G networks is presented after discussing the evolution of wireless networks and mobility management process. Finally, the results shows that the performance of proposed approach obtains the values For 50 nodes the PDR-96.98%, Packet loss-8 Packets, Throughput-94.21%, Network Delay (Milli Seconds)-14.23 MS, For 100 nodes the PDR-96.98%, Packet loss-12 Packets, Throughput-95.43%, Network Delay (Milli Seconds)-23.45 MS, and for 150 Nodes the PDR-97.34%, Packet loss-17 Packets, Throughput-96.78%, Network Delay (Milli Seconds)-29.67 MS.

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