Adaptive Probablistic Broadcasting in Vanet

Rekha Patil., Pooja Aspalli

Abstract- VANET is an autonomous dynamic topology network where moving vehicles exchange their position information with each other. The basic objective of VANET is that all the nodes should be able to gather information about position of all the other nodes. Based on position information of other nodes, nodes can determine their course of action like changing route or changing speed and so on. Due to broadcasting nature of the message, Network runs a risk at broadcasting too many packets which puts a constraint on bandwidth, node battery and packet delivery success due to increased packet collision. Thus suitable technique should be adopted at the network layer that can limit both L2 and L3 type broadcasting depending upon the information about previous transmission, Neighbour state.

Hence in this work we emphasize on adaptive probabilistic broadcast based routing from one unicast group to another and compare the performance with Probabilistic Broadcast based routing. In Probabilistic Broadcast every node broadcast packet with a probability P which depends upon several parameters including bit rate, number of transmitting and receiving nodes, path loss etc. To improve the probability of success we opt for adaptive probabilistic broadcast where delay of broadcast is adjusted according to state of success of current node and the same of the neighbour nodes. The adjustment factor is called beta whose values are varied in step to avoid drastic change in data rate. Proposed protocol is simulated with Erlang city's realistic simulation and a custom traffic scenario of road junction developed by us. Thus our simulation results show justifies the proposed technique over the other broadcast based routing protocols.

Keywords- VANET, Probabilistic Broadcast based routing

I.INTRODUCTION

A Vehicular Ad-Hoc Network, or VANET is a technology that uses moving cars as nodes in a network to create a mobile network. VANET turns every participating car into a wireless router or node, allowing cars approximately 100 to 300 metres of each other to connect and, in turn, create a network with a wide range. As cars fall out of the signal range and drop out of the network, other cars can join in, connecting vehicles to one another so that a mobile Internet is created. It is estimated that the first systems that will integrate this technology are police and fire vehicles to communicate with each other for safety purposes.

VANETs can be considered as a subset or special case of Mobile Ad Hoc Networks (MANETs) which have been studied extensively in the literature [1]. The research in this area is relatively new and it essentially spans the last decade. While some significant progress has been made, it is fair to say that several key research and development problems remain open. In terms of V2V communications, the use of both radio (very high frequency (i.e., VHF), micro, and millimeter waves) and infrared waves have been reported in experimental V2V systems [6-8]. While infrared and millimeter waves can support only line-of-sight communications, VHF and microwaves can support broadcast communications as well. VHF can provide long links but at low speed and for this reason the mainstream mode of communications is to use microwaves.

Using vehicular communications, drivers can be well informed of vital traffic information such as treacherous road conditions and accident sites by communicating amongst vehicles and/or with the roadside infrastructure. With the large information of traffic conditions, vehicles will have better knowledge and it is reasonable that the problem of road accidents can be alleviated. Vehicular communications also facilitate traffic monitoring and management (e.g., vehicle platooning in order to raise traffic flow capacity and improve vehicle fuel economy.

1.1Architecture of Vehicular Networking

A Vehicular Ad hoc Network (VANET) is a kind of wireless ad hoc network to provide communications among vehicles and nearby roadside equipments. VANET consists of vehicles with on-board sensors and roadside units (RSUs) deployed along highways/sidewalks, which provides communications between vehicle-to-vehicle (V2V) and communications between vehicles-to-infrastructure (V2I). Figure 1 gives an illustration of the architecture of VANET. Vehicles V1, V2, and V3 have access to a roadside infrastructure, which has limited coverage.

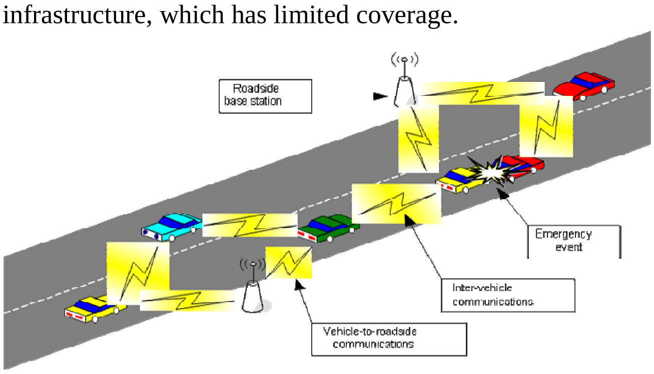

Fig 1:Architecture of vanetThese vehicles can obtain information from the roadside base station. However, vehicles V4, V5, and V6 have no communications with the fixed infrastructure. For instance, Vehicle V6 will have to rely upon information from vehicle V5, which in turn has obtained information that has passed through vehicles V1 and V4. Each vehicle communicates with nearby vehicles in a highly dynamic ad hoc networking environment via V2V communications.

Traffic-related information can be exchanged through periodic beaconing to allow drivers to be aware of surrounding traffic conditions. Event driven messages can

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be generated in case of emergency and disseminated to the vehicles in the zone of relevance (ZOR) . Infotainment applications such as gaming, file downloading requiring peer-to-peer communications can also be supported through V2V communications. In the presence of RSUs, Internet access can also be made possible for the occupants in the vehicle. Information from a remote data server can be delivered to a vehicle through the Internet backbone, and vice versa. RSU provides larger communication service area and can provide infotainment services such as advertisements, parking lot availability, and automatic tolling with ease.

Characteristics of VANET :

In addition to the similarities to ad hoc networks, VANETs possess unique network characteristics that distinguish it from other kinds of ad hoc networks and influence research in this area. Few important characteristics of VANETs are as follows:

- Somewhat predictable but Highly Dynamic Topology: In VANET, the movement of each vehicle is restricted to roads patterns. With the knowledge of roadway geometry, the mobility pattern of vehicles can be predicted to a certain extent. Although mobility pattern of vehicles can be predicted in VANET but vehicles move at a very high speed and hence the topology of VANETs changes frequently.
- Frequent Network Disconnection: Due to the highly dynamic topology, the link connectivity in VANETs also changes frequently. Especially when the density of vehicles is low, the chances of network disconnection are quite high.
- Mobility Modeling and Predication: Due to the high vehicle movement and dynamic topology, mobility models and predication play key role in designing the data dissemination approaches for VANETs.
- Geographical Type of Communication: In contrast to other mobile wireless networks that only use either unicast or multicast way for communication where the end points are defined by ID or group ID, the VANETs also supports a different type of communication that deals with packet forwarding based on geographical area.
- Different Communication Environments: Generally VANET operates in two typical communication environments known as highway scenarios and city scenarios. In highway traffic scenarios, the communication environment is comparatively simpler and straightforward (e.g., constrained one-dimensional movement), while in city traffic conditions it becomes quite complex.
- Adequate Storage and Energy: In VANET, nodes have sufficient amount of energy and computing power including both processing and storage because nodes are vehicles in VANET instead of small handheld devices in other networks.
- Hard Delay Constraints: Some of the applications in VANET do not require high data rates but has hard delay constraints.
- Interaction with On-Board Sensors: Each node in VANET is equipped with on-board sensors and GPS to provide information that can be further used to form communication links and data dissemination.

1.2Applications of VANET

1)Curve Speed Warning: In this use case, a combination of GPS and digital maps are used to judge threat levels for a driver approaching a curve too quickly. If the driver enters a curve at a high speed and will not be able to drive through the curve safely, he will be warned automatically with a message. Acoustic as well as visual symbols may be used to warn the driver. The signal may directly appear on the instrument panel or in the navigation system.

2) Traffic Signal Violation Warning: This use case is designed to send a warning message to a driver when it detects that the vehicle is in risk of running the traffic signal. The decision to send a massage is made on the basis of traffic signal status and timing and the vehicle's speed and position. The road surface and weather conditions are some other factors that are considered in such situations. This traffic violation information is further broadcasted by the RSU to all other vehicles in the neighborhood.

3) Emergency Electronic Brake Lights: In this use case, the driver is alerted with a message when a preceding vehicle makes a severe braking maneuver. This alert notification is sent using the cooperation of other vehicles and/or road side units. Surrounding vehicles that receive this warning message will act accordingly if the event is relevant or ignore if it is not concerned with them.

4) Pre-Crash Sensing / Warning: In this use case, it is assumed that a crash is unavoidable and will take place. The system is designed in a way to reduce the effect of an accident using equipments like actuators, air bags, motorized seat belt pre-tensioners and extensible bumpers. Also the driver is warned, brakes are pre-charged, seat belts are retracted, excess slack is removed and automatically applying partial or full braking to minimize the crash severity. Vehicles and the available RSUs also share information periodically to predict collisions. The exchanged information includes detailed position data and vehicle size.

5) Collision Risk Warning: In this system, vehicles and RSU detect chances of collision between multiple vehicles that are not able to communicate amongst themselves. The system will collect data about vehicles that are coming from opposite direction and are approaching towards the intersection, using sensors or DSRC communications. The collected information is further disseminated to inform vehicles that are going to take turn. One way to implement such system is by collecting the data continuously, and when there is a vehicle with its turn signal on, the system will send a message to that vehicle about the traffic traveling in the opposite direction of the vehicle

6) Lane Change Assistance / Warning: In this application, electronic systems incorporated in vehicle monitor the position of a vehicle within a roadway lane and warn a driver if it is unsafe to change lanes or merge into a line of traffic at any instant. These systems are backward looking and assist drivers who are intentionally changing lanes by detecting vehicles in the driver's blind spot. Therefore, the risk of lateral collisions for vehicles is reduced by accomplishing a lane change with blind spot.

7) Stop Sign Movements Assistance: In this system both V2V and V2I communications are used. This system is designed in way to avoid accidents at stop sign intersections. Data is collected by sensors or DSRC communications that is further used to inform the driver when it is unsafe to pass through an intersection. Moreover it also warns drivers if there is any traffic coming through the intersection at the same time.

8) Control Loss Warning: In this use case the system is intended to enable the driver of a vehicle to generate and

broadcast a message to all surrounding vehicles in case of control-loss. Upon receiving such information, the nearby vehicles decide the relevance of the event and provide a warning to the drivers, if appropriate.

The paper is organized as follows section **I** Introduction, section **II** related work, section **III** represents Methodology, system design and implementation algorithm, section **IV** represents Results and Discussion, section **V** finally conclusion.

II. RELATED WORK

In this paper the author has proposed a new scheme for dynamic adaptation of transmission power and contention window (CW) size to enhance performance of information dissemination in Vehicular Ad-hoc Networks (VANETs). The proposed scheme incorporates the Enhanced Distributed Channel Access (EDCA) mechanism of 802.11e and uses a joint approach to adapt transmission power at the physical (PHY) layer and quality-of-service (QoS) parameters at the medium access control (MAC) layer. In this scheme, transmission power is adapted based on the estimated local vehicle density to change the transmission range dynamically, while the CW size is adapted according to the instantaneous collision rate to enable service differentiation.

In this paper the author has provided information about vehicles' position is essential in VANETs. Currently, GPS positioning is widely used, but the accuracy is not adequate for emerging safety applications. In order to provide accurate positioning, this paper proposes RF-GPS, a RFID-assisted localization system that reliably supports lane-level position accuracy. It improves accuracy of the GPS system by employing a DGPS-like concept.

This article provides a comprehensive study of challenges in these networks, which we concentrate on the problems and proposed solutions. Then the author has outlined current state of the research and future perspectives. Vehicular Ad hoc Network (VANET), a subclass of mobile Ad Hoc networks (MANETs), is a promising approach for future intelligent transportation system (ITS). These networks have no fixed infrastructure and instead rely on the vehicles themselves to provide network functionality.

In this paper the author has mainly compared AODV and OLSR routing protocols by comparing its process of routing, sending hello messages and then further with sending the request and then replying back with reply message. The author has also defined about how to do the routing calculations and has also discussed the advantages and disadvantages of both the protocols. The author has also described the special feature of the OLSR routing protocol i.e the multi point relay nodes. And lastly the author has compared the performance and scalability of both these protocols.

In this paper the author has offered an efficient routing strategy which is crucial to deploy VANETs. This work mainly deals with the optimal parameter setting of the OLSR, a well-known mobile *ad hoc* network routing protocol, by defining an optimization problem. This way, a series of representative metaheuristic algorithms (PSO, DE, GA, and SA) are studied in this paper in order to find automatically optimal configurations of this routing protocol. In addition, a set of realistic VANET scenarios (based in the city of M´alaga) have been defined to accurately evaluate the performance of the network under our automatically optimized OLSR**.**The optimization methodology presented in this paper (coupling metaheuristics and a simulator) offers the possibility of automatically and efficiently customizing any protocol for any VANET scenario. In the experiments analysis, the tuned OLSR configurations result in better QoS than the standard (RFC 3626) and than several human experts, making it amenable for utilization in VANETs configurations.

In this paper the author has categorized broadcasting into deterministic and probabilistic schemes. The author reviews the probabilistic broadcasting protocol because of its adaptability in changing environment. Probabilistic broadcasting is best suited in terms of ad hoc network which is well known for its decentralized network nature. The author has discussed Probability, counter and distance based scheme under probabilistic scheme. Besides the basic probability scheme the author has also included their recent advancements. Rebroadcast is one of the initial tasks for route discovery in reactive protocols. This review paper identifies which protocol gives better performance in terms of reacheability, saved rebroadcast and average latency in rebroadcasting a route request message. Therefore the author has concluded by saying that combinatorial probabilistic broadcasting schemes are best suited for route discovery in reactive protocols.

III. METHODOLOGY

In the present work sumo is connected to the omnet++ through TCP connection manger, this TCP connection manager provides the information such as, position of the vehicles, routes, congestion and connection between vehicles etc which are generated by the sumo simulator and this information is inturn given to the mobility manger (traci manager) which links omnet++ and sumo road simulator. The mobility manager gives the information about position of the vehicles, routes etc to the application layer. Application layer generates the UDP burst packet message about position or congestion of the vehicles which is then sent to the network layer where the packet is flooded to the one hop neighbour. And again further the packet delay is generated. Now the MAC layer senses the channel if the channel is not ideal then it goes for back off adjustment otherwise frame goes for fair scheduling management if the MAC frame is suffering from collision then it sends the frame with higher priority. Now physical layer receives the frame from the MAC layer this layer uses analog modulation i.e QAM with noise cancellation now the frame is ready to transmit through the antenna. Once the signal is received by the vehicle the decider module checks the signal strength if the signal to noise ratio(SNR) is greater than SNR threshold then the frame is accepted otherwise its rejected. If the frame is already received then the decider module does not send to the upper layer.

Proposed Work

In the proposed system the basic objective is to notify the positional data of the nodes to all the other nodes in the network. There are two approaches to do this, 1st is a multicast based approach & 2nd is unicast based approach. In multicast based approach, multicast group formation is an overhead which can be reduced by adapting unicast approach. However, due to very high rate of change of topology, conventional AODV technique can not be used as this will lead exponentiontial amount of control overhead.

The main problem with AODV is periodic network and root maintenance.

As the basic objective is to transmit the packect to as many number of nodes, determining end to end root for every node is not essential. Hence, we adaptive probalistic broadcast where a node follows a packet or broadcast the packet at every T instance of time with probability P which depends upon beta value. Beta value is estimated again periodically based on measured delay. A node upon receiving this packet creates one hop table entry for the sending node, appends its own ID & Rebroadcast. Receiving nodes now have a path from 1st sender as well as the intermediate sender nodes.

Each node in the network generates an application packet and forwards it with an initial probability 'p' to all its nearest neighbours. Nodes receiving the packets measures the latency and adjusts the channel error probability 'beta'. When a node receives a packet with an error factor greater than beta it does not reforwards this packet to any of its neighbours. If a packet is received with error probability less than beta then it forwards it to all its neighbours again with probability 'p'. If current beta value is different from last registered value, then change the value of beta with respect to the neighbour nodes.

The formula to calculate the probability 'p' is given by

P=1/ total no of nodes

And the formula to calculate beta value is given by

beta =current delay/idle delay(per packet)

beta value is varied from 1 to 10.

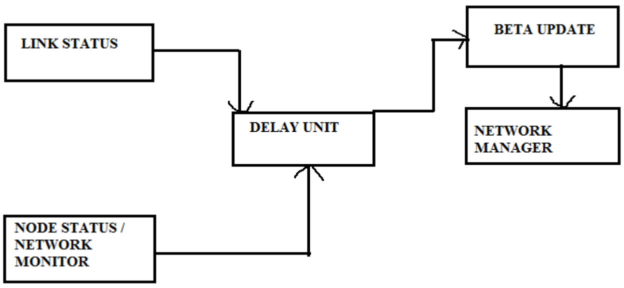


Fig 2:Protocol Block Diagram

In the above protocol block diagram, we notice that the link status and node status or network monitor information is given to the delay unit block. This delay unit information is sent for the beta update process,where if the value is less than 10 only then it is processed, otherwise it is discarded and then again it is brought to its normal range. And then once the beta value is updated this information is sent to the network manager.

ALGORITHM

Step 1: First in the application layer, the UDP burst packet is generated.

Step 2: Now the application layer packet is sent to the network layer.

Step 3: Now in the network layer 1st the beta value is initialized to 1.

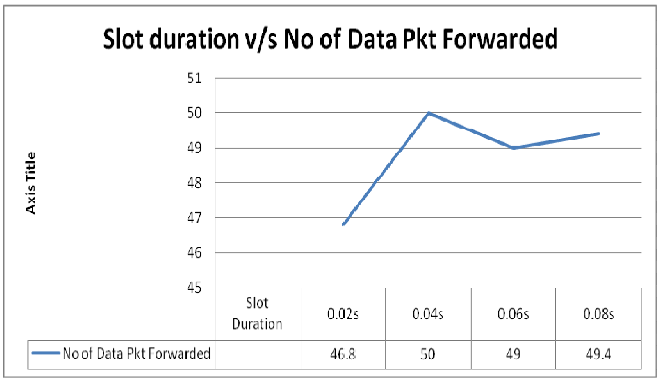
Step 4: Depending on the beta value, the packet is forwarded to the neighbours of the node.

Step 5: If packet is not forwarded, then latency is generated, therefore in turn the beta value is again adjusted.

Step 6: Once the beta value reaches to its normal range, packets are again forwarded to the neighbours.

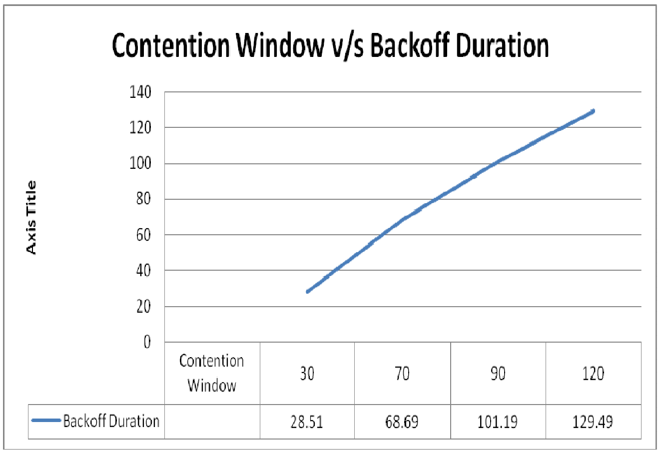
IV .Simulation Results

1.SLOT DURATION

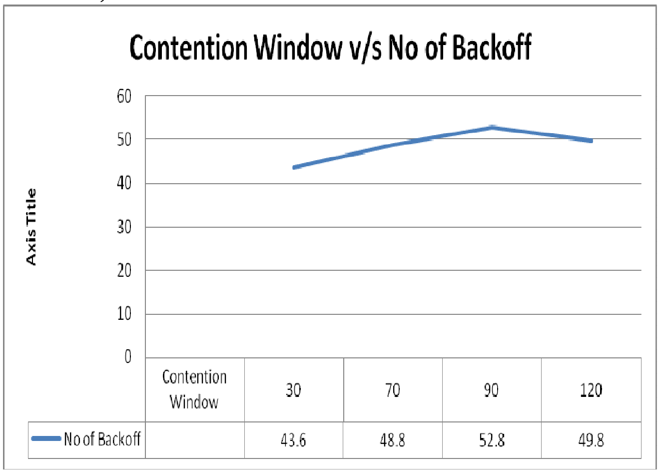


Slot duration is the time period for which a particular slot is allotted for the transmission of packets. As shown in the figure as the slot slot duration increases the no of data packets forwarded also increases. It reaches to its maximum value at 0.04s.

2.CONTENTION WINDOW .

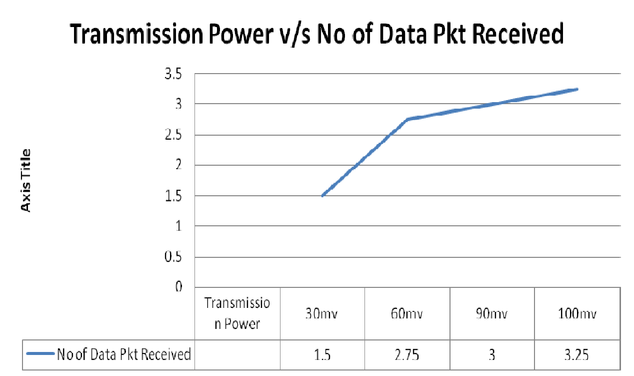


In the above given graph as the contention window period increases, we observe that the backoff duration period also increases,and then reaches its maximum value at 120.

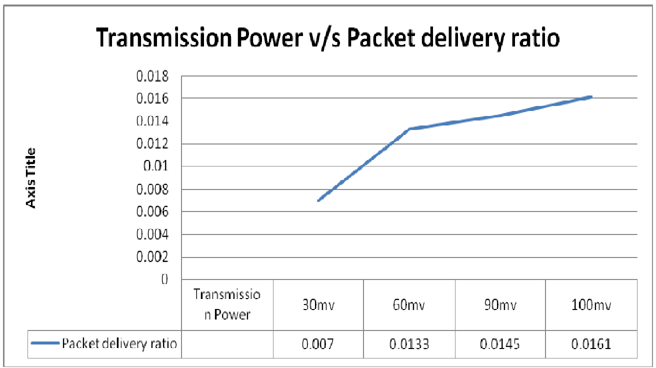


In the above given figure as the contention window period increases the no of backoff also increases and then reaches its peak point at a value of 90. And then we observe a gradually decrease from 90 to 120.

3.TRANSMISSION POWER

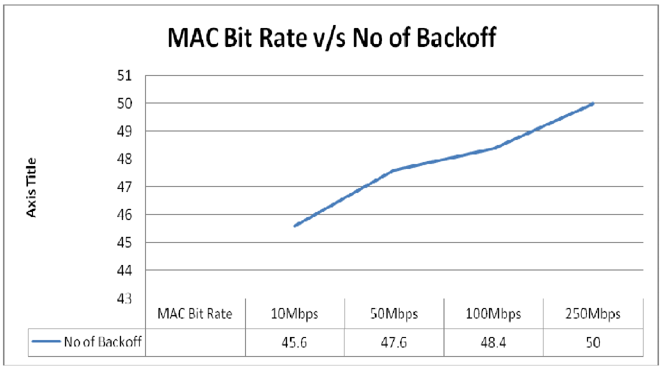


In the given graph as the transmission power increases, the no of data packet received also increases gradually, it has a optimum point at 60mv.



Packet delivery ratio is defined as the ratio b/w the no of packets received to the no of packets forwarded. It is also defined as total no of packets received to the destination via intermediate nodes. In the above given graph, as the transmission power increases the packet delivery ratio also increases.

4.MAC BITRATE



In this graph we observe that as the MAC bit rate increases, the no of backoff also increases, and it reaches its maximum point with no of backoff of 50 at a MAC bit rate of 250Mbps.

V .CONCLUSION

In general we can conclude that a Vehicular Ad-Hoc Network, or VANET is a technology that uses moving cars as nodes in a network to create a mobile network. VANET turns every participating car into a wireless router or node, allowing cars approximately 100 to 300 metres of each other to connect and, in turn, create a network with a wide range. As cars fall out of the signal range and drop out of the network, other network can join in.

Thus in the proposed system we have proposed an adaptive probabilistic broadcast routing in which every node in the network layer when it receives a packet from the application layer with an initial probability 'p' measures the latency and adjusts the channel error probability 'beta'. In this project we have beta range ranging from 1 to 10. In case its greater than beta the packets are not forwarded to its neighbour node in the network. Our simulation shown that the our simulation results shows that by using adaptative probabilistic broadcast routing the data packets forwarded in the network from the source to the destination by reducing the route path from the source to the destination by using the unicast method which involves a packet being relayed from link to link along a chain leading from the packet's source to its destination, by increasing the no of packets forwarded,no of packets received, backoff duration etc. In practice, broadcast packets are not forwarded everywhere on a network, but only to devices within a broadcast domain.

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