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AN ENHANCED STRATEGY IN BEACON OVERHEAD AND PDR IN MANET USING GEOGRAPHIC ROUTING STRATEGIES

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ABSTRACT

MANET is self-configured Mobile Ad hoc network of mobile nodes connected via random topology. The main issue in MANET is the selection of best path between any two nodes. Routing in MANET is to find the efficient path to transfer the data from source to destination. APU strategy is routing strategy for geographic routing in Mobile ad-hoc network which dynamically adjust the frequency of position updates based on the mobility dynamics of the nodes and the forwarding patterns in the network. The beacon updates include the current location and velocity of the nodes. An Enhanced APU strategy in the proposed system use destination aware routing with minimum distance dynamically adjusts the beacon update intervals based on the minimum distance from source to destination, mobility dynamics of the nodes and the forwarding patterns in the network. Results of the proposed system are compared with Periodic Beaconing on the basis of packet delivery ratio, beacon overhead, energy consumption. Experiment results show a high improvement in results on the parameters discussed. Energy consumption in Periodic beacon scheme is high compared to proposed system since periodic beacon causes high energy consumption in the nodes. APU saves energy by avoiding unnecessary beacon update and do the beacon update adaptively. Beacon overhead in Periodic beacon scheme is high compared to proposed system due to periodic beacon. Proposed system reduces the beacon overhead by avoiding unnecessary beacon update and only does the beacon update process adaptively.

KEYWORDS: APU, Enhanced APU, MANET, Destination aware routing.

INTRODUCTION

A mobile ad-hoc network (MANET) is a self-arranging wireless network of mobile hosts connected through arbitrary topology without the guide of any centralized administration. It is an optimization of link-state routing [19]. It is a collection of mobile nodes sharing a wireless channel without any centralized control or established communication backbone. They have no fixed routers with all nodes capable of movement and arbitrarily dynamic. These nodes can act as both end systems and routers at the same time. When acting as routers, they discover and maintain routes to other nodes in the network. The topology of the ad hoc network depends on the transmission power of the nodes and the location of the mobile nodes, which may change from time to time. Normal routing protocol which works well in fixed networks does not show same performance in Mobile Ad Hoc Networks. In these networks routing protocols ought to be more dynamic so that they rapidly react to topological changes. Figure 1.1 depicts the ad-hoc network and the routing of packets in the network. Different uses of MANET are characterized which incorporate military battle fields, commercial sector like emergency rescue operations, local levels like conferences or classrooms, personal area network(PAN) and numerous more applications [22].

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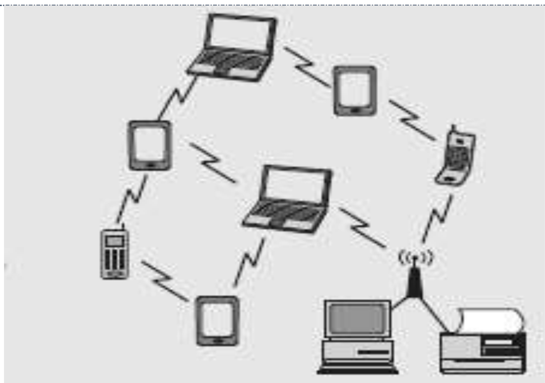

Figure 1.1 Mobile Ad-Hoc Network [41]

Characteristics of Manet

Dynamic Topologies: Since nodes are free to move arbitrarily, the network topology may change randomly and rapidly at unpredictable times. The links may be unidirectional bidirectional.

Bandwidth constrained, variable capacity links: Wireless links have significantly lower capacity than their hardwired counterparts. Also, due to multiple access, fading, noise, and interference conditions etc. the wireless links have low throughput.

Energy constrained operation: Some or all of the nodes in a MANET may rely on batteries. In this scenario, the most important system design criteria for optimization may be energy conservation.

Limited physical security: Mobile wireless networks are generally more prone to physical security threats than are fixed- cable nets. The increased possibility of eavesdropping, spoofing, and denial-of-service attacks should be carefully considered. Existing link security techniques are often applied within wireless networks to reduce security threats. As a benefit, the decentralized nature of network control in MANET provides additional robustness against the single points of failure of more centralized approaches [14].

Routing protocols and there categories

In Topology based approach, routing protocols are classified into three categories, based on the time at which the routes are discovered and updated.
a. Proactive Routing Protocol (Table Driven)
b. Reactive Routing Protocol (On-Demand)
c. Hybrid Routing Protocol

Adaptive Position Update (Apu)

APU strategy is routing strategy for geographic routing in Mobile ad-hoc network which dynamically adjust the frequency of position updates based on the mobility dynamics of the nodes and the forwarding patterns in the network. APU is based on two simple principles: 1) nodes whose movements are harder to predict update their positions more frequently (ii) nodes closer to forwarding paths update their positions more frequently (and vice versa).
There are some assumptions considered for this strategy:
1. All nodes are aware of their own position and velocity,
2. All links are bidirectional,
3. The beacon updates include the current location and velocity of the nodes, and
4. Data packets can piggyback position and velocity updates and all one-hop neighbors operate in the promiscuous mode and hence can overhear the data packets.

Upon initialization, each node broadcasts a beacon informing its neighbors about its presence and its current location and velocity. Following this, in most geographic routing protocols such as GPSR, each node periodically broadcasts its current location information. The position information received from neighboring beacons is stored at each node. Based on the position updates received from its neighbors, each node continuously updates its local topology, which is represented as a neighbor list. Only those nodes from the neighbor list are considered as possible candidates for data forwarding. Thus, the beacons play an important part in maintaining an accurate representation of the local topology. Instead of periodic beaconing, APU adapts the beacon update intervals to the mobility dynamics of the nodes and the amount of data being forwarded in the neighborhood of the nodes. APU employs two mutually exclusive beacon triggering rules, which are discussed in the following [27].

In Figure 1.2 the architecture of APU depicts the routing of packets from source to destination on the basis of APU strategy. In this packet is routed to the neighboring nodes within transmission range and beacon is updated on the basis of mobility prediction (MP) and on-demand learning (ODL) rule and the highly stable nodes from source to destination greedy forwarder is selected as best path for forwarding packet.

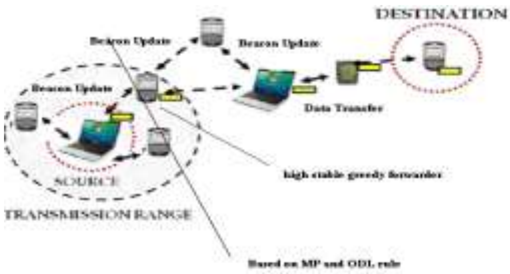

Figure 1.2 Architecture of APU

LITERATURE SURVEY

Tracy Camp, Jeff Boleng, Brad Williams, Lucas Wilcox, William Navidi (2002): This paper presents the results of a detailed performance evaluation on two of these protocols: Location-Aided Routing (LAR) and Distance Routing Effect Algorithm for Mobility (DREAM). The performance is compared with the Dynamic Source Routing (DSR) protocol. It uses NS-2 to simulate 50 nodes moving according to the random waypoint model. Main performance investigation was to stress the protocols evaluated with high data load during both low and high speeds. Results conclude that the increase in performance is worth the increase in cost. Lastly, the implementation of DREAM provides a simple location service that could be used with other ad hoc network routing protocols [3].

C. Perkins, E. Belding-Royer and S. Das (2003): In this paper authors present Ad-hoc on Demand Distance Vector Routing (AODV) a novel algorithm for the operation of ad-hoc networks. New routing algorithm is quite suitable for a dynamic self starting network as required by users wishing to utilize ad-hoc networks AODV provides loop free routes even while repairing broken links. This shows that the algorithm scales to large populations of mobile nodes wishing to form ad-hoc networks and also include an evaluation methodology and simulation results to verify the operation of their algorithm [4].

Ananth Rao, Sylvia Ratnasamy, Christos Papadimitriou, Scott Shenker, Ion Stoica (Sept, 2003): This paper defines a scalable coordinate-based routing algorithm that does not rely on location information, and thus can be used in a wide variety of ad hoc and sensornet environments [5].

Michele Zorzi, Ramesh R. Rao(2003): In this paper, authors study a novel forwarding technique based on geographical location of the nodes involved and random selection of the relaying node via contention among receivers. They provide a detailed description of a MAC scheme based on these concepts and on collision avoidance, and report on its energy and latency performance. A simplified analysis is given first, some relevant tradeoffs are highlighted and parameter optimization is pursued. Further, a semi-Markov model is developed which provides a more accurate performance evaluation [6].

Zhenqiang Ye, Srikanth V. Krishnamurthy, Satish K. Tripathi (2003): In this modified version of the popular AODV protocol is proposed and it allows discovering multiple node-disjoint paths from a source to a destination. It is necessary to place nodes called *reliable nodes* in the network for efficient operations. For this deployment strategy is proposed that determines the positions and the trajectories of these reliable nodes such that framework for reliable routing information can be achieved. Another notion of a *reliable path* is also defined which is made up of multiple segments, each of which is entirely consists of reliable nodes. [8].

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RESEARCH METHODOLOGY

An Enhanced APU strategy in the proposed system use destination aware routing with minimum distance dynamically adjusts the beacon update intervals based on the minimum distance from source to destination, ***mobility dynamics*** of the nodes and the ***forwarding patterns*** in the network.

The beacons transmitted by the nodes contain their current position and speed. Nodes estimate their positions periodically by employing linear kinematic equations based on the parameters announced in the last announced beacon. If the predicted location is different from the actual location, a new beacon is broadcast to inform the neighbors about changes in the node's mobility characteristics.

An accurate representation of the local topology is particularly desired at those nodes that are responsible for forwarding packets. Hence, APU seeks to increase the frequency of beacon updates at those nodes that overhear data packet transmissions. As a result, nodes involved in forwarding packets can build an enriched view of the local topology.

Advantages of the Proposed System:

Cost reduction in Beacon Update: Due to destination aware routing cost to update the position of beacon decreases.

Increase in Performance: highly mobile nodes can broadcast frequent beacons to ensure that their neighbors are aware of the rapidly changing topology.

NS2 Environment settings for proposed work:

TABLE 2 NS2 Environment settings

Serial no.	Type	Category
1	Channel/Wirelesschannel	Channel type
2	Propagation/TwoRayGround	Radio propagation
3	Antenna/OmniAntenna	Antenna type
4	CMUPriqueue	Interface queue type
5	1024	Max packet in ifq
6	Phy/Wirelessphy	Network interface
7	Mac/802_11	MAC type
8	DSR	Routing protocol
9	48	No. of mobile nodes
10	1050	X co-ordinate
11	850	Y co-ordinate
12	EnergyModel	Energy model
13	100	Initial energy in Joules

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PHASES OF THE PROPOSED WORK

Phase1

1. Network Configuration and Initial Beacon Exchange
2. Mobility Prediction (MP) Rule – (mobility dynamics)

Phase2

3. On-Demand Learning (ODL) Rule **–** (forwarding patterns)
4. Mobility based forwarding node selection
5. Performance Evaluation

Modules of the proposed work

1. Network Configuration and Initial Beacon Broadcast
2. Mobility Prediction (MP) Rule – (mobility dynamics)
3. On-Demand Learning (ODL) Rule **–** (forwarding patterns)
4. Mobility based forwarding node selection
5. Performance Evaluation

Modules Description:

Network Configuration and Initial Beacon Broadcast
Input: Node Configuration settings
Output: Beacon exchange among neighbors in MANET

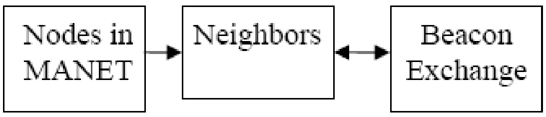

Figure 3.2 Initial Beacon Broadcast in MANET

Mobile Ad hoc network is created with the total number of 48 wireless nodes. Nodes are configured with simulation parameters listed in the simulation model table. In Figure 3.2 Nodes are deployed in the initial location. After the deployment, each node identifies its neighbors by sending beacon. Nodes which are located within the communication range are known as neighbors. Each node broadcast the beacon to its neighbors.

Mobility Prediction (MP) Rule – (mobility dynamics)
Input: location difference
Output: Beacon update

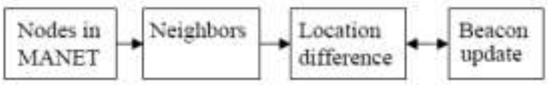

Figure 3.3 Mobility Prediction Rule of APU

In Figure 3.3 the beacons transmitted by the nodes contain their current position and speed. Nodes estimate their positions periodically by employing linear kinematic equations based on the parameters announced in the last announced beacon. If the predicted location is different from the actual location, a new beacon is broadcast to inform the neighbors about changes in the node's mobility characteristics.

On-Demand Learning (ODL) Rule – (forwarding patterns)
Input: Nodes in the forwarding path overhearing Data Transmission
Output: Beacon update

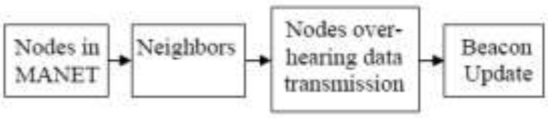

Figure 3.4 Nodes overhearing data transmission

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An accurate representation of the local topology is particularly desired at those nodes that are responsible for forwarding packets. Hence, in Figure 3.4 APU seeks to increase the frequency of beacon updates at those nodes that overhear data packet transmissions. As a result, nodes involved in forwarding packets can build an enriched view of the local topology.

Mobility based forwarding node selection
Input: Data from source
Output: Transmission through stable nodes

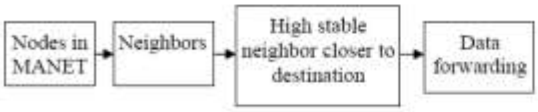

Figure 3.5 Forwarding node selection

In Mobile Ad-hoc Networks if forwarding nodes have high mobility, may chances to make local topology inaccuracy. Figure 3.5 depicts that if the node involved in the forwarding path node moves frequently then there is the situation of frequent beacon update is required which leads to network traffic in turn packet collision. Hence it is required to select the nodes with low mobility which means selection of stable node as forwarder based on its mobility. This thesis with low mobility based forwarding node selection that improves routing performance more than APU.

Source node finds the distance of each neighbor from itself at particular time (t). After certain time (t+T) it finds the distance again. If the difference between the two distances is less than the threshold, the neighbor is considered as highly stable neighbor. To apply highly stable greedy forwarding distance between destination and highly stable neighbors are calculated. The neighbor which is having the minimum distance is selected as forwarder.

Figure 3.6 Block Diagram of proposed work (Enhanced APU)

Given the block diagram (Figure 3.6) represents the proposed work and the enhanced APU strategy. Initially it is assumed that all nodes are aware of their location called beacons. Beacons are exchanged between all the neighbors in the network. According to mobility prediction rule, beacons are updated and on-demand learning rule maintains a more accurate neighbor list. Then node for data forwarding is selected on the basis of these rules. Data is transferred over the network. The performance can be evaluated on the basis of energy consumption, beacon overhead and packet delivery ratio.

Algorithm for selection of forwarder:
Step1:
Find distance [d (t)] of each neighbor from source at time T
Step2:
Find distance [d (t+T)] of each neighbor from source at time (T+t)
Step3:
If {[d (t+T)] - [d (t)] < Threshold}→ Select the neighbor as high stable link
Step4:
Find distance D_{des} between destination and the node having high stable link
Step5:
Link having minimum D_{des} is selected as next hop

This algorithm is method to select the next hop for routing first the distance is calculated lets say d(t) at time T then find distance at time (t+T) if the difference is less then threshold then it is considered as highly stable then the distance between destination node and highly stable node is selected as next hop.

Flow Chart:
The Flowchart (Figure 3.7) of the proposed work represents the methodology of the work done. Initially the nodes in the network have been deployed in such a way that all the nodes are location aware. Location aware nodes are called beacons. All location aware nodes broadcast beacons to their neighbor nodes to calculate the distance from source node at instance of time T. after that the distance at time (t+T) is calculated. If the difference between the

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calculated distances is less than threshold then it is considered as stable link. Select the link having the minimum distance by calculating the distance between destination node and highly stable link and then data can be transferred over the network.

Figure 3.7 Flow chart of proposed work (Enhanced APU)

RESULTS AND DISCUSSION

Proposed system is evaluated on the following parameters:

PDR (Packets Delivery Ratio): PDR is the proportion to the total amount of packets reached the receiver and amount of packet sent by source. If the amount of malicious node increases, PDR decreases. The higher mobility of nodes causes PDR to decrease.

Energy Consumption: It is the amount of energy consumed by the sensors for the data transmission over the network.
Energy Consumption = Sum of energy consumed by each sensor.

Overhead: It is defined as the number of messages involved in the beacon update process.
Overhead = Number of messages involved in beacon update process

Following is an implementation of the proposed system in NS2 environment:

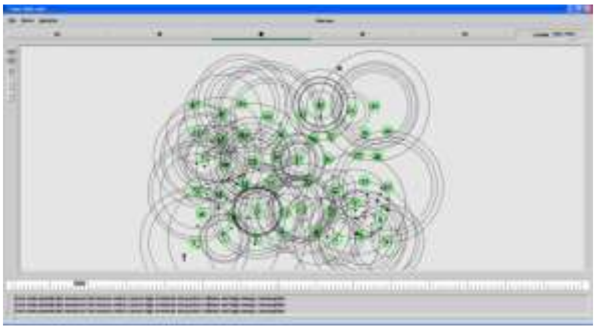

Figure 4.1 periodically broadcast beacons in NS2

Above snapshot (Figure 4.1) shows each node periodically broadcast the beacon which causes high overhead and packet collision and high energy consumption.

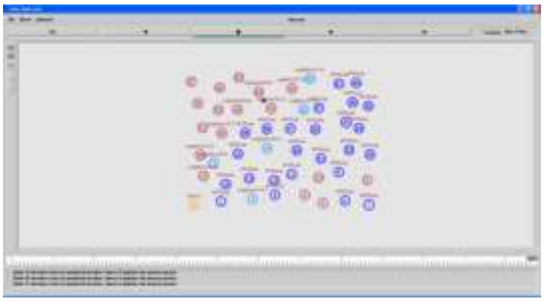

Figure 4.2 Node selection in Enhanced APU

In this Figure 4.2 Nodes in orange color depicts the source and destination node and maroon colored nodes are beacon updated nodes and nodes in blue color are MP nodes which are having the actual location with larger difference from its predicted location. Hence MP nodes update the beacon packet. Deviation threshold is fixed as 60m. If there exists difference between actual locations and predicted of a node is greater than 60m then beacon packet is sent by the node otherwise the other node distance is considered having the minimum distance.

The results are shown graphically with the help of tables containing values of existing and proposed work. With graphs it is found that there is enhancement in previous simulations and we are succeeded in improving the results of the parameters discussed as energy consumption is improved and beacon overhead is reduced and packet delivery ratio is increased. In the graph for energy consumption, energy consumption in y-axis and time in x-axis is plotted and in graph for beacon overhead the packets in beacon process in y-axis and time in x-axis is plotted and last graph for packet delivery ratio the packets ration in y-axis and time in x-axis is plotted.

Energy Consumption versus Time

TABLE 3 Values for energy consumption (Joules)

Time (s)	Existing system	Proposed system
0	0	0
2	75	40
4	150	75
6	225	120
8	310	160
10	380	190
12	460	230
14	540	275

Given the table 3 for Energy consumption values in existing system and proposed system and depicts that there is much reduction in energy consumed.

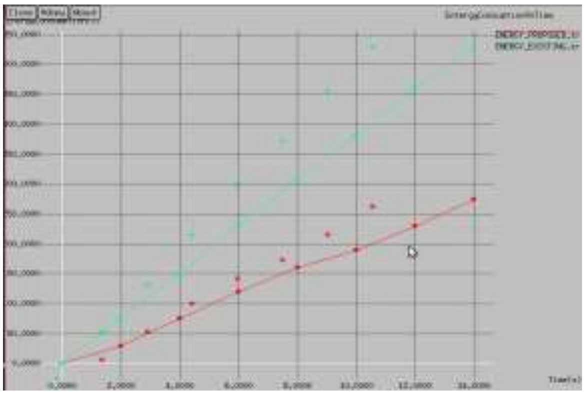

Figure 4.3 X-graph for Energy consumption

Given graph depicts that Energy consumption in proposed scheme is high compared to existing APU since periodic beacon causes high energy consumption in the nodes. APU saves energy by avoiding unnecessary beacon update and do the beacon update adaptively.

Beacon Overhead versus Time

TABLE 4 Values for Beacon overhead (packets * 10^3)

Time (s)	Existing system	Proposed system
0	0	0
2	14	0
4	27	1
6	40	1
8	54	2
10	68	3
12	81	3
14	95	4

Given the table 4 for Beacon overhead values in existing system and proposed system and depicts that there is much less overhead in proposed system.

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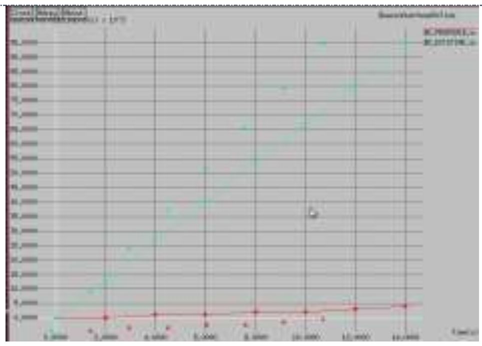

Figure 4.4 X-graph for Beacon overhead

Given graph depicts that Beacon overhead in existing APU scheme is high compared to proposed scheme due to periodic beacon. APU reduces the beacon overhead by avoiding unnecessary beacon update and only does the beacon update process adaptively.

Packet Delivery Ratio versus Time

TABLE 5 Values for Packet delivery ratio

Time (s)	Existing system	Proposed system
0	0	0
2	5	12
4	9	23
6	14	35
8	19	47
10	23	59
12	27	72
14	37	83

Given the table 5 for Packet delivery ratio in existing system and proposed system and depicts that there is very high packet delivery ratio in proposed system.

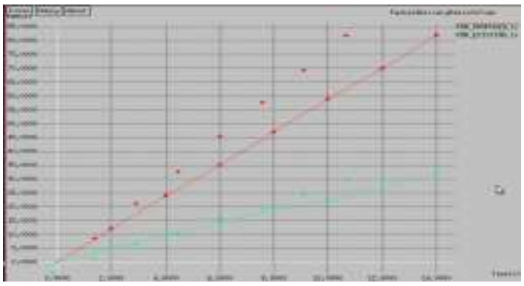

Figure 4.5 X-graph for Packet delivery ratio

Given graph depicts that Packet delivery ratio of proposed scheme is high compared to existing APU scheme. Since network traffic in APU is reduced due to adaptive beacon update instead of periodic beacons in the case of periodic beacon scheme. In PB data gets dropped due to high traffic in the network.

CONCLUSION AND FUTURE SCOPE

In the proposed work, the need to adapt the beacon update is identified and the corresponding policy is employed in geographic routing protocols to the node mobility dynamics and the traffic load. The Adaptive Position Update (APU) strategy is proposed to address these problems. The APU scheme employs two mutually exclusive rules. The MP rule uses mobility prediction to estimate the accuracy of the location estimate and adapts the beacon update interval accordingly, instead of using periodic beaconing. The ODL rule allows nodes along the data forwarding path to maintain an accurate view of the local topology by exchanging beacons in response to data packets that are overheard from new neighbors. Performance of APU is evaluated using extensive NS-2 simulations for varying node speeds and traffic load. Results indicate that the APU strategy generates less or similar amount of beacon overhead as other beaconing schemes but achieve better packet delivery ratio, less overhead and energy consumption.

Future work will be the exploring the new techniques to the proposed work to reduce the overhead and energy consumption further in the network. The following can be future guidelines to improve the performance of the proposed system:

1. To develop an approach that consider all types of energy parameters like battery power, router energy, path energy in a combination with node energy to minimize the energy consumption in the network.
2. In Future, a new function of path stability checking can also be implemented that can check the stability of the selected path after every successful data transfer to improve the overall performance of the network.

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