ISSN 2395-695X (Print)
ISSN 2395-695X (Online)

International Journal of Advanced Research in Biology Engineering Science and Technology (IJARBEST)

Vol. 2, Special Issue 10, March 2016

MULTIHOP ROUTING PROTOCOL BASED ON DELIVERY QUALITY AND DWINDLEMENT OF DATA USAGE USING HINGE NODE IN DELAY TOLERANT NETWORK

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ABSTRACT

In Delay-Tolerant Networks (DTN), stable end to end connections are not always available. Messages forwarded is supported by store and Carry Forward paradigm. The mobility of nodes in most DTN has a certain statistical regularity that is, with historical information in DTN, the quality of delivery of nodes that can help to choose a good forwarding node are computed. The proposed work aims to create a routing scheme based on multihop delivery quality, which is designed to reduce the delay and simultaneously achieve a high flow rate and also efficiently manages the data in the network. The basic idea is to find a optimum path by minimizing the delay and by maximizing the expected probability. Two algorithms namely delay based forwarding and probability based forwarding accompanied by hop count constrained forwarding and a method is formulated accordingly. The data redundancy lead by the store and carry forward paradigm is monitored and managed by hinge node scheme.. The hinge node consists of the data burst copy and sends the signal neighboring hops to discard the data is copied into the corresponding node.

1. INTRODUCTION

The existing DTN are sparse mobile networks, where stable end to end connections do not always exist. Messages are forwarded, assisted by the mobility of nodes, in a store carry forward paradigm. The delivery quality of each node is usually calculated assuming long term regularity in the historical contact information of a DTN. Short term regularity is relatively unstable over times and may have to be updated frequently. To represent the delivery quality, most opportunistic routing schemes use the one hop quality (e.g., the encounter frequency of a pair of nodes), which has some drawbacks. The most obvious one is that they cannot find multihop good forwarders for a particular destination. Many challenging problems arises such as routing, resource allocation, content placement etc.The main focus of the proposed system is to provide an optimal forwarding path by minimizing the expected delay and by maximizing the expected probability respectively. Also significantly aims improve the message delivery rate and yield more improvement as the mobility of nodes become more regular. The proposed system facilitates smaller forwarding overhead (with the maximum reduction in the number of forwarding). The selection of forwarding nodes of data bundles is facilitated by the delay inferred forwarding and probability inferred forwarding scheme. The multi hop transmission is regulated with the help of reserved hop count forwarding scheme. The algorithms used in the proposed system aims to significantly reduce the number of message copies that are stored and forwarded in the nodes. The proposed system also targets to reduce the redundancy which is facilitated by the hinge nodes and increase the data quality of the data transmitted. The power consumption for transmission is a crucial factor which is also intended to be reduced in the proposed work.

2. RELATED WORKS

Adriano Galati, et al (2014) have stated a system that explores how ICT systems for collective intelligence can be used to foster economic and social empowerment of rural communities. They also establish the case for DTN as a socially grounded approach to mobile empowerment in the context of rural development. They have established a station that provides communities in rural South Africa with cinema experience by training microentrepreneurs in the operation of a DTN enabled microfranchise. (Mobile Enabled Delay Tolerant Networking in Rural Developing Regions)[1]

AndreeaPicu et al (2015) have proposed an Opportunistic or delay tolerant networks (DTNs) that may be used to enable communication in case of failure or lack of infrastructure. They proposed DTN Meteo, a new unified analytical model that maps an important class of DTN optimization problems over heterogeneous mobility/contact models into a Markov chain traversal over the relevant solution space. Their work that can predict performance for utility based algorithms and heterogeneous node contact rates. (DTN Metro: Forecasting the Performance of DTN Protocols under Heterogeneous Mobility) [2]

BambangSoelistijanto and Michael Howarth(2014) have projected the state of the art of proposals for transfer reliability and storage congestion control strategies in opportunistic networks. Potential mechanisms for transfer reliability service, i.e. hop by hop custody transfer and end to end return receipt is discussed. They also identify the requirements for storage congestion control and categorize these issues based on the number of message copies distributed in the networks. The main contributions are considering transfer reliability and congestion control proposals taking account of opportunistic networks' characteristics and Identifying open research issues in transfer reliability and congestion control in opportunistic networks. (Transfer Reliability and Congestion Control Strategies in Opportunistic Networks: A Survey) [4]

Bora Karaoglu et al (2015) have presented a lightweight dynamic channel allocation mechanism and a cooperative load balancing strategy that are applicable to cluster based MANETs to address this problem. We present protocols that utilize these mechanisms to improve performance in terms of throughput, energy consumption and Inter Packet Delay Variation (IPDV) (Cooperative Load Balancing and Dynamic Channel Allocation for Cluster Based Mobile Ad Hoc Networks)[5]

Carla Fabiana et al (2014) have suggested a wireless sensor network whose nodes may enter the so called sleep mode, corresponding to low power consumption and reduced operational capabilities and developed a Markov model of the network representing, the behavior of a single sensor as well as the dynamics of the entire network, the channel contention among sensors, and the data routing through the network. We use this model to evaluate the system performance in terms of energy consumption, network capacity, and data delivery delay. (An Analytical Model for Wireless Sensor Networks with Sleeping Nodes) [6]

Cheng Wang et al (2014) have studied the asymptotic capacity and delay, and their tradeoffs in mobile ad hoc networks (MANETs) and investigated the impact of an adaptive rate communication model on capacity delay tradeoffs in MANETs under classical mobility models. a well known adaptive rate model called the generalized physical model is adopted. The mobility of nodes is characterized by two broad classes of practical mobility models and they are hybrid random walk models and discrete random direction models. The two models generalize many mobility models studied in the literature, including the random walk, Brownian, and random way point models. (The Impact of Rate Adaptation on Capacity Delay Tradeoffs in Mobile Ad Hoc Networks)[7]

Edward Hua et al (2015) have proposed an algorithm that estimates of residual link lifetime (RLL) in mobile ad hoc networks (MANET) using the distances between the link's nodes. they proved that to compute uniquely the RLL, at least four distance measurements are required. They also demonstrated that random measurement errors are the dominant factor in prediction inaccuracy and that systematic errors are negligible. To account for velocity changes, the MPT is enhanced with a velocity change detection test. (Mobile Projected TrajectoryAlgorithm with Velocity Change Detection for Predicting Residual Link Lifetime in MANET).[8]

Greg Goth (2006) have discussed the origins surrounding the inadequacies of Transmission Control Protocol and Internet Protocol for deep space and interplanetary communications. The explosion of wireless networks, however, has given the concept's terrestrial implications a much higher profile.They developed simple prototypes and suggested a small accelerator that can be plugged into any network to explore how DTNs would impact. (Delay Tolerant Network Technologies Coming Together)[9]

Henry Chenji et al (2013) have proposed Anonymous Net (AnonNet), a system for emergency response in large scale disaster areas, e.g., earthquake and tsunami in Japan and earthquake in Haiti. AnonNet, designed in collaboration with US&R responders, is designed to aid in identifying victims under collapsed buildings, deliver victims' physiological information on time, deliver high volumes of field data at high through put and in an energy efficient manner, and integrates new social networking paradigms. AnonNet is a large academic effort, proposing open systems, instead of proprietary solutions. AnonNet and its subsystems are evaluated in real deployments and simulations (A Wireless Sensor, AdHoc and Delay Tolerant Network System for Disaster Response). [10]

JunfeiXie et al (2014) have presented a comprehensive survey and comparative analysis of mobility models that are either adapted to or developed for Airbone Network evaluation purposes and evaluated the mobility models based on the metrics adaptability, networking performance, and ability to realistically capture the mobility attributes of Airbone Networks including high mobility,mechanical and aerodynamic constraint, and safety requirements. (A Survey and Analysis of Mobility Models for Airborne Networks) [11]

Jingjing Luo et al (2015) have analyzed asymptotic throughput delay performance of mobile ad hoc networks (MANETs) under a location popularity based scenario, where users are more likely to visit popular locations and conducted the analysis under traditional store carry forward paradigm. Their scheme outperforms all delay capacity results obtained in conventional scheme and can achieve a constant capacity with an average delay. (Impact of Location Popularity on Throughput and Delay in Mobile Ad Hoc Networks)Kyunghan Lee et al (2013) have presented a joint optimization of link scheduling, routing and replication for DTN. Their work defines a new notion of approximation to the optimality for DTNs, called snapshot approximation where nodes are not clairvoyant, i.e., not looking ahead into future events, and thus decisions are made using only contemporarily available knowledges. They defined an algorithm, Max Contribution (MC) that approximates MWIS problem with a greedy method and its distributed online approximation algorithm, Distributed Max Contribution (DMC) that performs scheduling, routing and replication based only on locally and contemporarily available information. (Max Contribution: An Online Approximation of Optimal Resource Allocation in Delay Tolerant Networks).[12]

Qiao Fu et al (2013) have proposed a local capacity constrained density adaptive routing algorithm for large scale vehicular DTN in urban areas which targets to increase the packet delivery ratio within deadline, namely Density Adaptive Routing With Node deadline awareness (DAWN). DAWN enables the mobile nodes awareness of their neighbor density, to which the nodes'transmission manners are adapted so as to better utilize the limited capacity and increase the data delivery probability within delay constraint based only on local information. (DAWN: A Density Adaptive Routing for Deadline Based Data Collection in Vehicular Delay Tolerant Networks).[13]

Sergio M. Tornell, et al (2013) have proposed a generic DTN model that compares various representative DTN solutions in a metropolitan scenario. A generic DTN model called Generic One Copy DTN Model (GOD) with the objective of fairly comparing various DTN solutions in a metropolitan scenario is contemplated studied the weak and strong points of the various proposals by taking into consideration

ISSN 2395-695X (Print)
ISSN 2395-695X (Online)

International Journal of Advanced Research in Biology Engineering Science and Technology (IJARBEST)

Vol. 2, Special Issue 10, March 2016

different sending strategies, adopted to improve the performance of the DTN protocols is evaluated. Their model integrates within the TCP/IP protocol architecture and represents as a new layer between the application and the transport layers, allowing DTN protocol to work independently of the IP routing protocol (Assessing the Effectiveness of DTN Techniques Under Realistic Urban Environments).[15]

Xiaoyan Wang et al (2015) have proposed a novel cross layer distributed energy adaptive location based CMAC protocol, namely DEL CMAC, for Mobile Ad hoc Networks (MANETs). A distributed utility based best relay selection strategy is incorporated, which selects the best relay based on location information and residual energy. With the purpose of enhancing the spatial reuse, an innovative network allocation vector setting is provided to deal with the varying transmitting power of the source and relay terminals. (Improving the Network Lifetime of MANETs through Cooperative MAC Protocol Design). [18]

Yang Qin et al (2014) have showed that MANETs are still vulnerable under passive statistical traffic analysis attacks and to demonstrate how to discover the communication patterns without decrypting the captured packets they presented a novel statistical traffic pattern discovery system that works passively to perform traffic analysis based on statistical characteristics of captured raw traffic. (STARS: A Statistical Traffic Pattern Discovery System for MANET)[20]

Ze Li et al (2014) have proposed a QoS Oriented Distributed routing protocol (QOD) to enhance the QoS support capability of hybrid networks by Taking advantage of fewer transmission hops and any cast transmission features of the hybrid networks, QOD transforms the packet routing problem to a resource scheduling problem. QOD incorporates algorithms such as QoS guaranteed neighbor selection algorithm to meet the transmission delay requirement, distributed packet scheduling algorithm to further reduce transmission delay, mobility based segment resizing algorithm that adaptively adjusts segment size according to node mobility in order to reduce transmission time, traffic redundant elimination algorithm to increase the transmission throughput, and data redundancy elimination based transmission algorithm to eliminate the redundantdata to further improve the transmission QoS.(A QoS Oriented Distributed Routing Protocol for Hybrid Wireless Networks)

Zijie Zhang et al (2015) have investigated information broadcast schemes in 2 D mobile ad hoc networks where nodes are initially randomly distributed and then move following a random direction mobility model. Based on an in depth analysis of the popular susceptible infectious recovered epidemic broadcast scheme, proposed a novel energy and bandwidth efficient broadcast scheme, named the energy efficient broadcast scheme, which is able to adapt to fast changing network topology and channel randomness. (Energy Efficient Broadcast in Mobile Networks Subject to Channel Randomness) [24].

3. PROPOSED WORK

In the proposed work messages from being forwarded, through the mobility of nodes is supported, in a business presentation paradigm. The mobility of nodes in most DTNs has calculated a certain statistical regularity with historical information in DTNs to delivery quality of nodes helps to select a good routing node. This system aims to provide a routing scheme based on multihop delivery quality, which is designed to reduce the delay and increase the delivery quality of message forwarding that simultaneously yields a high flow rate. The proposed work is a routing scheme, which can reduce the number of message copies while maintaining a high flow rate. Predicting the good forwarders and only messages to simplifying the process. The proposed work uses an expected delay and an expected probability that parameterized by the remaining number of hops to describe the quality of delivery of nodes, or are. These can accurately find the quality of delivery of nodes of a particular hop.The proposed method uses reserved Hops forwarding scheme, in which each message contains a value, called the remaining number of hops. It represents the maximum number of hops that the message be relayed. If a message with a residual hop number k is passed from one node to another, the remaining number of hops of the two copies in the two nodes is k - 1 if k = 0, the message will not be forwarded to any node, with the exception the target. Therefore, the conveyance of a communication course is similar to a complete binary tree. An advantage of this line scheme is that there is a constant further costs.The proposed work characterizes the multihop delivery quality of each node with an expected delay and an expected probability parameterized by the remaining number of hops. Based on these two quality metrics, two algorithms, namely, the delay Based Forwarding (DBF), and the likelihood algorithm on the basis of forwarding (PBF) algorithm. The basic idea of DBF and PBF is to determine the optimal conduction path by minimizing the expected delay and by maximizing the expected likelihood of each hop in graphs that are defined in this system. The data redundancy and residual data which are located behind the nodes by memory switching paradigm, remain by the hinge node scheme in which the excess or unnecessary residues are discarded when a hinge is determined manages. The hinge node consists of the data burst copy and sends the signal neighboring hops to discard the data is copied into the corresponding node.

4. SYSTEM DESIGN

The proposed system has four modules namely reserved hop count forwarding scheme, the delay based forwarding, probability based forwarding scheme and the hinge node determination. The data bundle messages once generated are enclosed with the hop count. The hop count decreases linearly during propagation of data bundle from one node to another. With the remaining hop count, estimated delay and estimated probability, the delay based forwarding algorithm and probability based algorithm selects the next best forwarder node in the network. During data transmission since the DTN uses store and forward paradigm, there exists a copy of data in every node of propagation (because of replication routing). This leads to redundancy and power consumption and over usage of memory in the propagation nodes. This situation is run down by the hinge node, which enables only one node to store the message bundle. Each blocks of the block diagram are explained below.

ISSN 2395-695X (Print)
ISSN 2395-695X (Online)

International Journal of Advanced Research in Biology Engineering Science and Technology (IJARBEST)

Vol. 2, Special Issue 10, March 2016

Fig. 1. Block diagram of the proposed system

5. METHOD

5.1 HOP COUNT CONSTRAINED FORWARDING

In the hop count routing limited scheme each message holds a value, called the remaining number of hops. It represents the maximum number of hops that the message be relayed. If a message with a residual hop number k is passed from one node to another, the remaining number of hops of the two copies in the two nodes is $k - 1$ if $k = 0$, the message will not be forwarded to any node, with the exception the target. Therefore, the conveyance of a communication course is similar to a complete binary tree. An advantage of this line scheme is that there is a constant further costs.

5.2 ESTIMATION OF EXPECTED DELAY

Estimation of delay expected helps to find multihop good forwarders which cannot be computed through one hop delivery quality. For example, although j seldom meets with the destination d, j may encounter m in the near future, which has high probability of meeting with d. Thus, j is a good forwarder, but it cannot be identified using one hop delivery quality. To rectify the aforementioned drawback, an expected delay Di, d, k parameterized by the remaining hop count k is defined in the Optimal Opportunistic Forwarding algorithm. Di, d, k denotes the expected time that it takes to deliver a message from i to destination d with remaining hop count k. A smaller expected delay means a higher delivery quality.

5.3 DELAY BASED FORWARDING

DBF algorithm presented, uses the expected delay Di, d, k to characterize the multihop delivery quality of each node. The proposed algorithm uses the hop count limited forwarding scheme to restrict the maximum number of hops of each message, and it seeks to find the optimal message forwarding path by minimizing the expected delay in the delay hop graph. When a message with the remaining hop count k is forwarded from one node to another, the two nodes will both have a message copy, in which their remaining hop counts become $k - 1$. If one of the two copies successfully reaches the destination node, the message is considered delivered. Let the expected delay after forwarding be D. Then D =min{Di, d, k−1, Dj, d, k−1}. Therefore, a message should be forwarded if D <Di, d, k, which implies the expected delay will be smaller after forwarding. When a message with remaining hop count k is forwarded from node i to node j, the expected delay D is exactly equal to Dj, d, k−1 after forwarding. For any source i and destination d, the expected delays with different remaining hop counts satisfy Di, d, k ≤ Di, d, k−1 ≤ Di, d, k−2 ≤ · · · ≤ Di, d, 0. This is because with a higher remaining hop count, there is a higher chance of finding a better forwarding path, and the expected delay will be smaller. The expected delay Di, d, k of the current hop k can be derived from the last hop. The following analysis first presents the calculation of the expected delay for remaining hop count 0. Finally, the expected delay for any hop ($k > 1$) is derived using induction.The delay hop graph of hop 1 is shown in figure3.3, from which some edges are omitted for better readability. Node j in the graph represents any relay node, except node I or node d, and all expected delays of hop 0 are known. To obtain the minimum value of Di, d, 1, thus traversal of all the relay nodes, calculate different values using, and select the smallest valuefor Di, d, 1. Di, d, 1 = min {Ii, j/2 + Dj, d, 0}. If min {Ii, j/2 + Dj, d, 0} > Di, d, 0, theexpected delay will become larger, the message is forwarded through any relay node (i.e., the path from ito j and then to d is longer than the one directly from i to d in the graph). In this situation, the optimal solution will be using the direct path and not forwarding the message to any relay node.

Algorithm for Delay based forwarding

The following algorithm is executed in delay based forwarding scheme

1) 1: N ← number of nodes
2) 2: I i, j ← mean of intermeeting time (i,j)
3) 3: Initialize Dmin
4) 4: for j in 1 to N do = D i, d, k−1
5) 5: if j = i || j = d then

ISSN 2395-695X (Print)
ISSN 2395-695X (Online)

International Journal of Advanced Research in Biology Engineering Science and Technology (IJARBEST)

Vol. 2, Special Issue 10, March 2016

6) 6: if I i, j/2
7) 7: Dmin
8) 8: end if
9) 9 : end if
10) 10: end for
11) 11: Di , d, k = Dmin

DBF first initializes Di, d, k to Di, d, k−1 and then finds a smaller value of Ii, j/2 + Dj, d, k−1 in the node set if there exists one.

5.4 PROBABILITY ESTIMATION

Initially a variable Mi, j , which denotes the encounter probability of nodes i and j is defined. Assuming an exponential intermeeting time, the Mi, j is estimated by Mi, j = 1 − exp(−T/Ii, j) where T is the residual time to live (TTL) of the message, and Ii, j is the mean intermeeting time between nodes i and j. The only concern is with making relative comparisons between different pairs of nodes, T = 1 is set for simplicity. The calculation of the expected probability Pi, d, k with the current hop count k also uses the induction method.

5.5 PROBABILITY BASED FORWARDING

The PBF algorithm is presented and the expected probability Pi, d, k to describe the multihop delivery quality of each node is defined. The steps of the PBF algorithm are similar to that of DBF. Instead of minimizing the expected delay as in Delay based forwarding, Probability based forwarding finds the optimal forwarding path by maximizing the expected probability in the probability hop graph.

The expected probability Pi, d, k, also has the parameter of the remaining hop count to characterize the multihop delivery quality of each node. Pi, d, k denotes the expected probability for a message delivered from i to d with the remaining hop count k. When a message with the remaining hop count k is forwarded from one node to another, the two nodes will both have a copy, in which the remaining hop count becomes k − 1. If one of the two copies successfully reaches the destination node, the message is considered delivered. Let the expected probability after forwarding be P, gives P = max{Pi, d, k−1, Pj, d, k−1}. Therefore, a message should be forwarded if >Pi, d, k, which means that the expected probability will be larger after forwarding.

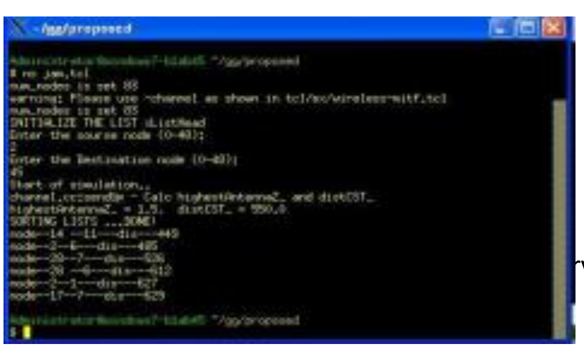
5.6 HINGE NODE:

A hinge node is a node in the network which is entitled to act as hinge. The hinge network typically holds the data bundle in the network and rest of the nodes discards the data bundle packet which are stored in them due to store and forward paradigm. The hinge node determination is carried out by features such as resource availability system capacity and capability, standby power and cumulative distance amongst the group of nodes. The hinge node determination is decided by the technique which is widely used in wireless sensor networks, the beacon technique.

For every constant hop count number (say for example 10) the nodes track back and sends a beacon to the source that is previous sender the detailed description of the individual node(self-node) namely the configuration, standby etc. to be explained in detail for the node of hop count 10 after decrement the beacon packet is sent to its sender the node with hop count 9. The beacon of 10th node and 9th node is compared. The node with dominant resource and capacity along with distance priority's is forwarded to the successive node of n-1 hop count for every 10 nodes. Once the node with hop count of n-1=0 is reached the beacon of the node which remains is entitled to be the hinge. The data bundle that is transmitted over the network with store and forward paradigm is kept in that hinge node and data packet in all other is discarded. The hinge sends a signal to the group of nodes to discard. When the data is lost or corrupted the hinge node resends the data if requested.

6. RESULTS AND DISCUSSION

The following are the simulation results of the delay based forwarding and probability based forwarding in the NS2. The command window, the input window and the output windows are shown below.The NS2 simulator once started running and the following window appears. This is the command window in which the .bat file is executed. The command <startxwin.bat> is executed that in turn generates the input window in which the inputs can be given and are shown in the figure.This NAM window gives the simulation result which is implemented using the delay based forwarding and forwarding based algorithms. The sorted route for the given source and destination is illustrated in figure.



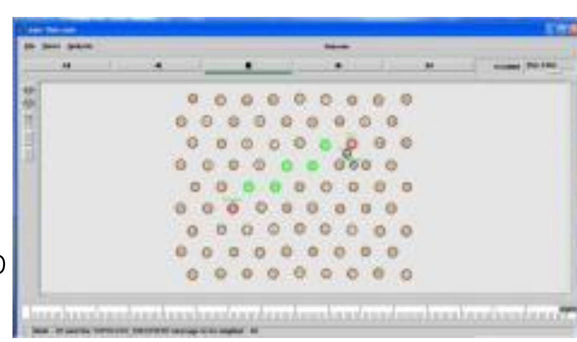


Fig.2 COMMAND WINDOW Fig .3 NAM window

6. CONCLUSION

A routing rules that make better use of historical information in the network and improve the routing performance may be proposed. An algorithm of the expected delay and the expected probability were used parameterized with the remaining number of hops used to characterize the multi-hop delivery quality of each node and DBF and PBF algorithms have been developed on the delay weighted graph and the probability weighted graph respectively calculated. The proposed DBF and PBF algorithms to find the optimal routing path by minimizing the expected delay and by maximizing the expected probability. The DBF and PBF significantly improve message delivery and to increase the capacity. Reduce the number of copies of messages clearly.DTN environments are regular, improving DBF and PBF offer is more important. The reason is that DBF and PBF algorithms using multihop delivery quality that they know when to order the optimal routing may have to find way enough time. To summarize, with the algorithms multihop delivery quality (ie, OOF, DBF and PBF) the slightest delay between all algorithms, with the exception of epidemic routing algorithm. The effect of bandwidth in DBF and PBF algorithms concluded that hops restriction is slight improvement in the performance of delay-based routing and the probability-based routing algorithms quite robust bandwidth limitation.The future work of the proposed system is to monitor the use of data and reducing the data usage in the node. This is achieved by joint nodes that achieved on the basis of resource availability, load balancing and determined cumulatively at the next node which is achieved by the hinge node and beacon technique.

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