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An Comparison and Evaluation for Data Gathering and Sharing with Inter Node Communication in Mobile-Sink

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Abstract

The rapid advances in processor, memory, and radio technology have enabled the development of distributed networks of small, inexpensive nodes that are capable of sensing, computation, and wireless communication. Sensor networks of the future are envisioned to revolutionize the paradigm of collecting and processing information in diverse environments. Traditional utility-based data-gathering models consider the maximization of the gathered information and the minimization of energy consumption in Wireless Sensor Network with reliable channels. In this paper we have taken the approach of data gathering from node to node communication. We provide five different comparisons 1) Comparison based on Data Gathering. 2) Comparison based on execution. 3) Comparison based on Energy Efficiency 4) Comparison Based on Availability 5) Comparison Based on Future security.

Keywords

Sensor Network; Mobile Sink, WSN, DGPNDS

1. Introduction

Communication within intra clusters and inter clusters can be either one hop or multi-hop, and in general, intracluster communication adopts one-hop scheme and intercluster communication uses both models. However, the one hop transmission from the cluster heads to the sink is not scalable because of the limitation of the maximum transmission range. At the same time, since the nodes closer to the sink are burdened with heavy relay traffic, they are normally drained out energy much faster than those in a farther location. The phenomenon is called the ”hot spot” problem or ”energy hole” problem in the literatures [1], [2], [3], [4], [5], [6] and [7].

Recently, it has come to be generally believed by academia and industry alike that the sensor network will have a key role to extend the reachability of the next generation Internet. A key characteristic of this network is that there is no single node in the network that is powerful enough to perform the assigned tasks. An application should be served via the cooperation of several nodes or even the entire network. The network serves as an information base, and is data driven, as opposed to a provider for the point-to-point connection. The main challenge of this network is huge information organization, including information storage, searching and retrieval, especially in a continuous way. There are many specific and interrelated problems.

The ubiquitous data collection problem considered in this paper essentially differs from traditional data collection problems in static settings. In a static sensor network, an optimal data collection tree is usually built to collect the network wide data. The data collection tree is fixed and suffices to efficiently deliver data to the static sink [8][9][10][11][12][13]. In the presence of user mobility and the requirement of ubiquitous data access, however, the data collection tree constructed at one point is normally not enough as the mobile user moves.

To efficiently deliver network-wide data to the mobile user, the data collection tree needs to be constructed or updated from time to time according to the mobile user’s movement. Directly adopting traditional data collection paradigm results in building a series of independent data collection trees when the mobile user is at different positions. Unveiled by [14], building the data collection tree introduces a large volume of communication overheads. Besides, the routing transitions between different data collection trees contain a non-negligible time delay and may lead to discontinuity or even loss of the data delivered to the mobile user, which significantly decreases the QoS of ubiquitous data collection.

In this paper we provide an overview of several aspects about previous research. The rest of this paper is arranged as follows: Section 2 introduces Data Gathering in WSN; Section 3 describes about Literature Survey; Section 4 shows Mobile sink with java Environment; Section 5 describes about proposed method. Section 6 describes Conclusion and Future work.

2. Data Aggregation

Sensor Networks (hereinafter called WSNs) consists of a large number of smart sensor nodes which connect to each other in a wireless network. Each node receives the data from the environment and forwards it to its base station (technically called sink) (Figure2.1). Energy is the main important factor in the WSN because each sensor works with its non-rechargeable battery. Data collection is the principle application in the WSN. The applications consist of wildlife habitat monitoring, environmental research, volcano monitoring, civil engineering and wild land fire forecast/detection. If data collection is not performed efficiently, the sensors will have a lot of traffic and energy consumption. Consequently, the life time of the sensors will be short.

Figure 1 illustrates a simple structure of WSNs in general. First the Sink broadcasts the request, when one node finds the data it tries to transmit this with the help of other nodes to the Sink. WSN is classified into three categories:

(1) Cluster-Based: sensors in the network are divided into clusters. The nodes transmit data to the cluster head then cluster heads aggregate and compress the data, and forward it to the sink.

(2) Chain-Based: a chain is formed to serve as a network structure. Data transmission is divided into multiple levels. Only subsets of nodes communicate with neighboring nodes at each level.

(3) Tree-Based: all nodes are organized in the form of a logical hierarchical tree. In this model the leaf node senses and forwards the data to the intermediate node. These inter-mediate nodes play the role of aggregators. Finally the Sink node serves as the root of the tree.

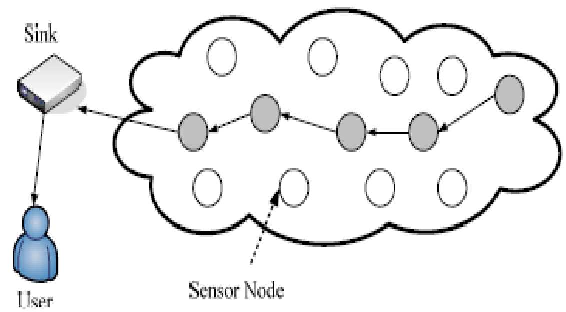

Figure 1: Wireless Sensors Network

A problem with chain-based structure happens when one neighbor fails and consequently the chain for that data transmission is lost. In cluster-based structure, the cluster head or aggregator node may be attacked by malicious attacker. The common issue with all of these structures is that when a forwarding node fails to transmit the received data to its neighbor or a node in a higher position, the whole structure is lost. Consequently, the algorithm to construct the structure again needs to be repeated. This challenging point causes to use more energy, and leads to latency in data forwarding.

In this section, we also describe some of protocols related to our work from [15]. The main purpose of these designs is how to collect data and forward it to the sink efficiently in order to save the energy of the sensors. Considering energy efficiency, Low-Energy Adaptive Clustering Hierarchy (LEACH) is the first energy conserving cluster formation protocol. Figure 2 illustrates the structure of this protocol in which all sensors are divided into several clusters for fusion. A cluster head collects all data from the sensor nodes and sends it to the sink.

Leach

This protocol, LEACH, is a good solution for data transmission to the sink compared to direct data transmission.

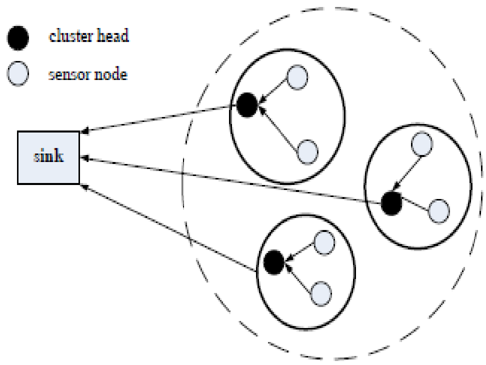

Figure 2: network structure of LEACH

The drawback of this protocol is that, it suffers from extra overhead because of its dynamic clustering. Moreover, when a cluster head dies, the cluster member nodes fail to forward the collected data. To solve this problem, the algorithm needs to be repeated to find the next cluster head.

PEGASIS

Power Efficient Data-Gathering Protocol for Sensor Information Systems (PEGASIS) is a chain-based data collection protocol. Figure 3 illustrates data transmission with eight nodes. All nodes are structured into a linear chain. In each step the closest neighbor of a node is selected. The selected node receives a data packet from one of its neighbors and forwards it to the next node. This process continues until the leader node sends the data to the sink. At the initial phase, a chain head is chosen with the following algorithm.

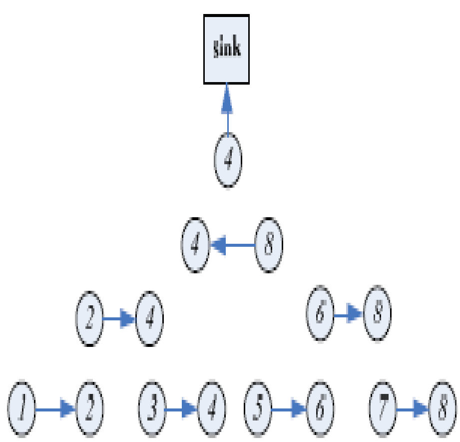

Figure 3: Chain in PEGASIS

The performance of PEGASIS is better than LEACH when the product of energy delay for energy consumption is considered as performance metrics. In special cases when the nodes are capable to communicate directly with the sink, it is not efficient to send data through a chain or a cluster head.

TBDCS

Tree Based Data Collection Scheme (TBDCS) [5] is a tree-based protocol. This protocol uses a logical hierarchy tree to forward the collected data from the leaf node to its root, the sink. This protocol runs an algorithm by a query message to find the shortest path length between the nodes and the sink (Figure 4). This mechanism of forwarding the collected data is efficient because the data is forwarded through the shortest path length between the sink and the other nodes. Though efficient, the drawback of this protocol is that when an intermediate node fails to forward the data because of its lack of energy, the data cannot be sent to the sink.

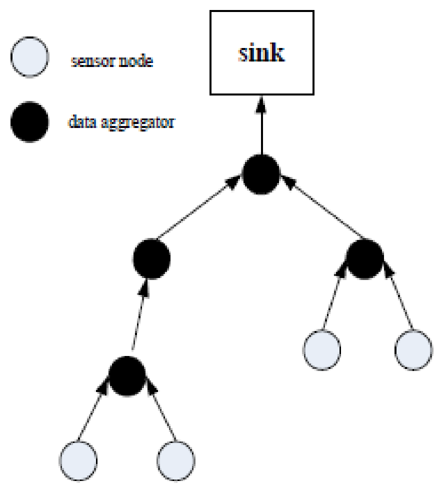

Figure 4: Tree Based Structure

As noticed, the common issue with all these protocols is that when a cluster head in cluster-based protocol, a chain member in chain-based protocol, and an intermediate node in tree-based protocol has failed to forward its data, the algorithm needs to be repeated again to deliver the data to its sink. This causes energy consumption which leads to shorten the life time of the nodes. In order to solve this common issue and to save the energy, in this paper, we propose an efficient protocol which improves the drawback of the tree-based protocol.

3. Literature Survey

In 2010, Young Sang Yun et al. [16] proposed a framework to maximize the lifetime of the wireless sensor networks (WSNs) by using a mobile sink when the underlying applications tolerate delayed information delivery to the sink. Within a prescribed delay tolerance level, each node does not need to send the data immediately as it becomes available. Instead, the node can store the data temporarily and transmit it when the mobile sink is at the most favorable location for achieving the longest WSN lifetime. To find the best solution within the proposed framework, we formulate optimization problems that maximize the lifetime of the WSN subject to the delay bound constraints, node energy constraints, and flow conservation constraints. They conduct extensive computational experiments on the optimization problems and find that the lifetime can be increased significantly as compared to not only the stationary sink model but also more traditional mobile sink models.

In 2010, Babar Nazir et al. [17] proposed and address hotspot problem and Mobile Sink based Routing Protocol (MSRP) for Prolonging Network Lifetime in Clustered Wireless Sensor Network. In MSRP, mobile sink moves in the clustered WSN to collect sensed data from the CHs within its vicinity. During data gathering mobile sink also maintains information about the residual energy of the CHs. Mobile sink based on the residual energy of CHs move to the CHs having higher energy. Consequently, the hotspot problem is minimized as the immediate neighbor of the sink is high energy node and it changes because of regular sink movement. It results in a balanced use of WSN energy and improves network life time.

In 2010, Xu Jianbo et al. [18] studies mobile sink-based data gathering protocol, according to mobile wireless sensor network model, adopts a joint strategy of sink mobility and routing to realize high-efficient data gathering based on which nodes in network are divided into certain number of clusters, demonstrates that in the square monitoring area with any side length L, the minimum energy consumption of the network is used for data gathering when sink nodes move along the path. In the presented MSDG(Mobile Sink-based data gathering), sink chooses the closest fixed nodes along the path as roots to build a routing tree dynamically, cluster-heads gather the data of all common nodes within cluster and perform data aggregation, the aggregated data is sent to sink reversely by tree.

In 2010, Jin Wang [19] optimizes each individual distance so that all sensor nodes consume their energy at similar rate. After the theoretically analysis of hotspot based on certain energy and traffic models, they propose their Distance-based Energy Aware Routing (DEAR) algorithm for WSNs. Simulation results show that their DEAR algorithm has a better performance in energy consumption as well as network lifetime.

4. Mobile Sink with Java Environment

The main function of the network layer is routing packets from the source machine to the destination machine, often requiring multiple hops. For broadcast networks routing is an issue if source and destination are not on the same network. The routing algorithm is that part of the network layer software responsible for deciding which output line an incoming packet should be transmitted on. With VC's networks one speaks of session routing, because a route remains in force for an entire user session (e.g. a login session or a file transfer). The following properties are desirable in a routing algorithm:

- Correctness and simplicity.
- Robustness, against software and hardware failures, traffic changes and topology changes for very long periods.
- Stability, some algorithms never converge to equilibrium.
- Fairness and optimality, which are conflicting goals.

Intuitively, increasing the sink velocity v will improve the system efficiency, since in unit time interval the mobile sink can meet more sensors and gather more information throughout the sensor field. However, we should carefully choose this parameter as explained follows. On the one hand, the higher mobile sink velocity, the higher the probability for static sensors to meet mobile sinks. On the other hand, when mobile sinks are moving too fast across the effective communication region of static sensors, there may not be a sufficient long session interval for the sensor and sink to successfully exchange one potentially long packet. In other words, with the increase of sink velocity, the "outage probability" of packet transmission will arise. . Therefore, finding a proper value for sink velocity must be a tradeoff between minimizing the sensor-sink meeting latency and minimizing the outage probability.

Figure 5 further shows the data collection latency, defined as the time differences between when the data is sampled and when they are entered into the DC Genome central database. When using three wireless channels concurrently, over 90 percent of sensor data is collected before the 30 second deadline.

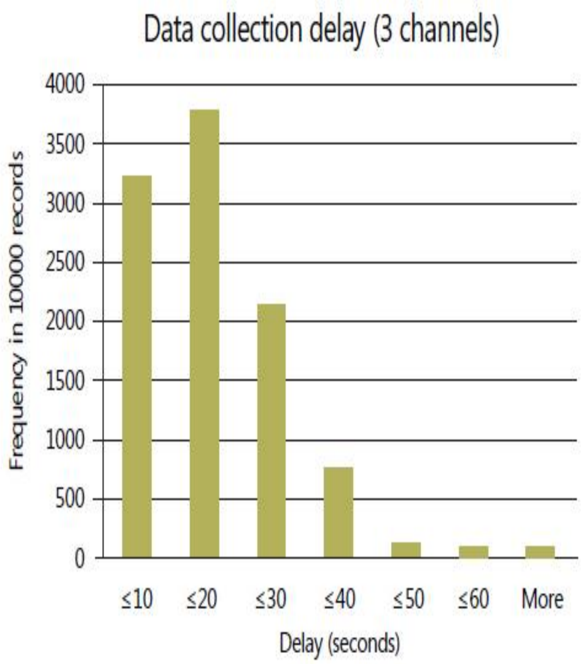

Figure 5: Data collection latency distribution of 10,000 data samples using three wireless channels.

These unprecedented results show that a wireless sensor network can be used to reliably collect environmental data in data centers with low hardware cost and easy installation and maintenance.

Power-efficient gathering for sensor information systems (PEGASIS) is a data-gathering protocol based on the assumption that all sensor nodes know the location of every other node, that is, the topology information is available to all nodes.

Also, any node has the required transmission range to reach the BS in one hop, when it is selected as a leader. The goals of PEGASIS are as follows:

1. Minimize the distance over which each node transmits.
2. Minimize the broadcasting overhead.
3. Minimize the number of messages that need to be sent to the BS.
4. Distribute the energy consumption equally across all nodes.

A greedy algorithm is used to construct a chain of sensor nodes, starting from the node farthest from the BS. At each step, the nearest neighbor which has not been visited is added to the chain. The chain is constructed apriori, before data transmission begins, and is reconstructed when nodes die out.

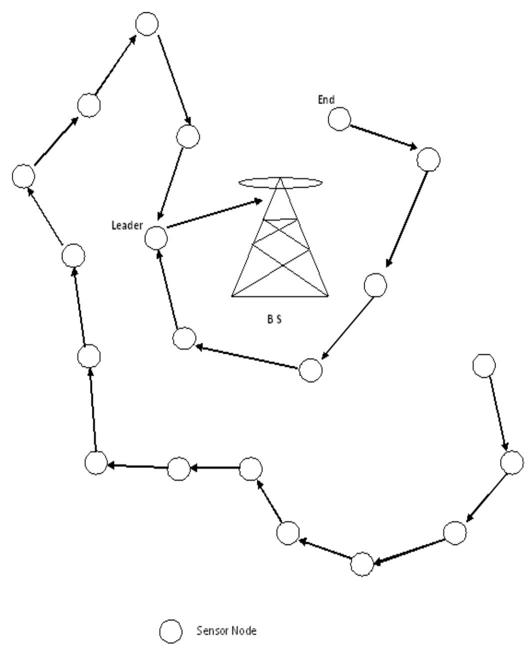

Figure 6: Data gathering with PEGASIS.

At every node, data fusion or aggregation is carried out, so that only one message is passed on from one node to the next. A node which is designated as the leader finally transmits one message to the BS.

5. Comparison Result

In this section we provide five different comparisons 1) Comparison based on Data Gathering. 2) Comparison based on execution. 3) Comparison based on Energy Efficiency 4) Comparison Based on Availability 5) Comparison Based on Future security.

The first comparison shows better data gathering.

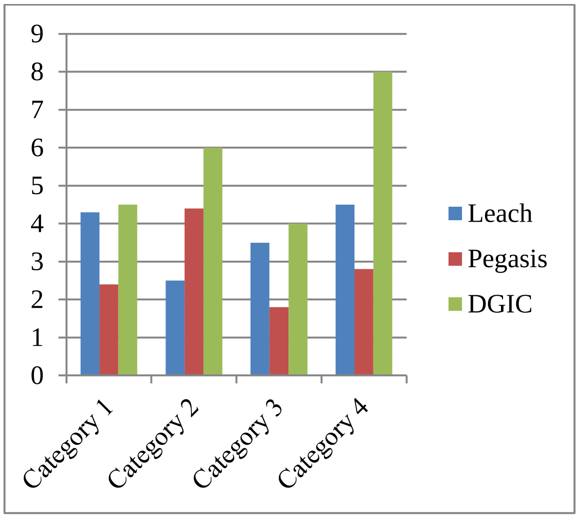

Figure 7: Data Gathering

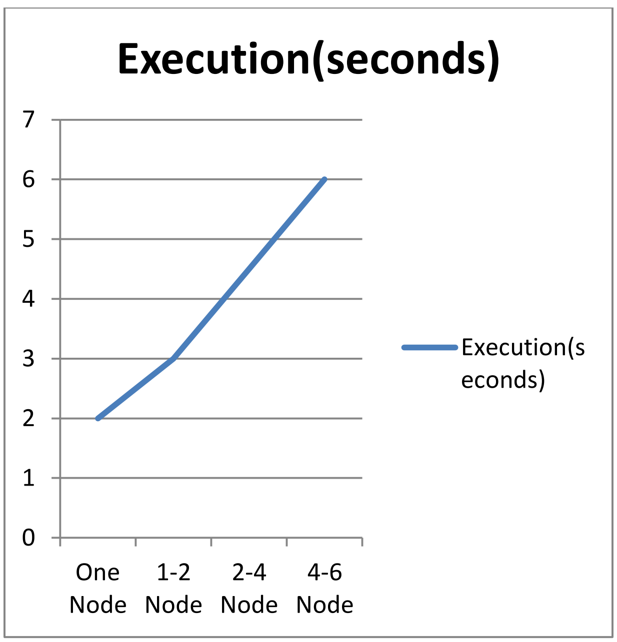

Figure 8: Execution Speed

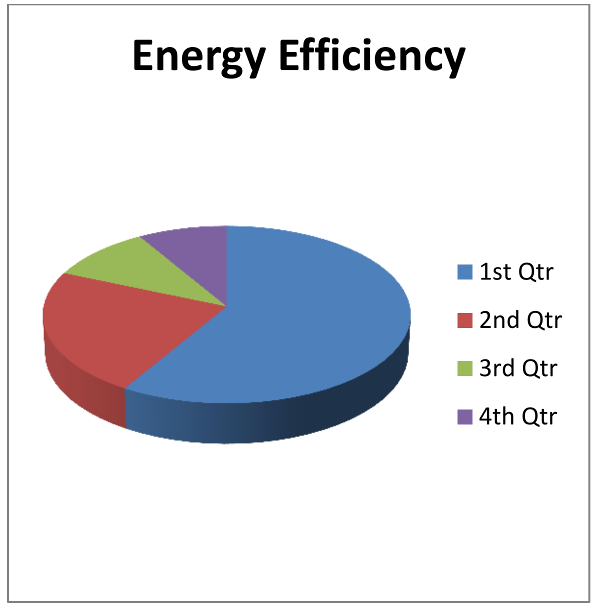

Figure 9: Energy Efficiency

The below figure shows that the availability is increases because of the neighbor nodes and it is 2^{n}.

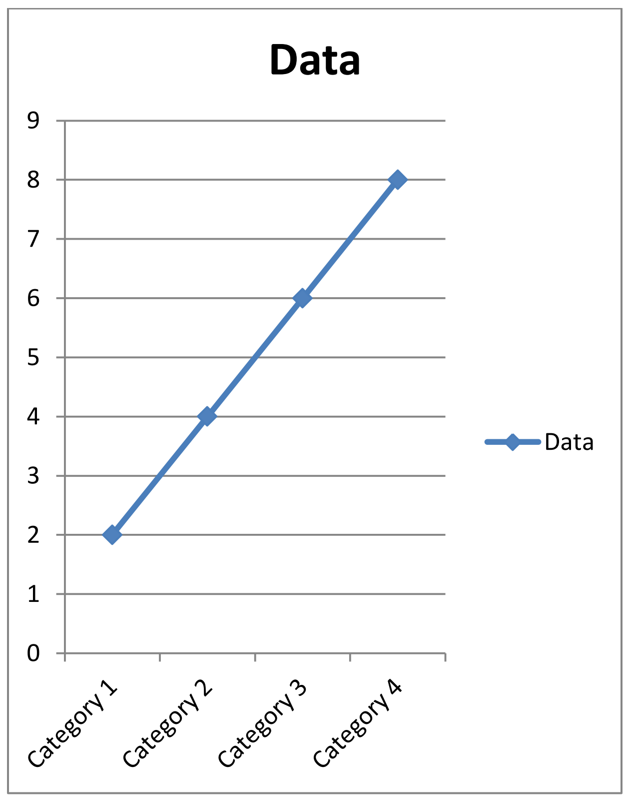

Figure. 10: Availability

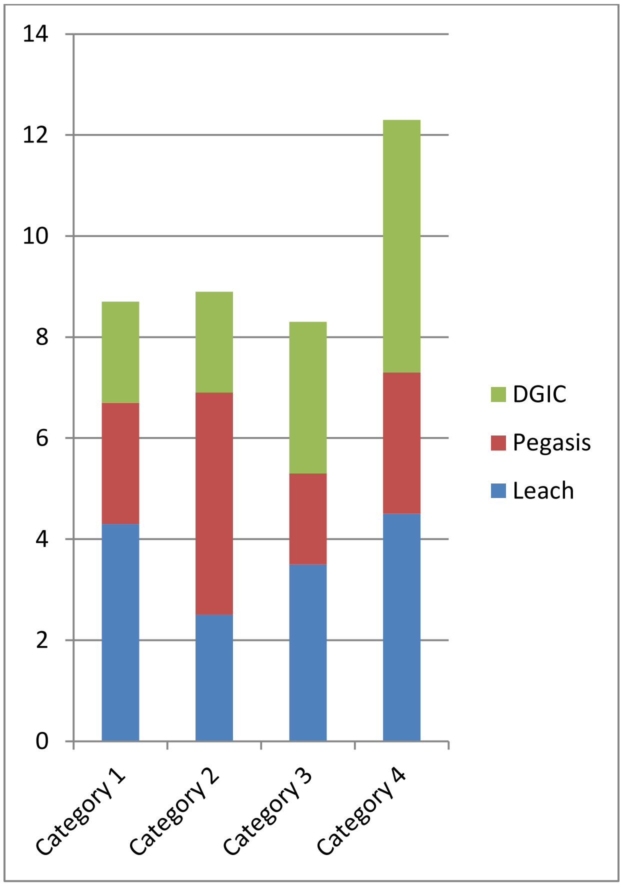

Figure. 11: Security

6. Conclusion and Future Aspect

In this paper we proposed five different types of comparison for data aggregation between different nodes. The comparison shows that the approach is better in comparison to the previous approach of data gathering in wireless sensor network.

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