Review on Unstructured Peer-to-Peer Overlay Network Applications

Yousef Fazea
School of Computing
University Utara Malaysia
06010 Sintok, Kedah, Malaysia
yosiffz@uum.edu.my

Zainab S. Attarbash
School of Computing
University Utara Malaysia
06010 Sintok, Kedah, Malaysia
zainab.senan@uum.edu.my

Fathey Mohammed
School of Computing
University Utara Malaysia
06010 Sintok, Kedah, Malaysia
Fathey.mohammed@uum.edu.my

Ibrahim Abdullahi
Department of Computer, Science, Ibrahim Badamasi Babangida University Lapai. Nigeria
ibrojay01@ibbu.edu.ng

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***Abstract* — Peer-to-Peer (P2P) network is a distributed computing architecture that allows network devices to share, access files, and folders with everyone or with selected users without requiring separate server computer or server software. This paper reviews different structures of P2P overlay network applications and presents their strengths and weaknesses. It also reviews different data replacement techniques as the scalability characteristic of such networks having a big impact on the memory resources and capacities and may lead to degrading the efficiency.**

Keywords—distributed, computing, P2P, Unstructured overlay

I. Introduction

Peer-to-Peer (P2P) network has gained popularity in past decades due to high performance on its services and features in terms of scalability, dynamicity, availability, fault tolerance, and efficient content distribution [1-3]. In a distributed system, P2P architecture employs the resources of distributed to perform critical functions using a decentralized method [4, 5]. This type of network permits nodes to communicate straight with each other without requiring a central server, as opposed to a client-server network, where each node connects to a server to reach any other node in the network [6]. Besides, all nodes in the P2P network system is normally playing symmetric roles with equivalent capabilities and responsibilities among them. Thus these nodes are named as peers [7, 8]. Network connection used in the P2P network is systematic home access links using Digital Subscriber Line (DSL) or cable [8]. Peers can be able to freely joining, or else leave from the P2P system at any period without any constraint [9, 10]. Furthermore, the P2P paradigm is most suitable for applications such as instant messaging, video conferencing, peer-to-peer file sharing, and collaborative work. P2P frameworks are routinely utilized by limitless, both in the working area and versatile situations, and they produce a pleasing bit of the general Internet traffic. In any case, numerous basic P2P conventions and applications were planned to dismiss the vitality problem. Truth be told, they frequently require dependably on devices so as to work properly, thus creating huge vitality squander [11]. Besides, P2P defines a decentralized structure, where all peers contribute with what they have accessible for a house based delivering, exchanging, or disseminating a decent or administration. P2P and network-based ideas have clearly been connected under a collective economy rule as the structure that encourages the trading of center among all peers [12].

In a shared system, a record is isolated into several pieces, and each companion transfers the pieces acquired to different friends while it keeps on downloading the rest of the pieces. This outcome in high use of the transmission capacity everything being equal prompting improved adaptability over a customary server-customer structure. Such frameworks have been conveyed broadly, as clear from their number of clients and the part of in general web traffic they order, and they are ready to turn out to be even progressively noticeable with the ascent of haze organizing. An abnormal state P2P convention can be comprehended to be a lot of standards that manage how a companion contacts another friend and picks the piece to transfer/download to/from that peer, contingent upon whether a "push" or "force" strategy is utilized individually.

This paper is organized as follows. Section I presents the introduction. Section II presents an overview of P2P system structures. Section III data replacement technique. Section IV presents the current issues and challenges. Finally, the conclusion of this paper is presented in Section V.

II. Overview of P2P System Structures

Generally, overlay of peer-to-peer nets may be formed into double groups, which known as structured and unstructured. A structured overlay network of P2P is built on centralized management, while an unstructured overlay network of P2P is built on a distributed search mechanism [13, 14]. In an unstructured P2P system, peers are connected randomly based on some proximity metric between the nodes [15]. Processes and mechanisms are measured for an overlay networks of structured P2P and unstructured P2P to enhance their operation and resource discovery mechanism [2, 16]. Fig. 1 shows some applications from each type.

A. Napster

Napster was primarily proposed by [17]. It established the idea of P2P file sharing and supported with a centralized file search facility. Napster is an application that allows peers to share MP3 files with other peers [18]. Napster protocols were used to provide a central list of peers, those had folders and files to be shared [19]. Fig. 2 shows the Napster network architecture.

B. BitTorrent

BitTorrent is one of the most common P2P distributed applications, it helps users to share their digital content across the Internet with significantly improved download speed. This architecture enables everybody to share files and distribute the load into the network [20]. It takes the bandwidth's load away from the providers. Due to the nature of BitTorrent protocols, peers who have higher upload bandwidth will be pleased with higher download speed as they contributed to the network at higher rates [21]. While using the BitTorrent protocol, the file is separated into smaller parts of same sizes. After client downloads, some files, SHA-1 hash is computed and compared to the value with the one in the torrent file. If the values match the peer replies to other peers with the availability of that file parts. BitTorrent protocol utilizes TCP connection [22, 23]. Fig. 3 shows the Bit Torrent network architecture.

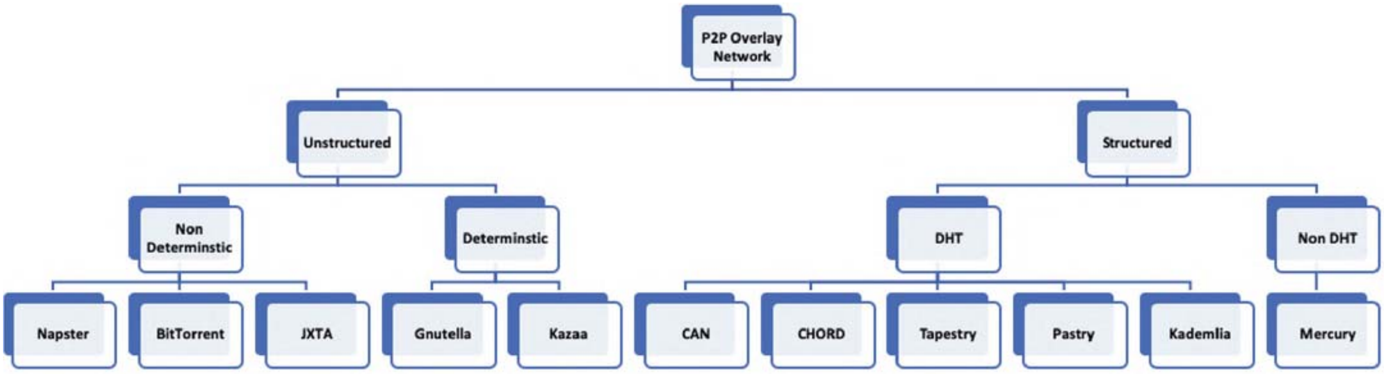

Fig. 1. Overview of P2P overlay network

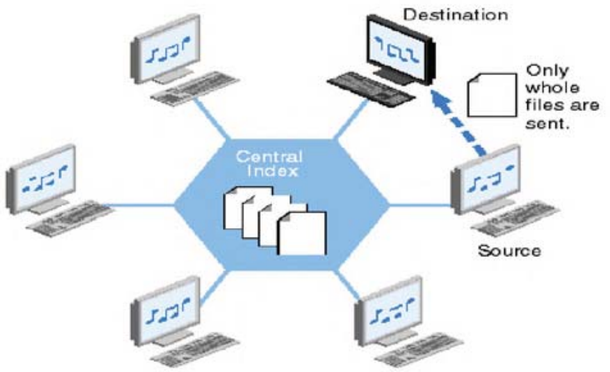

Fig. 2. Napster Diagram

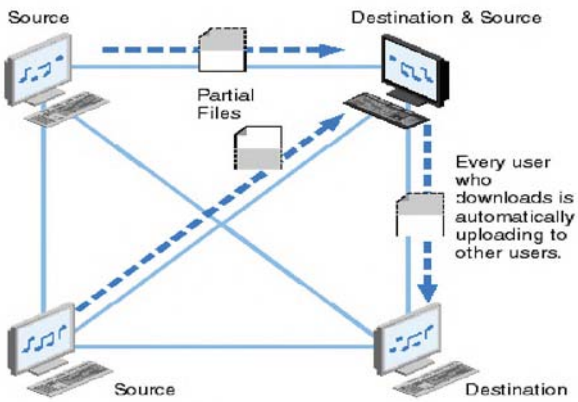

Fig. 3. Bit Torrent Diagram

C. *Gnutella*

Gnutella is a file-sharing protocol, it defines the methods of distributed nodes communicates over a P2P network [24]. Gnutella was the biggest decentralized peer network at the time of development [17]. Gnutella's structure uses the topology of ad-hoc, where every peer in-network is joined with other nodes or peers in the network. The structure holds its property of the peers instead of disturbing the performance of the other peers those can be a disconnect from the network, thus it also holds the features of a dynamic network. Fig. 4 Shows Gnutella network architecture.

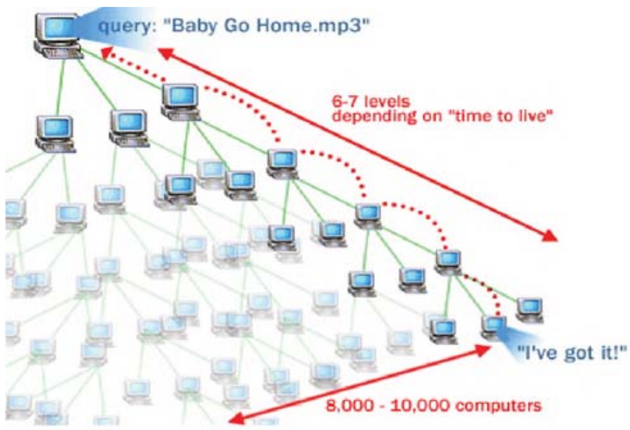

Fig. 4. Gnutella Diagram

D. *Kazaa*

KaZaa was created by Niklas Zennstrom. KaZaa combines strengths of Napster and Gnutella. In Kazaa, the files are downloaded into pieces from several sources. Kazaa uses a decentralized system by contacting one another directly to share content [25]. Fig. 5 shows the KaZaa Diagram.

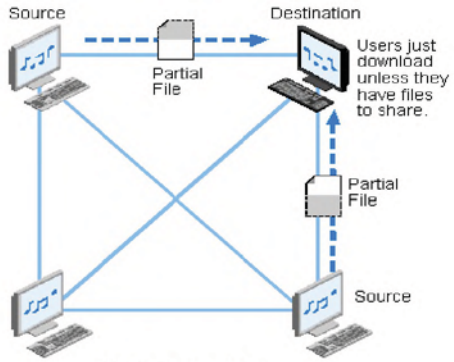

Fig. 5. KaZaa Diagram

TABLE 1: STRENGTHS AND DRAWBACKS OF DIFFERENT P2P SYSTEMS

P2P Application	Strengths	Drawbacks
Napster [17]	• Fast, efficient, and overall search. • Consistent view of the network	• Central server is a single point of failure. • Expensive to maintain central server.
BitTorrent [20]	• Works quite well, only slow in the beginning. • Efficient distribution mechanism. • Enforces contribution discourages free-riding.	• Files must be large. • No searching. • Everyone must contribute.
Gnutella [24]	• Fully distributed. • Open protocol.	• Flooding a query extremely inefficient. • Search process reaches only at a peers' subset due to limited radius of query.
Kazaa [25]	• Combines good strengths from Napster and Gnutella.	• No overall search. • Easy to be attack.
Freenet [26]	• Resistant to attacks, where other peer should not be able to deny the access to a file. • Decentralize architecture (robust and scalable).	• Does not always guarantee about a file is found, even if the file is in the network.

E. *Freenet*

Generally, Freenet is a utilized control strong distributing framework. It is based on the idea of giving namelessness to distributors, requesters, and substance providers. Besides, for informants and opportunity contenders utilizing Freenet to spread basic data that dangers abuse, obscurity is especially significant [26]. Each Freenet client is required to add to the system by providing the information store with transmission capacity and a part of their hard drive to store records. However, as they are encoded, the client cannot discover the substance of those documents. Thusly, no client comprehends what is in his information store and ideally cannot be considered in charge of it. Freenet's capacity to store famous substance is an intriguing component. Then, contingent upon how mainstream they are, documents are consequently kept or disposed. This naturally makes the least famous substance to be disposed of and preparing for new or prevalent substance [27]. Table 1 is summarizing the strengths and drawbacks of all the P2P network distribution mentioned in this section.

III. DATA REPLACEMENT TECHNIQUES

In any scalable system, the memory cannot hold caching for a longer period due to its limited resources and capacities, which lead to degrading efficiency. Therefore, different data replacement techniques were used in different P2P networks.

A. *Clustering method: Fixed Cluster Repair System*

The clustering technique of Fixed Cluster Repair System (FCRS) is used as per an innovative part for distributes storage systems to reach a small repair bandwidth with guaranteeing high availability. The main objective of FCRS is to prevent a permanent data loss, even in the event of multiple concurrent failures. Besides, these unsuccessful servers will be replaced with a new one's inefficiency by not producing too much traffic. Fig. 6 shows the diagram of the FCRS technique. The term Fixed Cluster Repair System was explicitly chosen to diverge from Adjustable Cluster Repair System (ACRS), a general model where two distinctive server fix bunches do not really agree. Considering an ACRS should prompt a general inquiry being replied. Assume we are given a DSS comprising of servers following the previously mentioned information recuperation, fix necessities while guaranteeing accessibility [29].

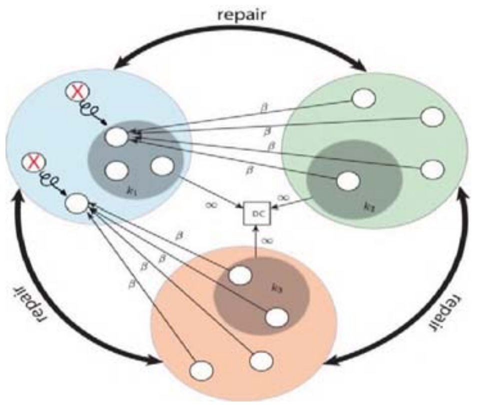

Fig. 6. Term Fixed Cluster Repair System Diagram

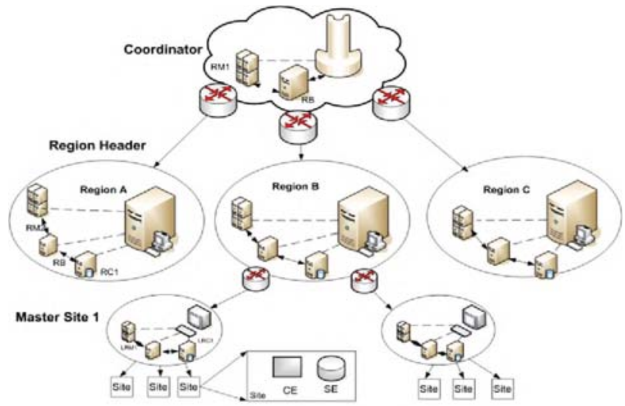

Fig. 7. The proposed system (DPUDEA)

B. *Correlation Based Data Placement*

A Data placement scheduler, Stork provides an ability to queue, schedule, manage, and monitor the data placement jobs. It also applies the technique of checkpointing jobs. It possesses the ability to recover from network, software, and storage system failures without human intervention. It performs dynamic adaption of data placement jobs at the execution time to the system environment. This approach provides complete automation for processing the data. The proposed system automates the data transfer fully automatically between the heterogeneous systems [30].

C. *Genetic Algorithm Based Data Placement*

The heuristic and genetic are combined for improving the ability to local search and reducing the search time. The heuristic idea is implemented in gene operations and initial population selection. The integer encoding rules are applied and placement process is represented by a gene. The ineffective fragments of genes that cannot be coded at data centers is determined by the encoding rule. Authors considered the factors of dependency among slices of data and distributed cost of transaction for the placement of data using genetic algorithm. It minimizes the transaction cost while balancing the load [30].

D. *Dewey Encoding (DPUDE)*

Data Placement Using Dewey Encoding (DPUDE) is a hierarchical data grid system that permits most scientists all over the place to access the resources with efficient methods. Besides, the data sets can be dispersed to suitable resources and can be opened by numerous places. The bandwidth of the network is used efficiently due to most files can be transferred with the resources of the local network. Besides, the structure of multi-tier enables scalable and flexible management for data sets as peers. The data grid shown in Fig. 7 is designed to contain 3 types of tiers. The coordinator is connected to the others to provide some influential computing resources which are used as computing elements [31].

E. *Cloud Computing System: Strategy Placement of Big Data (BDAP)*

BDAP applies a single algorithm for the original's placement then generated the intermediate of datasets. A random data set of placement schemes are created in the first method. To minimize the data movement from multiple virtual machines, most of the interdependent datasets are clustered together and stored probably into similar virtual machines in the cloud. Fig. 8 shows the diagram of BDAP.

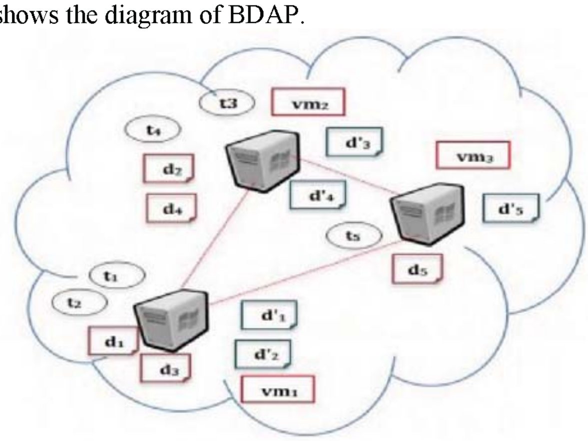

Fig. 8. Big Data Placement Configuration Diagram

Next, BDAP computes the produced schemes by implementing the heuristic's function and it also returns the greatest scheme. The function of heuristic is based on the interdependency of data inside the virtual machines in the cloud place. The best scheme is the one that can capitalize on data interdependency within each virtual machine and lower data interdependency of data between virtual machines [32]. BDAP also allocates and arranges workflow of tasks into matching virtual machines. BDAP may be implemented by any current workflow of scheduling algorithms in order to improve the workflow of output [32].

F. *MapReduce P2P System*

This system holds storage servers and peers. A typical peer used to possess a network, set, and MapReduce components. The network module also permits peers and components to make data exchange over the different sources of messages. For example, a group of response of connecting is furthered to the group system or else, a checking peer alive request will be forwarded to other next peers [33]. The architecture of Map Reduce P2P system is shown in Fig. 9.

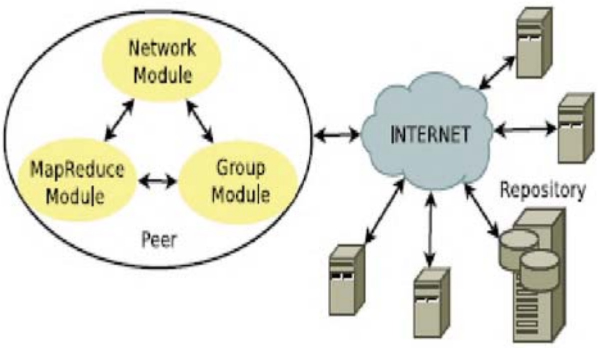

Fig. 9: MapReduce P2P system

Furthermore, the group system manages some collections, to where the user belongs by acting as a master or a slave. This module collaborates with other modules to maintain groups' stability and to deliver the peers' information. The main function of the MapReduce module is to control MapReduce peer's operations. This module is involving the responsibilities of generating, executing, allocating, and regaining datasets for peers and local repository kept in good ways. The architecture of Map Reduce P2P system keeps a super-peer of Gnutella's computing, where it holds the super peers and other peers. Super peers required to connect to other peers to form a super peers' P2P network, while peers can select and join with a super-peer to create a cluster of super peers, and peers. Super peers act as substitutions to the P2P network of Gnutella for peers. The client-server model is implemented by query mechanism in the cluster and with the P2P paradigm in the network of super-peer with several routing approaches. The network of super-peer make determinations heterogeneity issues and it also upsurges the Gnutella in term of network scalability by decreasing the incapable peers who are incorporating in actions of query routing.

G. Ceph's Distributed Storage System

The Ceph's storage system was developed with a specific architecture in mind to guarantee the robustness, scalability, and reliability it promises. Each component of Ceph's is infinitely scalable and by design contains no single point of failure. The three main components required for Ceph's to run are the Monitor service, Object Storage Daemon (OSD) service, and the Metadata Service. The storage servers run the OSD service, which is used to store the actual data on disks. The monitors are used to maintain the master copy of the cluster maps, the monitors distribute the cluster maps [35]. Ceph's has no single point of failure. As seen in Fig. 10, when clients read or write data into Ceph's they contact the storage nodes directly opposed to going through a proxy or a middleman. If a storage node goes down, the data on the backend will be reshuffled to ensure consistent replication and the clients will just continue writing to the other storage nodes. Table 2 summarizes all the data replacement techniques mentioned in this section with their advantages and drawbacks.

TABLE 2: SUMMARY OF DATA REPLACEMENT TECHNIQUES

computngTechniques	Advantages	Drawbacks
Clustering: Fixed Cluster Repair System [29].	- Achieving a minor repair of bandwidth, while guaranteeing a high availability of data.	- Servers involved in repair development of server that failed may not be available to accomplish other tasks.
Correlation-based data replacement [34]	- Provides an ability to queue, schedule, manage and monitor the data placement jobs - Saving the time for locating the data and grouping the file based on size	- Relies on independent services to transfer store and schedule the data. - Partitions are shared among different data centers
Genetic Algorithm Based data placement [30].	- Minimizes the transaction cost while balancing the load - Reduce movement of data among data centers leading to load balancing in data centers	- If the gene is found to be invalid. It refers to overloading of data centers
Ceph's Distributed Storage System [35].	- Consistent data - Less bottlenecks and better bandwidth - Safe data	- Need to implement one by one.
Data Placement Using Dewey Encoding [31]	- Balancing of duplicate servers loaded, because each client which request is examined by parent itself to executes a certain number load on that node.	- Most data set in the scientific of data grids are read data only.
Cloud Computing System: Big Data Placement Strategy [32].	- Minimizing data movement across multiple virtual machines.	- Large datasets needed to be handled.
Map Reduce P2P System [33].	- Not expensive - Allows internet peers not social and P2P network communities to accomplish huge data processing tests on environment of distributed. - Supporting peer failure management for fault tolerance.	- Requiring large amount of memory - Might be hard to express problem in MapReduce.

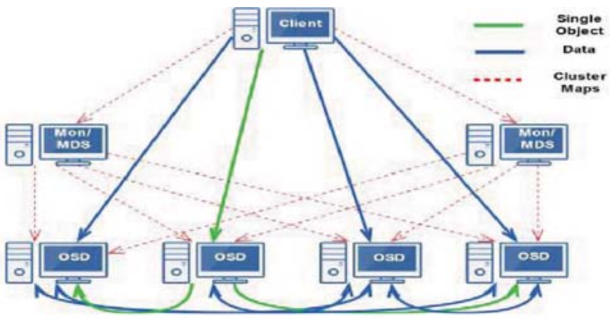

Fig. 10. Ceph's Storage System

IV. Challenges and Future Directions

The responsibility of the system of P2P is to maintain the advantage of both space and bandwidth resources at end of hosts besides realizing potentially substantial source saving at dedicated servers [36]. Peer-to-peer file sharing improves the moving performance. The further major contributing aspect to the strong academic interests but in our opinion, was the fact that the design of the system of P2P was able to start. In the system of P2P, each available node in the network forms logical links to a selected subset of other nodes, its neighbors. Particularly in an unstructured system of P2P, the selection of neighbors was initially mixed. However, for resource sharing algorithms and routing are mainly use flooding's variations and random walks to discover good resources, the neighbors of each node plays an important responsibility in the performance in term of algorithms [37]. Many incentive mechanisms have been proposed to curb these challenges such as tit for that machine that is employed by bit torrent to reduce the free-riding problem. So that nodes that upload a file are given the advantage of an increase in their bandwidth. This solution, however, has still not proved to be effective to this challenge [7].

V. Conclusion

Data placement is one of the necessary schemes that make cloud computing possible. Recently data replacement issue has become a popular matter in cloud computing while considering the scientific workflow applications because it can greatly reduce the execution time of workflows and increase the efficiency of data centers. Finally, we have finalized this overview with our considerations on a few headings for the future in P2P overlay organizing research that worries of how well the P2P overlay systems' virtual topology maps to the physical system foundation, which has sway on the extra weight on the foundation, will without a doubt, acquire costs for the specialist organizations. It is valuable to give a quantitative assessment on the application of P2P overlay and Internet topology coordinating and the adaptability of applications of P2P overlay by the effective utilization of the basic physical organize assets.

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