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# Comparative Analysis of Peer to Peer Networks

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**ABSTRACT**

**Today over the Internet, communication and computing environments are considerably and significantly becoming more and more chaotic and complex than normal classical distributed systems that have some lacking of any hierarchical control and some centralized organization. There in the emerging of Peer-to-Peer (P2P) networks overlays has become of much interest because P2P networks provide a good quality substrate to create a large-scale content distribution, data sharing, and multicast applications at the application-level. P2P networks are commonly used as "file-swapping" in any network to provide support in sharing of distributed contents. For data and file sharing, a number of P2P networks have been deployed and developed. Gnutella, Fast track and Napster are three popular and commonly used P2P networking systems. In this research a broad overview of P2P networks computing is presented. This research is focusing on content sharing technologies, networks and techniques. In this research, it is also tried to emphasize on the study and analysis of popular P2P network topologies used in networking systems. This research is also focuses, identifies and describes the most common architecture models of P2P networks and compares different properties, characteristics and features of four P2P systems—Fast track, Gnutella, Open FT and Napster. In P2P organization, every peer grosses mutually the parts of the server as well of the client. By way of a client, it can demand and copy its required record files from additional peers, and in place of a server, it can offer data files to additional peers. The survey basically analyzes and outlines the basic structuring of P2P networks together with their analysis, comparison, applications, advantages, and disadvantages. The survey presents numerous organized and unstructured P2P structures.**

Keywords -**Peer to Peer Networks, Centralized, Distributed, Structured, Unstructured.**

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## I. INTRODUCTION

Groups of networks in which all the connected peers have equal and comparable capabilities and accountabilitiesP2P networks are. In P2P networks, individual peers within the network tend to share data, storage, distributed virtual storage [102] and CD-ROM drives but on the contradictory side the structure of a client and server exhibits a tendency in which clients have accesses to data only through server [1] by using nay operating system i.e windows, Linux, Unix, Mac or any tinyOS[106].

P2Pis a communication model in which each party has the same capabilities and either party can initiate a communication session.

Other models with which it can be compared include the client/server model and the master/slave model [2].

There has been a developing deliberation in P2P organizations since the principal achievement of a typical application comprised of content sharing including Gnutella and Napster. The term "peer to peer" signifies to an assembly of organizations that conquers distributed possessions to achieve a risky operation in a dispersed mundane. By means of the established propagation of computers, P2P is gradually receiving attention in analysis and progression, product enlargement, and estimation clusters [3]. P2P organizations can be characterized based on the setup above data background, situation, and topology of the network. So taking this potential in mind, the classification of P2P organizations comprises: loosely structured, vastly structured and unstructured systems [4]. In an unstructured P2Psystem like Gnutella [5], no law subsists which describes where data is stored and the system topology is random. In a loosely organized system like Freenet [6] and Symphony [7], the overlap organization and the statistics position are not exactly firm. In Freenet, mutually the overlap topology and the statistics position are determined based on suggestions. The system topology ultimately progresses into certain projected arrangement. In Symphony, the intersection topology is resolute probabilistically, however, the facts locality is demarcated exactly [8].In an exceedingly organized P2P system like Chord, both the system design and the statistics location are exactly quantified. The nationals of a peer are well-defined. The statistics are stored in a clear position. P2Psystems can similarly be characterized into centralized and decentralized categories [9-11]. Within centralized P2P networks like Napster, a

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chief almanac of entity position, ID consignment is preserved in a solo position. Peers discover the positions of preferred files by enquiring the chief directory server.

P2P was initially used to define the interaction between two nodes or peers in a network and is equivalent to a telephone exchange. A phone exchange consists of two individuals (peers or nodes) of equivalent rank, interaction among a point to point construction [12].Peer to Peer network can also be used in ANN Based Task Scheduling Strategies in Heterogeneous Distributed Computing Systems [107], Wireless USB Home Security System using Internet Technology [108], password attacks and comparative analysis on methods for secure authentication [109], Priority based congestion control routing in wireless mesh network [110], Protecting Users against Phishing Attacks[111], Benchmarking of PVM and LAM/MPI Using OSCAR, Rocks and Knoppix Clustering Tools [112], Identification of a Lossy Channel in Wireless Mesh Network using Conservation of flow [113], A Unified Model for Computer Threat Protection (UMCTP) [114] and in Virtualization tools and techniques [115]. P2P can also be used in tracking a vehicle in any vehicular network [116].

Later on, the concept of the internet was introduced. The internet took place as a P2Porganization. The aim of the novel ARPANET was to part computing possessions nearby the USA. Its encounter was to attach a group or pairs of dispersed assets, by means of diverse organization connection, inside one mutual system construction [13]. After the late 1960s till 1994, the internet consumed single prototype of connection among peers. Equipment's or machines were anticipated to be constantly swapped on, permanently associated and allocated enduring internet protocol (IP)discourses [14]. The novel DNS organization was deliberated on behalf of this background, where a modification in IP address was expected to be anomalous and infrequent, and might yield days to broadcast through the organization. Conversely, with the creation of Mosaic, additional model originated to transpire in the arrangement of consumers linking to the internet through dial-up modems [15]. This formed an additional course of connectivity for the reason that computers would pass in and consent the system habitually and impulsively [16]. For a few years, considering computers as customers functioned healthy [17]. Over the period, however, like software and hardware enhanced, the vacant assets that occurred behind this covering of second-course connectivity took place to appear as somewhat value receiving at. Provided with the massive collection of presented computers cited previously, the software communal society started to yield P2P solicitations seriously [18]. Utmost prominently, P2P investigation is related in talking few of the chief problems of existing dispersed computing i.e. scalability, consistency, and interoperability [19]. The summary of history of P2P networks [20] can be analyzed below:

- July 1999: journal of Freenetprocedure.
- September 1999: formation of Napster.
- November 1999: principal discharge of Direct Connect customer.
- March 14, 2000: principal discharge of Gnutella.
- September 6, 2000: principal discharge of eDonkey2000.
- March 2001: outline of the Fast Track procedure.
- April 2001: the strategy of the Bit Torrent procedure.
- July 2001: closure of Napster.
- November 6, 2001: chief relief of GNU net.
- November 2002: start of the Gnutella2scheme.
- After 2002, a number of different P2P networks are developed.

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The roadmap of history of P2P networks is shown in Fig 1:

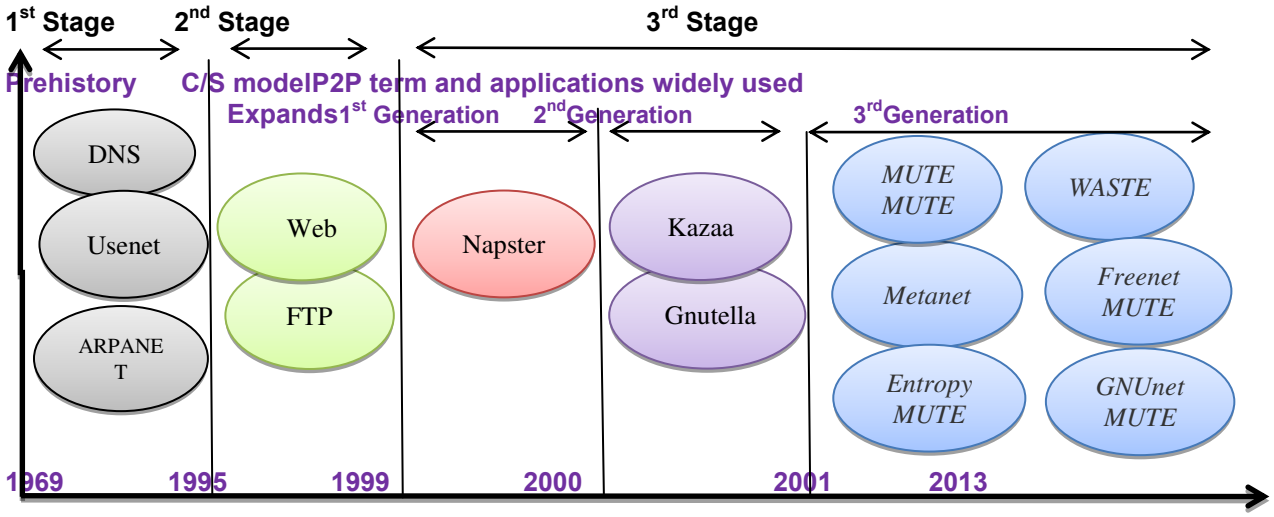


Fig 1: Roadmap of P2P networks history [118]

## II. RELATED WORK

By analyzing the literature, one can say that huge work has been done in the field of P2P networks. The enormous growth of P2Pnetworks is proving the fact that they are becoming the most important tool in the prospect of file sharing [21]. Communication among the different nodes and peers together with providing security and privacy is another important prospect in this regard [22]. Configuration management of P2P networks is one of the main concepts that can be applied to a number of different systems one [23]. Distribution of live streaming among the nodes or peers is another major field of P2P networks. Tree management algorithm for this purpose is proposed and developed in [24].Phoenix is another approach in P2P networks that generates low-diameter irrepressible P2P overlay network [25]. The service of lookup in P2P over random topology can be analyzed in [26] that mainly describe a search methodology deprived of obvious control of overly systems. A system named zigzag in the prospect of media streaming in P2P networks is another important area in P2P systems [27]. Another application includes evaluation of ascendable solicitation level multicast built through the use of P2P networks [28]. File sharing is the major functionality of P2Pnetworks. Modeling P2P networks on a number of diverse systems structure is presented in [29]. Evaluation and modeling of the flexibility of P2P networks can be analyzed in [30]. The analysis technique for adaptive selection centered procedures for the estimated replying of ad hoc, mobile ad hoc and wireless ad hoc [103-105] combination inquiries in P2P databases is presented in [31]. Analysis of file sharing mechanism, its modeling and improvement in Bit Torrent can be analyzed in [32]. Another technique presents an estimated native system aimed at categorizing upper liner products between sets of feature vectors in an enormous asynchronous dispersed atmosphere like a P2P network [33]. For firm standing accumulation in P2P networks a new system named Gossip Trust is presented in [34]. An approach proposes a new experimental weighting method for picking the best-expected route to create a role centered trust series. They put on past profound heuristics to measure the route complication and to measure the connecting competence [35]. Hybrid search in P2P networks is presented in [36]. Range query processing is one of the major applications in the domain of P2P networks; an approach handling this prospect is presented in [37]. An improved Hybrid P2P approach that proposes and controls the concept of boot net in P2P networks and the results showed that this approach is much harder to shutdown [38]. The concept of clustering through the use of k-mean approach in P2P networks is presented in [39].Liu et al. in[40]offered a principal approach intended for the topology discrepancy problem among unstructured P2P systems. The problem of resolving the mismatch problem can be analyzed [41].P2P streaming through a distributed protocol is presented in [42]. Management of multidimensional past data in unstructured P2P networks procedure through a novel method is presented in [43]. The concept of probabilistic flooding in generalized form in unstructured P2P networks is presented in [44]. Heterogeneous search in the P2P networks can be analyzed in [45].The structured P2P networks show a more efficient response to the fact of fault tolerance [46]. The design and analysis of a protocol named Ulysses can be analyzed in [47]. The analysis of P2P network properties through the use of a graph is presented in [48]. Analysis of P2Psystems in the prospect of error recovery is another important factor in the prospect of P2P networks [49]. The impact of free riding in P2P networks resulted that, with the presence of free riding concept, P2P networks operates more efficiently [50]. Routing or direction finding with secure parameters in structured P2P networks is presented in [51].The analysis of the contribution of each peer in P2P networks is important, an

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approach in this context is presented in [52]. Performance analysis in P2P networks in the context of file sharing can be analyzed in [53]. An approach presents a protocol named PCoord, a dispersed system coordinate organization aimed at overlap topology detection and distance extrapolation [54]. The simulation of P2P networks is another major field in the context of P2P networks [55]. A comparison of P2P overlay networks can be analyzed in [56]. Illegal data sharing including media files in P2P networks is an important research domain [57]. Content-based retrieval in hybrid P2P networks is presented in [58]. A survey on the management of P2P networks is presented in [59]. Distribution of data sharing a resource in hybrid P2P networks can be analyzed in [60].

## III. Architecture of P2P Networks

The architecture of the P2P networks can be classified into two broad categories. The networks are distributed on the basis of its file sharing method and the way they are connected. The P2P networks are distributed as centralized and decentralized networks in the case of file sharing schemes. P2P networks are distributed as structured and unstructured networks on the basis of the way the nodes are connected. The distribution of P2P networks architecture can be analyzed in Fig 2:

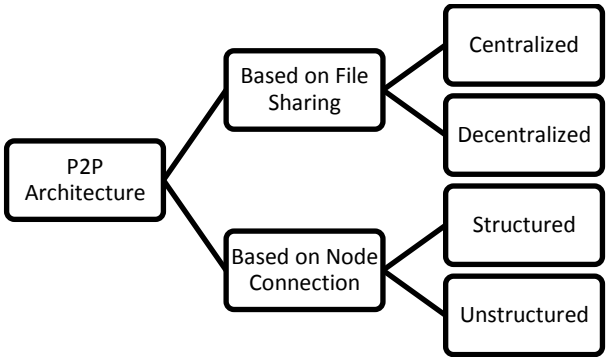


Fig 2: Architecture of P2P systems

### *A. Based on the File Sharing:*

If a P2P system is analyzed on the basis of file sharing prospect then P2P networks can be classified into two broad categories, which are centralized P2P networks and decentralized P2P networks. Here is a brief overview of each of the category.

### *1. Centralized:*

In centralized P2P systems, all the files exist on a central server. Peers are connected to this central server in order to provide services [61]. An example of centralized P2P network is shown in **Fig 3.***Examples: Napster, ICQ.*

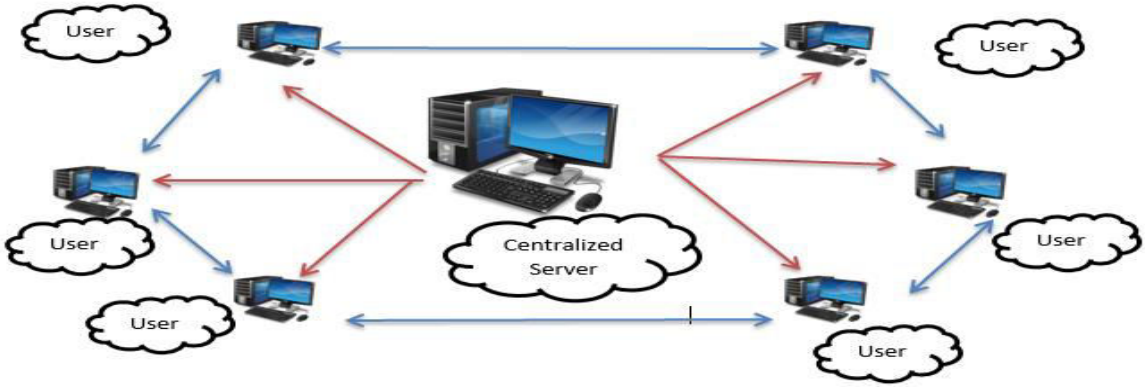


Fig 3: Centralized P2P Network [61]

### *2. Decentralized*

Here in decentralized there exist no central server; instead each peer or node is connected to a number of different nodes to get the proper services. In other words they are the pure peers or super peers [62]. In Fig 4, an example of decentralized P2P network is shown. *Examples: Gnutella, Bit Torrent*

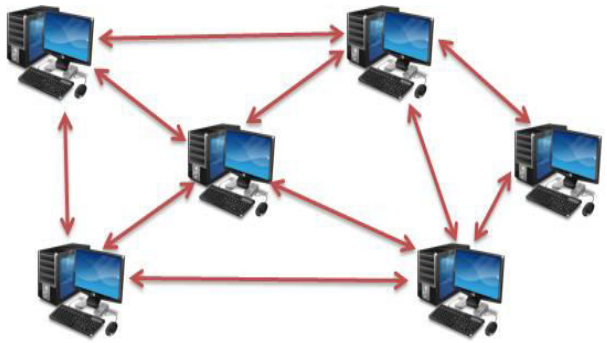

Fig 4: Decentralized P2P Network [62]

### *B. Depending on how the nodes are connected*

If P2P system is analyzed based on how the nodes are connected then P2P networks can be classified into two broad categories, which are structured P2P networks and unstructured P2P networks. Here is a brief overview of each of the category.

### *i. Structured*

It uses to implement algorithms in order to provide connection surely among the nodes. The structured systems are complex in structure but provide efficiency [63]. *Examples: DHT and Hyper Cup.* The architecture of the structured P2P network is shown in Fig 5:

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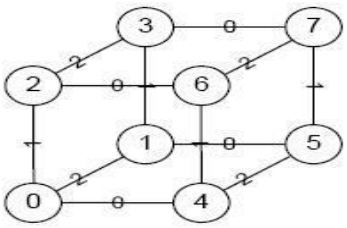


Fig 5: Structured P2P Network [63]

***2. Unstructured***

It involves the arbitrary creation of nodes and each node involved in this case has the ability to copy the information on the link between other connected nodes [64]. Examples in this regard involve *Fast Track, Gnutella*. The architecture of the unstructured P2P network is shown in Fig 6:

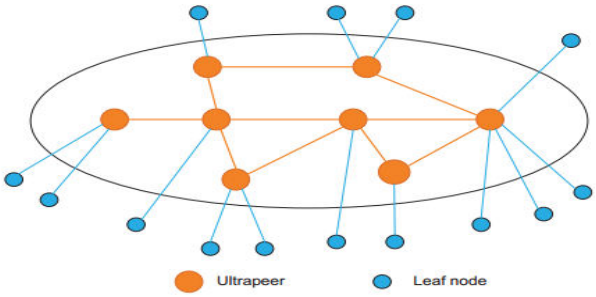


Fig 6: Architecture of Unstructured P2P Networks [64]

## IV. TYPES OF P2P NETWORKS

There exist three categories of P2P networks as shown in **Fig 7**:

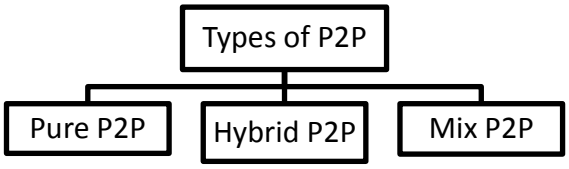


Fig 7: Types of P2PNetworks

***A. Pure P2P Networks***

All nodes perform equally, it replies that there is no devoted server, all nodes act likewise. It means that all the participating peers or nodes in a pure P2P network are equal in logic that each node or peer act as both i.e. as a client andas a server. There exists no central server. Examples of pure P2P networks are Gnutella and Freenet. The concept of pure P2P network in the Freenet architecture can be analyzed in the Fig8:

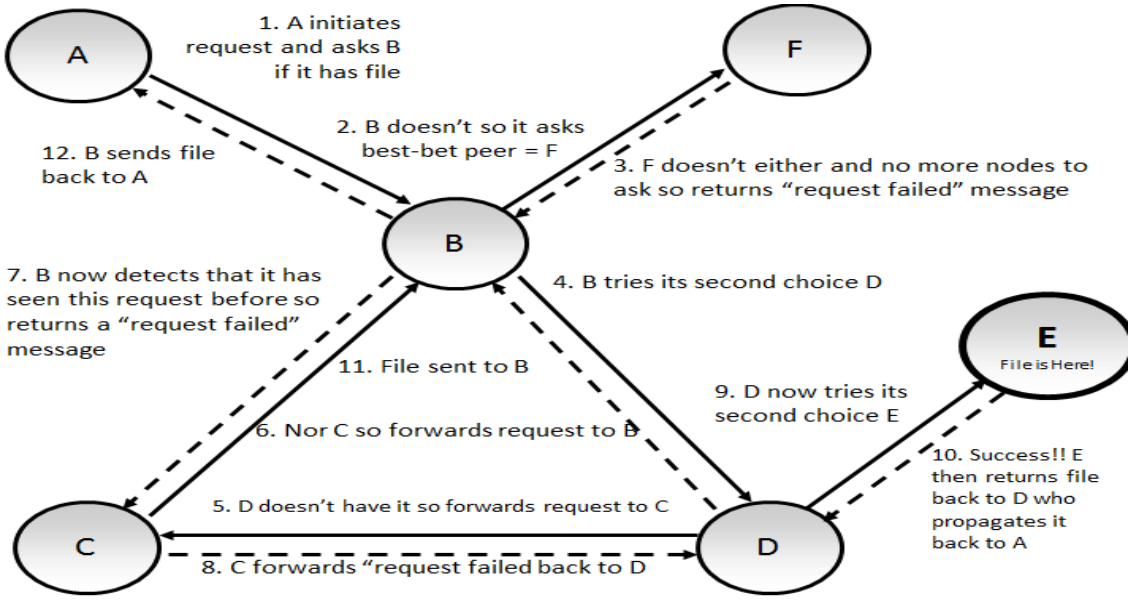


Fig 8: Freenet Architecture (Pure P2P Network) [117]

***B. Hybrid P2P Networks***

It performs as a client-server prototype as it has a chief node or peer that performs as a server that retains statistics on nodes and replies to entreaties on behalf of that information. Chief server (node or peer) recognizes what possessions are communal and what are allowed. They are also accountable for accommodating of offered assets [65]. The example of hybrid P2P network is Napster. In Napster, there is a server that assists nodes to search for a specific file and start a direct communication among the clients. The server only contains available files on its catalog. Another example in this prospect is of Bit Torrent (BT). In BT, there is a central server named tracker that coordinates interaction between the nodes accessing BT to download a file. The hybrid concept in the Napster architecture can be analyzed in the figure given below:

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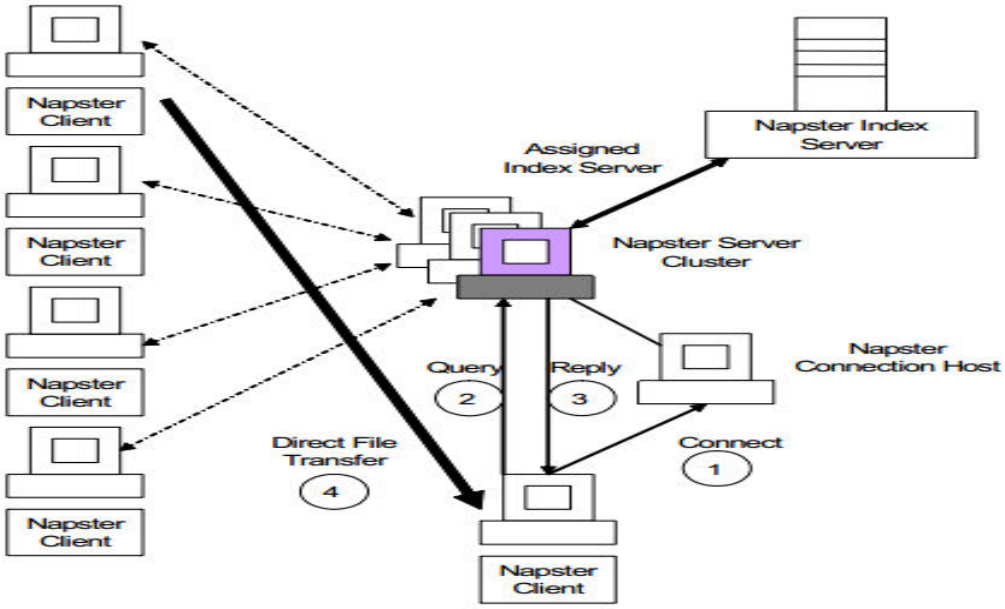


Fig 9: Napster Architecture (Hybrid P2P) [65]

***C. Mixed P2P***

Has both pure and hybrid characteristics.

The main and fundamental difference between hybrid and pure P2P network is that hybrid P2P networks have a central entity and there is no server in pure P2P networks. As compared to the hybrid P2P architecture, the pure P2P design is simple with higher fault tolerance level. While,in a hybrid P2P designfewer network resources are used. It is also more scalable as compared to pure P2P network.

## V. Types of P2P networks (Systems in P2P Networks)

In P2P networks the systems that are mostly used are unstructured and structured. In unstructured P2P no specified structure of overlay is imposed while in structured there is a specified structure of the network.

***A. Unstructured Systems:***

There are a number of P2P systems developed in this prospect, some major systems in this context includes:

***1. Napster***

Napster was mainly developed by Sean Parker, John Fanning, and Shawn Fanning. Initially, Napster was proposed as aself-governingP2P file allocation facility [66]. The provision functioned among June 1999 and July 2001.Its skills permitted individuals to effortlessly part their MP3 stores with further members. Though the innovative provision was closed down by law court command, the Napster product endured after the company's possessions were settled and acquired by other corporations through insolvency measures [67].

***i. Napster Clients***

There are two main clients of Napster, which are shown in Fig 10:

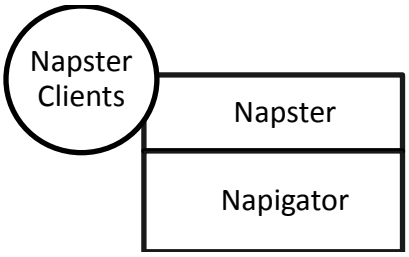


Fig 10: Napster Clients

***2. Gnutella***

Gnutella at the time of development was the largest decentralized P2P network. The structure of Gnutella uses ad-hoc topology where each peer is connected to each other node or peer in the network. Its structure holds the property that peers without affecting the performance of the other peers can disconnect from the network, so it also holds the property of dynamic network [68].

The population of Gnutella increased to about 1.81 million in June 2005 which approached around 3 million in 2006. And in 2007, it was considered among the utmost widespread system of context sharing comprising 40% of the market [69].

***i. Gnutella Clients***

The clients of Gnutella are shown in **Fig 11:**

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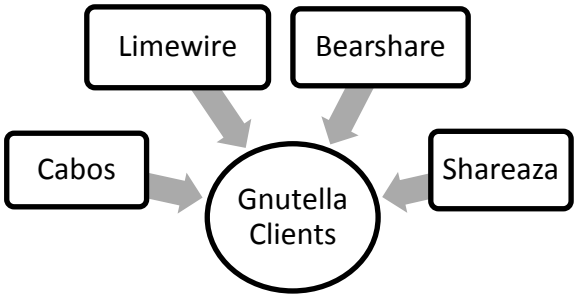

Fig 11: Gnutella Clients

*ii. Gnutella: Analysis and Improvement*

- Tractability
- Enactment & Immovability
- Consistency

***3. Fast Track***

The structure of Fast Track is centered on Hybrid architecture [70]. This P2P network is controlled using two tiers which are first tier and second tier. The first tier basically connects nodes or peer to the super peers whereas in the second tier the super peers are connected to each other. It provides the capability to download a file from multiple users [71].

***i. FastTrack Clients***

The clients of Fast Track involve:

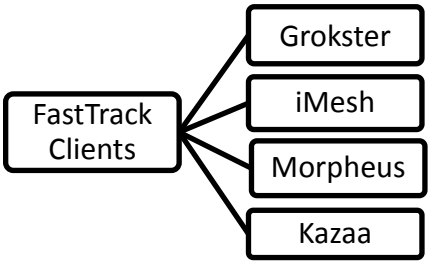

Fig 12: FastTrack Clients

***4. eDonkey***

It is centered on decentralized architecture [72]. It also comprises of two tiers [73]. The first tier contains a central server in order to maintain a list of files whereas the second tier handles the file transfer property of the network. EServer and MetaMachine are the two server software's supported by eDonkey [74].

***i.eDonkey Protocol Features***

- It uses the mechanism of Metadata in order to search data or contents including the size of the file, the available number of sources, bit rate, artist etc. [75].
- Provides the facility to download the same file from numerous peers simultaneously.
- It is capable of partial data or files sharing together with that handle and detects the corrupted data contents within a file.

***ii.eDonkey Clients***

The clients of eDonley involve:

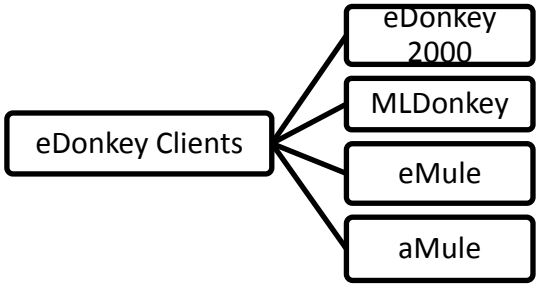

Fig 13: eDonkey Clients

***5 Bit Torrent***

The structure of BT is centered on decentralized architecture [76]. The files in this structure are divided into blocks or pieces where pieces size vary from 64 KB to 4MB and provides the way to further segment out these sections into 16KB blocks[77].

The three major components of BT involve:

- **Trackers** –the responsibility of this component is to track seeders, leechers and different pieces of files from diverse users.
- **Seeders** – This component comprises files in order to share with the other nodes or peers.
- **Leechers** – This unit has the responsibility for downloading files from other nodes or peers.

***i. Features of Bit Torrent***

- Consumers take. *Torrent* files which comprise meta-data evidence.
- Torrent collections can ensure one or numerous followers.
- Files are taken in fragments or chunks.
- Outfits file allocation equality.

**6. Skype**

Skype was developed by a team of software developers including Janus Friis and NiklasZennström [78]. This structure of P2P network provides the facility of instant messaging, chat, conferences, file sharing and transfer and connects directly to the user [79].

***7. Freenet***

Freenet is a P2P podium intended for robust communication. Its structure is decentralized and in order to hold and store data files it works with a group of free software. Jan Clarke designed the structure of Freenet together with its basic tools and designed Freenet with the objective of offering liberty of communication with robust privacy safeguard [80].

***8. Direct Connect***

Direct Connect was basically written by Neo-Modus. It is file allocation application. The major application used in Direct Connect is today. It is a centralized structure where in order to download a file users are connected to a central hub and have the ability to download from one another. Hubs offer a variety of clients that are connected to them

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[81]. Users here can chat and download files from the other users connected to the central hub.

***B. StructuredP2P networks***

In structured P2P networks the overlay is organized into a specific topology, and the protocol ensures that any node can work efficiently. Some major systems are given below.

***1. Chord***

Chord is a procedure and system designed forP2P dispersed hash table. A distributed hash table supplies fundamental consequence sets by conveying keys to diverse PCs (nodes); a node will collect the principles on behalf of all the keys for which it is accountable. Chord postulates in what way keys are allotted to nodes, and by what means a node may discern the worth aimed at a specified key through first discovering the node accountable on behalf of that key [82].

***2. CAN (Content Addressable Network)***

CAN is a dispersed and scattered P2P organization that delivers the feature of the hash table on an Internet. CAN was among the supreme innovative for dispersed hash table suggestions, familiarized simultaneously by way of Tapestry, CAD, and Pastry.

Similar further dispersed hash tables, CAN are intended to be ascendable, error accepting, and self-establishing. The structural scheme is a simulated Cartesian coordinate cosmos with various dimensions and is a category of drape system on a multi-torus [83].

***3. Tapestry***

Tapestry is a P2P overlay network which delivers a dispersed hash table, direction-finding and multicasting organization intended for dispersed applications. The Tapestry P2P structure is proposal effectual, ascendable, and self-mending, position conscious and direction-finding to neighboring possessions [84].

***4.Kademlia***

Kademlia is a dispersed hash counter on behalf of a dispersed P2P computer systems intended by David Mazières and PetarMaymounkov in 2002. It states the assembly of the system and the interchange of statistics through the peer lookups. Kademliapeers converse among them by means of UDP. A simulated or overlap system is molded through the contributing peers. Every peer is recognized by a symbol or *peer ID*. The ID of the peer assists not merely as identification; however the Kademlia process utilizes the peer ID to trace standard. In fact, the peer ID offers a straight plot to file hashes and that peer accounts statistics on where to acquire the file or resource [86].

***5. Pastry***

The pastry is a drape and direction-finding system aimed at the enactment of a dispersed hash table (DHT) like Chord. The key-value sets are deposited in a terminated P2P network of linked internet masses [87]. The procedure is bootstrapped by means of providing it through the IP discourse of a node previously in the system and from then on via the direction-finding counter which is animatedly constructed and renovated. For the reason that of its dismissed and dispersed environment, there is no solitary fact of disaster and any solo node can dispense the system at any period deprived of cautioning and with slight or no chance of statistics loss. The procedure is similarly talented of consuming a direction-finding metric provided by an external suite, such as chick or smidgeon way, to regulate the finest ways to collect in its routing table [88].

## VI. APPLICATIONS OF P2P NETWORKS

There are a number of different P2P networks applications. Some of the major application involves:

***A. File Sharing***

The exchange of contents, files and data are the major and most supreme zones of P2P application areas. The peer within the network provides the surety of file sharing focusing on storing and retrieving data to and from other peers within the network. Kazza and Emule are the optimal examples in this context [89].

***B. Distributed Computing***

The major task is carried out by the member of the network which offers the resources. The application works by providing the idle cycles to the peer or node in the network which requires extra time for the purpose of computation. One of the best examples of such application is SETI@home [90].

***C. Communication and Collaboration***

Another major application of P2P networks is the collaboration and communication that aims at providing a system for users to communicate with each other. The application provides chat instant messaging, shared apps and online games [91]. These applications can be used in various domains including home atmosphere, industry, and education. The major examples in this domain include Jabber and Groove.

***D. Network***

This application provides a mechanism for networking such as Dales which is a P2Pweb cache for LANs, Voice Peering Fabric and Open Garden [92].

***E. Science***

The application of P2P networks in the category of bioscience include biometrics and identification of drug candidate lastly, there is a science net P2P search engine as well [93].

***F. Search***

P2P also provides with some P2P architecture based search engines which include yahoo, google, ask etc. [94].

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## VII.PROS AND CONS OF P2P NETWORKS

There are many pros and cons of P2P network which are given below.

### A. ADVANTAGES OFP2P

- Easy to connect and organize.
- No devoted server needed.
- Consumers handle their specific assets.
- Economical to acquire and control.
- No professional software mandatory.
- No devoted supervisor to track the vital network.
- Nearly free.
- Profligate downloading.
- Malleable organization.

### B. DISADVANTAGES OF P2P NETWORKS

- Not so secure.
- Viruses, spam, spyware, downloaded collections might be septic, comprise an unsafe material, disrupt confidentiality.
- Occasionally unlawful as copyrighted collectionsinsideP2Pnetworks.
- Problematic to occupy a safety.
- More over numerous passwords for common possessions.
- Backups are challenging to handle.
- No centralism.

## VIII.CHALLENGES IN P2P

There are a number of challenges and problems that are faced by P2P networks. The major challenges that P2Psystems are facing are shown in Fig 10[94]:

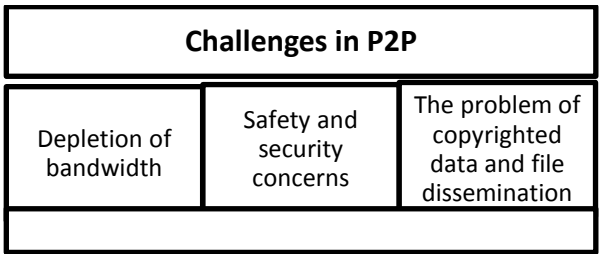


Fig 14: Challenges in P2P Networks

### *A. Distribution of Copyrighted Files*

P2Pnetworks are often sued by different organizations and companies, eg*(RIAA, MPAA, and ARIA).* There are chances that users can be targeted. Copyright laws are limited to few countries only.

### B. SECURITY ISSUES

There are a number of security issues that are faced by P2P systems including malware, the spread of null files and virus, spyware, steganography use and lastly peers can be dispersed status principles[95].

### C. BANDWIDTH CONSUMPTION

High bandwidth is essential [96].

## IX.ANALYSIS AND DISCUSSION

Here in this section, the major principles of structured and unstructured P2P networks will be analyzed and compared.

Structured organizations provide an ascendable key for rigorous match demands, i.e. inquiries in which the whole identifier of the demanded statistics entity is recognized. There are means to utilize rigorous match inquiries like a substrate aimed at keyword interrogations [28]. Conversely, it is not clear how these methods can be scaled in a dispersed background. The drawback of structured organizations is that it is difficult to preserve the arrangement essential for direction-finding in a brief peer or node residents, in which peer or nodes are connecting and separating to a great degree.

Unstructured P2P organizations can upkeep limited keyword exploration. These organizations rely on sightless exploration procedures, like random walk and flooding. Therefore, the produced capacity of inquiry circulation does not balance up with the development in network dimension. Numerous exploration accomplishments are intended towards enlightening the direction-finding enactment of unstructured P2P organizations through embracing suggestion centered direction-finding approaches. Nodes or peers acquire from the consequences of preceding direction-finding assessments, and prejudice upcoming query direction-finding centered on this information.

If unstructured P2P systems are looked into deeply, a number of significant advantages offered by them can be analyzed, which includes that it enforces minor requests on the discrete peers or nodes. Most important feature is that they permit its peer or nodes to leave the system or network without having any effect on the performance of the system. They also provide a better mechanism for content-based retrieval. The varying power of peers and nodes is also accommodated by unstructured P2P networks.

Subsequently, they also scale to enormous proportions and they propose supplementary strong enactment in the existence of peer let downs and linking unpredictability. Permitting to [97], if scalability apprehensions were detached commencing P2P networks with unstructured nature, they have the chance of getting preference in case of file-sharing on any cloud computing [98], and other environments. Other solicitations including keyword searching, content replication at a reasonable division of contributing spots and last but not the least the node populace is extremely brief [99]. Table 1 presents a comparison of certain convolutions of unstructured and structured P2P networks. The table given below compares the structured and unstructured P2P networks based on the factor of fault tolerance, type, and the degree of centralization, the cost of lookup, space complexity, scalability and space complexity [100-101]. The comparison of structured and unstructured P2P networks and centralized and decentralized networks is shown in Table 1 and Table 2 respectively.

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Table 1: Comparison of structured and unstructured P2P networks

| Architecture | Type | Degree of centralization | Cost lookup | Space Complexity |
|---|---|---|---|---|
| Kademlia | Structured | Decentralized | O(log(n)) | O(log(n)) |
| Pastry | Structured | Decentralized | $O(log_2{}^b(n))$ | $O(log_2{}^b(n))$ |
| Tapestry | Structured | Decntralized | $O(log_b(n))$ | $O(log_b(n))$ |
| CAN | Structured | Decentralized | $O(n^{1/d})$ | 2d |
| Chord | Structured | Decentralized | O(log(n)) | O(log(n)) |
| Napster | Unstructured | Centralized | O(1) | O(n) |
| Gnutella | Unstructured | Decentralized | O(n) | O(n) |
| Freenet | Unstructured | Centralized | Hops to Leave | Hops to Leave |
| Direct Connect | Unstructured | Centralized | O(n) | O(n) |
| Skype | Unstructured | Centralized | O(n) | O(n) |
| BitTorrent | Unstructured | Centralized | O(n) | O(n) |
| eDonkey | Unstructured | Centralized | O(n) | O(n) |

Table 2: Comparison of structured and unstructured P2P networks

| Architecture | Fault Tolerance | Scalability | Query Efficiency |
|---|---|---|---|
| Kademlia | Random | Fair | Good |
| Pastry | Random | Fair | Good |
| Tapestry | Random | Fair | Good |
| CAN | Random | Fair | Good |
| Chord | Random | Fair | Good |
| Napster | Good | Fair | Poor |
| Gnutella | Good | Good | Poor |
| Freenet | Good | Good | Poor |
| Direct Connect | Random | Good | Average |
| Skype | Random | Good | Average |
| BitTorrent | Random | Good | Average |
| eDonkey | Random | Good | Average |

## X. CONCLUSION

The survey basically presents an overview and comparison of structured and unstructured P2P networks. The comparison shows that each system under the domain of P2P architecture has its own strengths and weaknesses. The optimal P2P network can be chosen based on the application and its essential task and performance metrics. P2P can be designated centered on content distribution, position facility, scalability, network routing enactment, file sharing, and so on.

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