Enabling P2P Mobile Payment through P2P Network

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Abstract—*Peer-to-Peer or Person to person (P2P) networks has emerged as a popular alternative to traditional client-server architectures for the distribution of information goods. Many new networks are being established and thousands of users are part of such P2P networks. The P2P layer must be well aware about the wireless network to minimize the traffic and to cope with frequent route breaks. Additionally the network layer needs knowledge about the Peer-to-Peer application, in order to establish routes only to appropriate communication partners. With this definition a comparative study on currently existing networking concepts in the Internet either as Pure P2P, or Hybrid P2P or Mixed P2P or Client/Server architecture are done in this paper. It is found that the hybrid P2P architecture consumes less network resources and is more scalable than other approaches.*

Keyword: P2P Network, Napster, Gnutella, Freenet

I. INTRODUCTION

The concept of P2P can be defined as a highly distributed application architecture where equal entities, denoted as peers, voluntarily share resources via direct end-to-end exchanges on application layer. A P2P service is a loosely-coupled set of operations to provide a direct resource exchange. P2P services are typically focused on providing specific functions like distributed indices for locating resources or exchanging of resources. P2P resource sharing system has been more and more popular network system [1]. Distributed network architecture may be called a P2P network, if the participants share a part of their own hardware resources (processing power, storage capacity, network link capacity, printers, SMS, etc.). These shared resources are necessary to provide the Service and content offered by the network (e.g. file sharing or shared workspaces for collaboration). They are accessible by other peers directly, without passing intermediary entities. The participants of such a network are thus resource (Service and content) providers as well as resource (Service and content) requestors (Servant-concept).

The distributed nature of P2P networks also increases robustness and in pure P2P systems by enabling peers to find the data without relying on a centralized index server. In the latter case, there is no single point of failure in the system. Usually Internet providers (ISPs) don't welcome P2P users in their networks. The reason is that P2P clients tend to increase the traffic. Compared to Web browsing, e-mail or most other uses of the internet, where data is only transferred in short intervals and relative small quantities, P2P consists usually in a relatively heavy use of the internet connection due to the ongoing file transfers and swarm/network coordination packets.

II. P2P NETWORK

Person-to-Person or Peer-to-peer (P2P) networking has strongly increased in popularity during the recent years. P2P networking such as Napster, Gnutella, OpenFT and Fasttrack have paved the way for a new distributed model of content exchange challenging the traditional client-server model that has dominated computer networking for the last two decades. Due to the rapid development of mobile devices, P2P networking is also staking a new claim by entering the mobile networks. Thus far, many companies and research communities have announced their pioneering solutions, but only a few are in public use yet. Despite the increased capabilities of mobile devices, there are still many challenges and limitations to outrun by the researchers to find proper technologies for this new emerging trend.

Intel P2P working group gave the definition of P2P as "The sharing of computer resources and services by direct exchange between systems" [2]. This thus gives P2P systems two main key characteristics:

A. Scalability

There is no algorithmic, or technical limitation of the size of the system, e.g. the complexity of the system should be somewhat constant regardless of number of nodes in the system.

B. Reliability

The malfunction on any given node will not affect the whole system (Or maybe even any other nodes).

P2P resource sharing system has been popular accepted because of its multiple-peers downloading, rich resources, service stability, such has come more famous systems: BitTorrent, Napster, Gnutella, Kaza and Maze [3] [4] [5]. P2P system can be divided into two kinds according to its topology structure: mixed and pure P2P, the mixed P2P system adopts the index server to find the peers, for example: Napster; while

the pure P2P system adopts the message broadcasting among peers.

A more technical definition of P2P was put together by Dave Winer of UserLand Software. He suggests that for a system to be P2P it should have the following seven characteristics [6].

i. User interfaces load outside of a web browser.

ii. User computers can act as both clients and servers.

iii. The overall system is easy to use and well integrated.

iv. The system includes tools to support users wanting to create content or add functionality.

v. The system provides connections with other users.

vi. The system does something new or exciting.

vii. The system supports "cross-network" protocols like SOAP or XML-RPC.

The basic idea is that two computing devices (peers) share resources and information with each other, with both acting as a kind of mini-server, that is to say neither is specifically a client or server. As there is no need for any central web-server, problems with controlling the information were soon to follow. A good quote remarking on this was made by Katherine Mieszkowski of Salon - "P2P is a particularly comical new coinage for a business model since the phrase starkly points out that there's no middleman - so how can anyone possibly make any money"

III. TYPE OF P2P NETWORK

There are different levels of P2P Networking. In other work there are three major type of P2P Network (Figure.1)

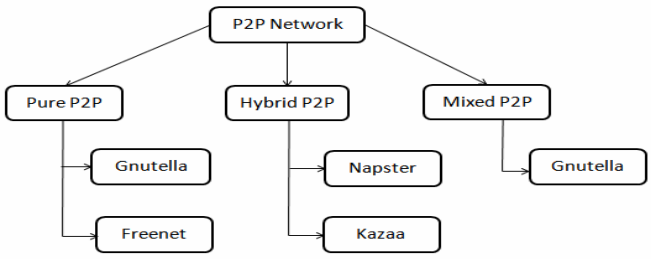

Figure.1: Major Type of P2P Network

IV. PURE P2P NETWORK

It is also known as purely decentralized networks. In a pure P2P network, all participating peers are equal, and each peer plays both the role of client and of server. The system does not rely on a central server to help control, coordinate, or manage the exchanges among the peers. Gnutella [7] and Freenet [8] are examples of a pure P2P network.

A. *Gnutella*

Gnutella was created by Justin Frankel and Tom Pepper in March'2000. Both were working under the Gnullsoft, which is one of AOL's subsidiaries. Research [9, 10, 11] shows that networks as diverse as natural networks formed by molecules in a cell, networks of people in a social group, or the Internet, organize themselves so that most nodes have few links while a tiny number of nodes, called hubs, have a large number of links (Figure.2). Gnutella neither has a centralized directory nor any precise control over the network topology or object placement in such architecture as the typical Gnutella [7]. To participate in Gnutella, a node first must connect to a known Gnutella node to get lists of some existed Gnutella nodes for start-up.

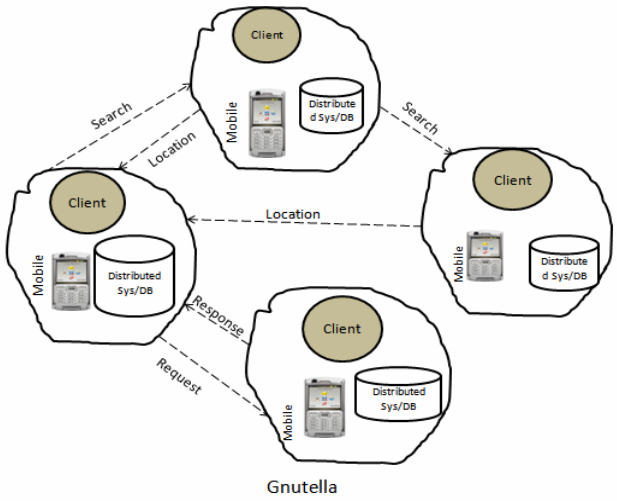

Figure.2: Gnutella model

B. *Freenet*

Freenet is an enhanced open source implementation of the system described by Ian Clarke's July 1999 paper "A distributed decentralized information storage and retrieval system" [12] and is classified as a third generation P2P application. A first version was released in March 2000. Freenet is a completely distributed decentralized peer-to-peer system. The system operates as a location-independent distributed file system across many individual computers that allow files to be inserted, stored, and requested anonymously. A node is simply a computer that is running the Freenet software, and all nodes are treated as equals by the network. Each node maintains its own local data store which it makes available to the network for reading and writing, as well as dynamic routing table containing addresses of other nodes and the keys that they are thought to hold. This removes any single point of failure or control. By following the Freenet protocol, many such nodes spontaneously organize them-selves into an efficient network. The basic model of Freenet as below [6]

Keys are passed along from node to node through a chain of requests in which each node makes a local decision about where to send the request next, in the style of IP (Internet Protocol) routing. Depending on the key requested the routes would vary. The routing algorithms adaptively adjust routes

over time to provide efficient performance while using only local, rather than global knowledge. As each node only has knowledge of their immediate upstream and downstream neighbors, to maintain privacy. Each request is given a hops-to-live limit, which is decremented at each node to prevent infinite chains. Each request is also assigned a pseudo-unique random identifier, so that nodes can prevent loops by rejecting requests they have seen before.

This process continues until the request is either satisfied or has exceeded its hops-to-live limit. Then the success or failure is passed back up the chain to the sending node.

V. HYBRID P2P

It is also known as hybrid decentralized networks. In a hybrid P2P network, a central server exists to perform certain "administrative" functions to facilitate P2P services. For example, in Napster, a server helps peers to "search for particular files and initiate a direct transfer between the clients" [13]. Only a catalogue of available files is kept on the server, while the actual files are scattered across the peers on the network. Another example is BitTorrent (BT), where a central server called a tracker helps coordinate communication among BT peers in order to complete a download. BT would be further research point.The central distinction between the two types of P2P network is that hybrid P2P networks have a central entity to perform certain administrative functions while there is no such server in pure P2P networks [14].

A. Napster

Napster is a file-sharing P2P application. It was single handedly written by a teenager named Shawn Fanning [15] [16]. He also pioneered the design of a protocol that would allow peer computers to communicate directly with each other. This paved a way for more efficient and complex P2P protocols by other organizations and groups.

Napster has a Server-Client structure where there is a central server system which directs traffic between individual registered users. The central servers maintain directories of the shared files stored on the respective PCs of registered users of the network. These directories are updated every time a user logs on or off the Napster server network. Clients connect automatically to an internally designated "metaserver" that acts as common connection arbiter. This metaserver assigns at random an available, lightly loaded server from one of the clusters. Servers appeared to be clustered about five to a geographical site and Internet feed, and able to handle up to 15,000 users each. The client then registers with the assigned server, providing identity and shared file information for the server's local database. In turn, the client receives information about connected users and available files from the server. Although formally organized around a user directory design, the Napster implementation is very data centric. The primary directory of users connected to a particular server is only used indirectly, to create file lists of content reported as shared by each node [17]. Users are almost always anonymous to each other; the user directory is never queried directly. Napster-like networks are known now as first generation networks. Such networks didn't have a complicated implementation and often relied on a central server (Figure.3).

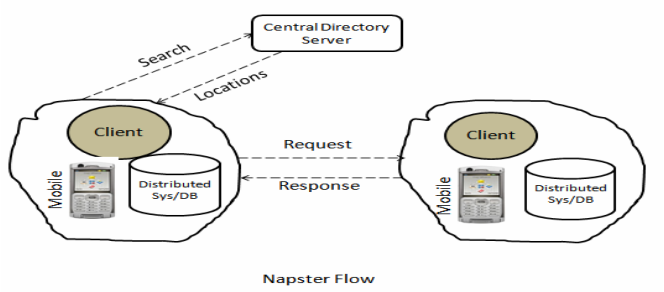

Figure.3: Napster model

One of the centralized Napster Model's main advantages is its central Directory server index that locates files quickly and efficiently. Because the central directory server constantly updates the index, files that users find through their searches are immediately available for download.

Another advantage lies in the fact that all individual users, or clients, must be registered to be on the server's network. As a result, search requests reach all logged-on users, which ensure that all searches are as comprehensive as possible.

VI. MIXED P2P

Mixed P2P network is a combination of a Pure P2P network and a Hybrid P2P network. It is also known as partially centralized networks. Some nodes are treated as superficial by allocating with responsibilities like maintaining central index of files shared by peers, helping a peer in establishing a relationship with another peer for existing file-sharing, etc. An example of such a network is Gnutella which has no central server but clusters its nodes around so-called 'Super nodes'.

VII. P2P MOBILE PAYMENT-PROPOSED ARCHITECTURE

Person-to-person or peer-to-peer (P2P) payment allows individuals to pay one another through a third party. P2P payment services, which are offered by many banks and third parties, can also allow business owners to transfer money to a customer or supplier account (and vice versa) using an e-mail address or mobile phone number. Users can conduct transactions using funds from a bank, credit, debit or prepaid account, or the payment can be funded through the mobile phone bill. P2P payment products are some of the most innovative developments from the payments industry in the past decade (Figure.4). Much ink has been spilled covering the cutting-edge opportunities for banks and other payments providers in P2P payments. Consumers have never had so many payment choices. Alongside a host of recent entrants like PayPal and CashEdge, longstanding industry players like Fiserv, Visa, and MasterCard all offer P2P products.

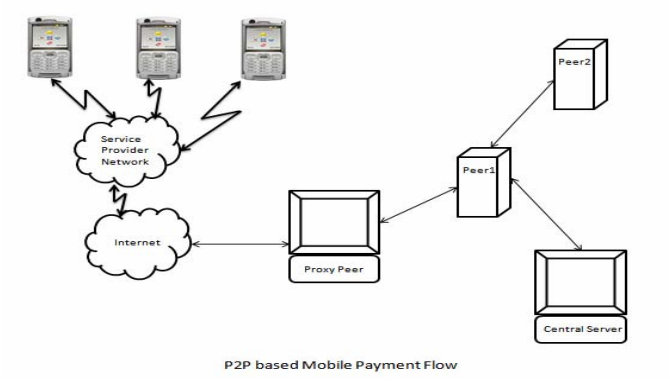

Figure.4: P2P Mobile Payment Flow

In the proposed architecture customers can use a mobile device to make the transaction either to individual or for paying any kind of payments/bills. P2P m-payments are private transactions between two individuals and are typically SMS-based. This may involve the dissemination of top-up credits (for example transferring minutes or minutes-value in exchange for a good or service), an m-banking transfer of funds, or digital barter such as in the exchange of content or virtual world goods. Thus, commercial platforms may be involved in the transaction, but the transaction is a direct one from one person to another. The architecture introduces the Mobile Payment which will be a third-party (external server) who provides an interface between the customer and the Bank. The customer initiates the transaction is called the customer and the person who receives it is called beneficiary. A customer initiates a mobile payment by entering the assigned shortcode of the beneficiary. This information is sent across from the Telecommunication Service Provider to the Mobile Payment Provider which in-turn communicates the same to the customer's bank. After the appropriate processing at the customer's bank, the transaction is sent to the beneficiary's bank. An important step here is to identify the beneficiary's bank. This can be accomplished by storing all the mapping data in a Central server through assigned shortcode. Lots of challenges are to be overcome for a successful implementation of mobile payments to be widely accepted as a mode of payment which would be SMS Based (Figure.5).

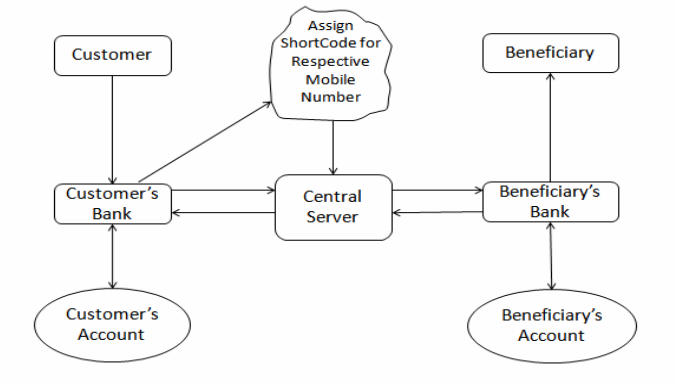

Figure.5. Proposed architecture which will ease the process and will take very less time to transfer money from one individual to another

CONCLUSION

This paper has compared the hybrid P2P architecture with Pure and Mixed P2P architecture, the pure P2P architecture is simpler and has a higher level of fault tolerance. It is observed that the hybrid P2P architecture consumes less network resources and is more scalable than the pure P2P approach. Further research would be required to address some new challenges that have been identified. As it has been shown in this paper, there exists a variety of P2P systems designed specifically for P2P networks or mobile networks, but few proposals deal with the problem of providing content information dissemination/discovery in delay tolerant networks. This analysis can be used as an example of measuring success factors of any new payment system.

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