

# An Initial Approach of a Scalable Multicast-based Pure Peer-to-Peer System

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## Abstract:

*There are always big question marks when implementing the Pure Peer-to-Peer architecture. Our research is a short-term initiative to investigate the evolution of future architecture for Pure Peer-to-Peer. Our first implementation is an infrastructure that supports a large number of Internet users by implementing IP multicast technology into the Pure Peer-to-Peer architecture. The prototype of our approach is known as Purep2p. In this poster we will outline the actual implementation of Purep2p and discuss the proposed architecture with particular emphasis on IP Multicast technology. Our design is independent of any central server and interoperable on any platform to communicate between each other.*

## INTRODUCTION

Many believe that Peer-to-Peer will revamp the Internet architecture and make computer owners feel more empowered. However, advanced features such as scalability and performance of these systems still remain to be considered as a de facto standard for developers as well as users.

Thus far, Pure Peer-to-Peer has been regarded as an insufficient Peer-to-Peer architecture to be implemented because of its complexity in peer discovery. We would like to address these problems by investigating the benefit of multicast technology into the Peer-to-Peer architecture and sufficient query communication. The technique described in this paper is to improve the scalability and peer discovery of Pure Peer-to-Peer architecture through multicast technology. By applying the multicast grouping mechanism, adding sufficient file searching method, and adequate query communication between the peers, we are able to manage the files in a decentralized way efficiently.

## MULTICAST

Traditionally multicast communication has been used to transmit stream-oriented data such as video and audio to a number of receivers simultaneously. However,

Multicast is not only restricted to these applications. The inherent transparency of multicast also makes its use attractive for Peer-to-Peer communication, resource location and information retrieval.

One advantage is that IP multicast enables a network planner to proactively manage network growth. When one user is sending the same data to multiple receivers, only one packet will be sent at each route. The copies of packets will be made where paths diverge. Thus, better bandwidth utilization and lesser host/router processing can be achieved. IP multicast is designed to scale well as the number of participants and collaboration expands.

Another benefit of implementing this approach is that it enables the simultaneous delivery of information to many receivers. Furthermore, multicast technology has its advantages in anonymity where the receiver's addresses are unknown. This is one of the core features when dealing with Peer-to-Peer technology nowadays.

By using multicast as our communication platform, we strongly believe that it is sufficient to make requests for data on the agreed upon multicast channel and any node that holds a match of the query data item may respond to the request. This property makes multicast communication an excellent choice for building a system that conveys data to numerous peers.

## IMPLEMENTATION

Our first goal is to explore the capabilities of multicast technology such as low overhead, anonymity and scalability to support any Pure Peer-to-Peer application. The idea is to send a multicast packet to a virtual peer network via multicast enabled routers. These connected routers will multicast the packet to all their connected peers as well as multicast routers which may be in different subnets. This process continues until the Time - To-Live (TTL) of the packet expires.

We have implemented our Purep2p system using UDP because UDP is a protocol over IP with very low overhead.

We tested our Purep2p system on 19 PCs and a notebook that use different operating systems. The tested

operating systems consist of Windows 95/98, Windows ME, Windows NT, and Windows 2K, to Linux. We also tested our Purep2p in a Local Area Network using a combination of shared Ethernet and switched Ethernet networks.

In this investigation, we used multicast group mechanism to support a single message to a group of peers. This is based on our previous work done on video conferencing and reliable file transfer over MBONE.

To support native IP multicast, the network infrastructure between the sending and receiving peers must be multicast-enabled, including intermediate routers.

## RESULTS

We tested our Purep2p system on a local area network (LAN). We measured the performance with 20 personal computers that connected to a specified multicast IP address. This experiment was conducted over a 10Mb/s and 100Mbps Ethernet on IBM ThinkPad and workstations with Intel Pentium I, II and III with different clock speed. To emulate a wide area network, 20 workstations have been tested at two different subnets.

In our experiment, we tested our system with different length of queries ranging from 1 to 11 characters. For each measurement, the performance is measured by numbers of matched filename. The results are categorized by length of queries and numbers of matched filename found.

From this experiment, it shows that the system can handle long characters search query. When the query occurs within the filename, a positive result will be returned. The amount of matched filename versus the length of queries can be identified in the table 2.0. From the table, we found that every peer is able to receive the query simultaneously and the matched result responded within 0.8 seconds. Ultimately, the response time depends on the size of the shared directory. Note that in this table, all the total matched results from the receivers are the same. The results also prove that all the peers managed to get the query and respond to the matched results completely.

This Purep2p system is practically able to scale up to 20 PCs and is totally platform independent. This proved that this system is essentially useful and scalable to a larger population, such as an enterprise user. In practice, our results are perfectly for the enterprise user to transmit their interested documents.

Table 2.0: Test results

Query	Number of matched filename									
	PC <sub>1</sub>	PC <sub>2</sub>	PC <sub>3</sub>	PC <sub>4</sub>	PC <sub>5</sub>	PC <sub>6</sub>	PC <sub>7</sub>	PC <sub>8</sub>	PC <sub>9</sub>	PC <sub>10</sub>
A	189	189	189	189	189	189	189	189	189	189
Java	156	156	156	156	156	156	156	156	156	156
Power	46	46	46	46	46	46	46	46	46	46
Network	97	97	97	97	97	97	97	97	97	97
Programming	71	71	71	71	71	71	71	71	71	71

Query	Number of matched filename									
	PC <sub>11</sub>	PC <sub>12</sub>	PC <sub>13</sub>	PC <sub>14</sub>	PC <sub>15</sub>	PC <sub>16</sub>	PC <sub>17</sub>	PC <sub>18</sub>	PC <sub>19</sub>	PC <sub>20</sub>
A	189	189	189	189	189	189	189	189	189	189
Java	156	156	156	156	156	156	156	156	156	156
Power	46	46	46	46	46	46	46	46	46	46
Network	97	97	97	97	97	97	97	97	97	97
Programming	71	71	71	71	71	71	71	71	71	71

## CONCLUSION

This paper presented a unique approach of Pure Peer-to-Peer architecture by implementing IP multicast technology. The main contribution of this approach is to provide alternative network architecture for current Pure Peer-to-Peer applications. We are convinced that our idea of implementing IP multicast address as a virtual IP server is new too.

The experimental results have indicated that the efficiency of our system is reasonably good in LAN. Our system is able to query and search for a particular file simultaneously to multiple peers by sending only one low overhead query packet. Hence, it saves network bandwidth. This proved that our system could scale to a larger population. Our system is also able to federate peers into a valid community without any mediator's intervention by using Multicast-grouping mechanism. In fact, the peers still can remain anonymous.

In the near future, we plan to extend our Purep2p system with a portable mobile agent. Moreover, we believe that our system is flexible and easily reconfigure for further enhancement. As the final word, we strongly believe that our approach is workable, scalable and reliable.

## REFERENCES

- [1] Andy Oram (editor). Peer-to-Peer: Harnessing the Benefits of a Disruptive Technology. O'Reilly, 2000.
- [2] S.Deering," *Multicast Routing in a Datagram Internetwork*" Phd. Thesis Stanford University, Dec 1991.
- [3] S.Deering , D.Estrin , D.Farinacci , V.Jacobson , C.Liu , L.Wei "The PIM Architecture for Wide-Area Multicast Routing , *IEEE/ACM Transaction on Networking*" 4(2), April 1996.
- [4] S.Floyd, V.Jacobson,C-G Liu,S.McCanne and L.Zhang,"Reliable Multicast Framework for light-weight sessions and application level framing" Processings from SigCOMM'95, Boston, MA, September 1995.
- [5] University of Cincinnati , "Scalability Issues in Large Peer-to-Peer Networks – A case Study of Gnutella", 2001.
- [6] Ross Lee Graham, "Pure P2P" 2001, <http://www.ida.liu.se/conferences/p2p/p2p2001/pure.htm>
- [7] Adam Langley , "The Freenet Protocol", <http://freenet.sourceforge.net/>