Reducing the Download Time in Stochastic P2P Content Delivery Networks by Improving Peer Selection  
by  
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**What research problem was the reviewed dissertation trying to address?**

The research problem is that Peer-to-Peer (P2P) networks take up enormous portions of the open Internets bandwidth (Zuo & Iamnitchi, 2016). The P2P networks consuming so much bandwidth on the open internet is a problem because of the congestion put on Internet Service Provider’s (ISP’s) networks (He, et al., 2016). Because open networks get saturated with high bandwidth and inefficient P2P traffic, other applications can see reduced performance (Ijaz, Saleem, & Welzl, 2013). The congestion in turn leads to poor user experience through low throughput and intermittent inefficiency (Brienza, et al., 2016). There have been attempts to solve the bandwidth issues through biased and random based switching techniques (Hsiao, et al., 2011; Pacifici, et al., 2016). The issue with biased based switching is it requires client overhead since connection data about other peers needs to be polled, stored, and analyzed (Wilkins & Simco, 2013). Biased based switching cannot switch peers if the selected nodes performance degrades (Wilkins & Simco, 2013). The issue with random switching is it only performs switching after the peers have been selected allowing for the potential problem of downloading from a faulty peer before a better one is chosen ( Chiu & Eun, 2008). Because of the issues mentioned above, the research problem of the reviewed dissertation addresses the attempts to improve P2P networks by addressing how to improve performance of peers before a connection is made and while a file transfer is in progress.

**What was the research goal of the reviewed dissertation?**

The research goal of the reviewed dissertation was to reduce the average download time for individual clients and application loads on networks. The goal was proposed using advanced knowledge for peer selection, monitoring the performance of the server peer after the connection has been made, and only replacing the worst performing peers. (This essay) Previous research from Lehrfeld & Simco, 2010 as well as Wilkins & Simco, 2013 showed that limiting the amount of time spent with poor performing peers reduces the average download time for the client and that the reviewed dissertation’s goal was achieved based on improved metrics compared to the metrics from the previous research.

**What evidence (literature, data, etc) was presented to support the reviewed dissertation research and achieve the research goal?**

A myriad of research literature was presented as evidence for the dissertation research and the research goal. The literature attempts to cover some of the accomplishments made to the problem of reducing download time in stochastic P2P content delivery networks through five peer selection strategies. The first being from Chiu & Eun, 2008 proposing that the heterogeneity of nodes needs to be considered in P2P download strategies. The second being the literature on random peer selection that has the advantage of having low overhead, being robust, and easy to implement (Sherman, Neih, & Stein, 2009). Third is literature about advance knowledge peer selection. The advanced peer selection has high overhead and cost but better download times when compared to random selection (Xie, et al., 2008). Fourth is ISP based selection, the problem being that cross ISP connections can be expensive and cause bottlenecks (Varvello & Steiner, 2011). The dissertation proposes that the research goal will need to reduce cross ISP traffic without the cooperation from the ISP’s because of privacy and security concerns. (Varvello & Steiner, 2011; Ijaz, et al., 2013). Last is proximity strategies that use the location of peers to make informed decisions using concepts such as Round-Trip Time (RTT), jitter, and number of hops (Fiorese, et al., 2013).

**What research methodology used and who claim this methodology is valid?**

The research methodology used was a simulation method. A P2P simulation based on the prior works of (Chui & Eun, 2008; Lehrfeld & Simco, 2010; Wilkins & Simco, 2013) was set up with a test environment comprising of the C++ programming language written in a Microsoft Visual Studio Integrated Development Environment (IDE). The experiments were run on an AsusG751J Graphics Processing Unit (GPU) with an Intel i7-470HQ processor. The system comprised of 32GB of RAM on the Windows 10 Operating’s System. The random number generator for each experiment had the same seed for each experiment. Each download strategy was performed 32 time to be consistent. Data was obtained from the OOKLA(2017) and MaxMind(2017) databases to populate simulated server peers with IP addresses and average service capacity. This P2P simulation environment used an AR-1 process to simulate the stochastic nature of the server peer’s service capacity just like in the previous works of Chiu & Eun (2008), Lehrfeld & Simco (2010), and Wilkins & Simco (2013)

Single client

* Without isp throttling’
* With isp throttleing

Multiple Client

A P2P simulator based on prior works (Chui & Eun, 2008; Lehrfeld & Simco, 2010; Wilkins & Simco, 2013) was modified to use service capacities, ISPs, and IP addresses obtained from the preprocessed data was developed.

**What were the findings of the reviewed dissertation research?**

The results of the reviewed dissertation research claim to have developed a new peer selection strategy for P2P content delivery networks that reduced download time by making informed decisions of selected peers.

The results of the experiments performed in this investigation showed that modifying the random based strategy to use advanced knowledge for initial peer selection, monitoring the connection, logging the current service capacity, and only replacing the

worst performing peers reduced the individual client’s average download duration in the simulated P2P network

The single client tests performed showed that the historic based strategy described in this research reduced the average download duration by an average 16.6% when compared to the Wilkins & Simco (2013) smart peer replacement strategy.

he multiple clients with competition experiments performed showed that the historic based strategy improved the average download duration for the individual client by an average 53.31% over the Wilkins & Simco (2013) smart peer replacement strategy. nterestingly the percentage of improvement decreased as the file size was increased and as the level of competition was increased.

## **References**

Brienza, S., Cebeci, S. E., Masoumzadeh, S. S., Hlavacs, H., Özkasap, Ö., & Anastasi, G.

(2016). A survey on energy efficiency in P2P systems: File distribution, content

streaming, and epidemics. *ACM Computing Surveys* (CSUR), 48(3), 36.

Chiu, Y.-M., & Eun, D. Y. (2008). Minimizing File Download Time in Stochastic Peer-

to-Peer Networks. *IEEE/ACM Transactions on Networking*, 16(2).

Fiorese, A., Simoes, P., & Boavida, F. (2013). Approach for service search and peer

selection in P2P service overlays. 2013 International Conference on Information

Networking (ICOIN), 303-308.

He, Q., Dong, Q., Zhao, B., Wang, Y., & Qiang, B. (2016). P2P Traffic Optimization

based on Congestion Distance and DHT. *Journal of Internet Services and*

*Information Security* (JISIS), 6(2), 53-69.

Hsiao, T. H., Hsu, M. H., & Miao, Y. B. (2011). Adaptive and Efficient Peer Selection in

Peer-to-Peer Streaming Networks. 2011 IEEE 17th *International Conference on*

*Parallel and Distributed Systems* (ICPADS), 753-758.

Ijaz, H., Saleem, S., & Welzl, M. (2013). Fewest common hops (FCH): an improved peer

selection approach for P2P applications. 2013 *21st Euromicro International*

*Conference on Parallel, Distributed, and Network-Based Processing*, 449-453.

Lehrfeld, M., & Simco, G. (2010). Choke-based switching algorithm in stochastic P2P

networks to reduce file download duration. *Proceedings of the IEEE*

*SoutheastCon* 2010, 127-130.

Sherman, A., Nieh, J., & Sten, C. (2009). FairTorrent: bringing fairness to peer-to-peer

systems. *Proceedings of the 5th international conference on Emerging networking*

*experiments and technologies*, 133-144. doi: 10.1145/1658939.1658955

Varvello, M., & Steiner, M. (2011). Traffic localization for DHT-based BitTorrent

networks. *International Conference on Research in Networking*, 40-53.

Wilkins, R., & Simco, G. (2013). Download Time Reduction Using Recent Performance-

Biased Peer Replacement In Stochastic P2P Content Delivery Networks. *2013*

*International Conference on Selected Topics in Mobile and Wireless Networking*

*(MoWNet)*, 86-91.

Xie, H., Yang, Y. R., Krishnamurthy, A., Liu, Y. G., & Silberschatz, A. (2008). P4P:

Provider Portal for Applications. Proceedings of the ACM SIGCOMM 2008

conference on Data Communication, 351-362.

Zuo, X., & Iamnitchi, A. (2016). A Survey of Socially Aware Peer-to-Peer Systems.

*ACM Computing Surveys* (CSUR), 49(1), 9.

**Certification of Authorship of Doctoral Course Assignment**

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Submitted to: Dr. Yair Levy

Student’s Name: Eric Webb

Date of Submission: November 27th, 2022

Purpose and Title of Submission: Assignment #2 Pre-Idea Paper “Defending Against Centralization via Asynchronicity.”

Certification of Authorship: I hereby certify that I am the author of this document and that any assistance I received in its preparation is fully acknowledged and disclosed in the document. I have also cited all sources from which I obtained data, ideas, or words that are copied directly or paraphrased in the document. Sources are properly credited according to accepted standards for professional publications. I also certify that this paper was prepared by me for this purpose.

Student's Signature: ERIC WEBB