Roberto Galea

Section B - Interim Report

Table of Content

Paper - 1 3
1.1 Outline of Research Methodologies 3
1.2 Academic Discourse 3
1.3 Implications 3
1.3 Explanations of Research Methodologies 4
1.4 Research Questions 4
Paper – 2 5
2.1 Outline of Methodology 5
2.2 Academic Discourse 5
2.3 Explanations of Research Methodology 5
2.4 Research questions 6
Paper - 3 7
3.1 Methodology 7
3.2 Objectives 7
3.3 Implications 7
3.4 Findings 7
3.5 Conclusions 8
Paper - 4 9
4.1 Methodology: 9
4.2 Objectives: 9
4.3 Implications: 9
4.4 Findings: 10
4.5 Conclusions: 10
Paper - 5 11
5.1 Methodology: 11
5.2 Objectives: 11
5.3 Implications: 11
5.4 Findings: 12
5.5 Conclusions: 12

Paper - 6 13
6.1 Methodology: 13
6.2 Objectives: 13
6.3 Implications: 13
6.4 Findings: 13
6.5 Conclusions 13
Paper - 7 14
7.1 Methodology 14
7.2 Objectives 14
7.3 Implications 14
7.4 Findings 14
7.5 Conclusions 15
Comparison and Contrast of Research Methodologies 15
Bibliography 16

Paper - 1

- **Paper Name: Caching in HTTP Adaptive Streaming: Friend or Foe?**
- **Author/s: Danny H. Lee, Constantine Dovrolis, Ali C. Begen**

1.1 Outline of Research Methodologies

In "*Caching in HTTP Adaptive Streaming: Friend or Foe?"* the authors adaptively controlled the rate at which the client was able to download video segments that stream from the cache (Lee, Dovrolis, & Begen, 2014). They could ensure that clients would receive a smooth video. The authors verified their results by utilizing simulation as well as demonstrated that in comparison with a standard cache. Their approach could perform four things. Firstly, it could lower bitrate oscillations. Secondly, it could prevent abrupt rate changes and in comparison to a non-cache event. Thirdly, it offered traffic savings. Finally, it promoted the quality of experience among the users.

1.2 Academic Discourse

The objective of the paper by Lee, Dovrolis, and Begen (2014) was to examine the interactions involved cache and client that lead to these problems and suggest an effective approach to solve it. The problem being the existence of the standard cache server within the video transfer path that may lead to bitrate oscillations as well as rapid changes for the Dynamic Adaptive Streaming over the HTTP (DASH) users.

1.3 Implications

The findings of the study established that oscillation often drains a playback buffer, leading to playback disruptions, specifically when users attempt to refill a certain buffer. The researchers introduced the ViSIC, which is the cache-based approach that utilizes shaping to get rid of oscillations (Lee, Dovrolis, & Begen, 2014). It was observed that ViSIC is responsible for maintaining cache server advantages such as lowering upstream traffic as well as serving segments within the range of high bandwidth.

1.3 Explanations of Research Methodologies

Lee, Dovrolis, and Begen (2014) developed the discrete-time simulator to validate their findings. The authors wrote the simulator in python and incorporated clients, caches, and servers, as well as described their behaviour. For their ViSIC evaluation, the authors implemented a network that has only a single origin server, client linked through variable bandwidths, and cache server. ViSIC and standard cache servers were examined.

1.4 Research Questions

The following research questions have been identified from the articles under review.

From Lee, Dovrolis, and Begen (2014):

a.). What are the interactions involved cache and client that lead to these problems?

b.). What is the approach to solving it?

Paper – 2

- **Paper Name: Cache Replacement Based on Distance to Origin Servers**
- **Author/s: Noriaki Kamiyama, Yuusuke Nakano, Kohei Shiomoto**

2.1 Outline of Methodology

In order to simplify the catching algorithm, the study divided the cache servers' storage capacity into various virtual caches as well as managed the contents of items individually based on a hop distance to the source of servers. The researchers applied numerical evaluation to demonstrate that the suggested method could reduce the average link-load by 10 percent in comparison to the normal LRU.

2.2 Academic Discourse

The objective of this research was to focus on lowering the traffic amount that is transmitted in networks as the influence of CDNs. The study suggested the cache-replacement policy based on hop distance to source servers (p.10). Based on the suggested method, the cache servers' storage capacity is separated into various virtual caches. The content items were individually managed based on hop distance to source servers. Further, the authors suggested a method effective to achieve optimal design of virtual cache capabilities which reduces the amount of expected reduction in the length of flow hop. The authors identified areas that would require future research, for example, the investigation of the impact of the suggested cache replacement method, specifically in the event of a dynamically varying content popularity.

2.3 Explanations of Research Methodology

The researchers conducted a numerical evaluation utilizing network topologies of six different ISPs within the United States to demonstrate that the suggested cache replacement can minimize the average link load (p.2). The expected reduction rate was anticipated to be higher than 10 percent in comparison with the three caching methods such as LRU, GreedyDual, as well as Greedy-Dual size.

2.4 Research questions

The following research questions were identified from the paper.

i. What the cache replacement method which can be used to promote the minimization impact on link load achieved by transmitting content from cache servers with the absence of complex operation at every replacement?

ii. What method can be created to optimally allocate the storage capacity within every virtual cache?

Paper - 3

- **Paper Name: Multi-Tier Caching Analysis in CDN-Based Over-the-Top Video Streaming Systems**
- **Author/s: Abubakr O. Al-Abbasi, Vaneet Aggarwal and Moo-Ryong Ra**

3.1 Methodology

The study optimized the probability of weighted-stall duration by factoring two-stage probabilistic scheduling for the selection of servers as well as parallel streams between the edge router and server (p. 12). Applying the two-stage scheduling probability as well as the mechanism of edge caching, characterization of upper-bound on the tail probability of stall duration was achieved. Besides, the optimization problem which reduces the tail probability of weighted-stall duration was designed over the selection of a two-stage probabilistic scheduling, edge-cache parameters, cache placement, in-bound auxiliary variables, and bandwidth allocation.

3.2 Objectives

The overall objective of this study was to analyze multi-tier caching in CDN-based over-the-top video streaming systems. The research aimed to investigate two-tiered caching within the video-streaming systems.

3.3 Implications

The study proposed a crucial framework for examining CDN-based over-the-top video streaming systems by utilizing multiple caching tiers as well as multiple parallel streams that exist within nodes (p.2). It further proposes a two-stage probabilistic scheduling policy to assign every client request to various cache servers as well as parallel video streams.

3.4 Findings

The study found that the implementation of a virtualized-cloud system controlled by OpenStack showed that the suggested algorithm could substantially improve the SDTP metric in comparison to baseline strategies.

3.5 Conclusions

The study concluded that the application of two-stage probabilistic scheduling, as well as edge caching mechanism, enhances the characterization of upper bound linked to the tail probability of stall duration. Moreover, it suggests the incorporation of an efficient algorithm to help in solving the problem of optimization as well as experiment outcomes on Openstack's managed virtual cloud system.

Paper - 4

- **Paper Name: A Survey on Bitrate Adaptation Schemes for Streaming Media Over HTTP**
- **Author/s: Abdelhak Bentaleb, Bayan Taani, Ali C. Begen, Christian Timmerer and Roger Zimmermann**

4.1 Methodology:

The study adopted a survey to give an overview of various methods suggested over the past years. The researchers categorized the schemes into 3 different categories, comprising client-side, in-network, and server-side approaches (p.564). The authors gave a general review regarding the measurement methods of video traffic as well as a series of characterization studies for famous providers of commercial streaming such as Netflix, Akamai, and You-Tube.

4.2 Objectives:

The overall objective of this study was to survey on Bitrate Adaptation Schemes for Streaming Media Over HTTP. The survey aimed to provide more effective bitrate adaptation algorithms for HTTP adaptive streaming (HAS). The objective of incorporating the algorithms is to enhance the high quality of experience (QoE) for clients in the existence of bandwidth fluctuations because of factors such as signal strength, network re-convergence events, as well as network congestion.

4.3 Implications:

The survey findings show that the nature of HAS design standards does not give room for a specific adaptation algorithm. The feature creates room for system builders to innovatively design as well as implement their preferred methods. The study compared surveyed schemes in the areas of a series of QoE as well as networking attributes (p.580). The comparison would help researchers in the field of adaptive streaming where it provides a consistent framework which may formally investigate and compare various bitrate adaptation logics as well as test efficiency of their elements.

4.4 Findings:

The study found that client-based schemes probably suffer HAS stability concerns and QoE variations because of the ON-OFF patterns of HAS (p.580). Further, server-based schemes come with an overhead as well as complexity, curtailing the scalability of the system with the growing clients.

4.5 Conclusions:

The study concluded that the schemes surveyed could do well under different conditions. However, all of them utilize different heuristics which broadly link to certain specific settings.

Paper - 5

- **Paper Name: Bitrate Adaptation-aware Cache Partitioning for Video Streaming over Information-Centric Networks**
- **Author/s: Wenjie Li, Sharief M.A. Oteafy, Marwan Fayed and Hossam S. Hassanei**n

5.1 Methodology:

The study introduced the scheme for dissecting the capacity of cache routers along the forwarding path as per the dedicated bitrates. The authors facilitated the partitioning by introducing RippleCache that stabilizes the fluctuations of bandwidth while attaining high cache usage through the safeguard of high-bitrate content within the edge as well as pushing content of low-bitrate within the core of the network. The researchers developed, implemented, and assessed cache streams that promote user quality of experience (QoE) by lowering bit oscillations. It initially conducted exploratory experiments to facilitate the understanding of the effect of cache placement within the adaptive streaming.

5.2 Objectives:

The overall objective of this study was to investigate the "Bitrate Adaptation-aware Cache Partitioning for Video Streaming over Information-Centric Networks." The aim was to develop, implement, and examine cache streams that promote user quality of experience (QoE) by minimizing bit oscillations.

5.3 Implications:

The authors conducted exploratory experiments on the current caching schemes to establish the cache distribution within adaptive streaming. The observation would also cover the interplay that exists in caches in line with the forwarding path that stimulates the idea of integration of caches with cache path. The RippleCache concept would act as the guiding principle towards the partitioning of cache adaptation-aware.

5.4 Findings:

The experimentation with RippleFinder established that bitrate adaptation algorithms operational mandate significantly influences caching schemes of in-networks (p. 7).

5.5 Conclusions:

The study concluded that results obtained are crucial to provide the foundation for caching schemes which interact with the choice of bitrate algorithms as well as containing the dependency in the adaptation control as well as caching through network forecast for the pattern of future request.

Paper - 6

- **Paper Name: A New Fragmentation Strategy for Video of HTTP Live Streaming**
- **Author/s: Xiaorui Li, Lei Wang, Jingwu Cui, Baoyu Zheng**

6.1 Methodology:

The authors developed projects within eclipse to analyze three strategies, including equal time fragmentation, two-layer fragmentation, and three-tier fragmentation strategies (p.87). The study contrasted the four performances against each other, specifically on the percentage of data padding, time taken to identify one block, video reception as well as video split time, and time to download a running video on the project.

6.2 Objectives:

The objective of this study is to explore a "new fragmentation strategy for video of HTTP live streaming". The exploration of the unfiled fragmentation approaches was conducted to ascertain the better performance method for different live video streaming environments.

6.3 Implications:

The study recommended the unfiled fragmentation method for HLS video as well as big files within the P2P-based system of IPTV. The fragmentation strategy is deemed crucial because it shows the features of P2P better and enhances datum on peer download better as well as efficient.

6.4 Findings:

The study tests identified that both BT and three-tier strategy were almost the same. However, the fragmentation strategy regarding equal time never applies to HLS video.

6.5 Conclusions

The study concluded that the three-tier strategy exhibit better performance within poor network settings (p.80). Hence, the three-tier fragmentation strategy is entirely a better approach compared to other fragmentation approaches.

Paper - 7

- **Paper Name: A Cache Replacement Method for Crowded Streaming Cache Servers Responding to Rapidly Changing Access Patterns**
- **Author/s: Toru Osuga, Takayoshi Asakura, and Kunihiro Taniguchi**

7.1 Methodology

The study evaluated the influence of cache servers by performing different metrics, including average link-load, average delivery flows of hop length, the load source servers, and cache hit ratio.

7.2 Objectives

The overall aim of this study was to investigate a "Cache Replacement Method for Crowded Streaming Cache Servers Responding to Rapidly Changing Access Patterns." The authors focused on lowering the magnitude of traffic transmitted in the networks as the influence of CDNs.

7.3 Implications

The authors recommended the introduction of a new strategy of replacing known as SELC to minimize the extreme lingering issue (p.1154). SEC effectively replaces the lingering caches to enable a design to evict them as well as bar content that holds similar access frequency from unnecessary replacement.

7.4 Findings

The findings obtained from the study showed that simulation depicted SELC could result in a higher cache ratio than or equivalent to certain conventional methods (p.1155). It was found that the influence of minimizing the traffic load on the network links through the transmission of content items that come from caches are highly dependent on the source distance from the server to clients. Nonetheless, most available methods fail to consider the source distance. Minimization of the link load from caches requires a cache-replacement policy driven by hop distance to the source servers.

7.5 Conclusions

The study concluded that the reduction of the magnitude of traffic transmitted in the networks as the influence of CDNs. In this regard, the authors recommended a policy based on the cache-replacement on hop distance to source servers.

Comparison and Contrast of Research Methodologies

The survey completed on “Bitrate Adaptation Schemes for Streaming Media Over HTTP” differed with others on the basis of its classification. The authors (p.564) concentrated on two major aspects, which comprised the structured scheme categorization on the basis of unique attributes of logic adaptations. The study also focused on a more detailed comparison. However, this was a qualitative study with limited mathematical tests as compared to the other studies which borrowed much from the quantitative aspects.

Bibliography

Lee, D.H., Dovrolis, C. and Begen, A.C., 2014, March. Caching in HTTP adaptive streaming: Friend or foe? In *Proceedings of Network and Operating System Support on Digital Audio and Video Workshop* A.C.M.

Kamiyama, N., Nakano, Y. and Shiomoto, K., 2016. Cache replacement based on the distance to origin servers. *IEEE Transactions on Network and Service Management*

Al-Abbasi, A., Aggarwal, V. and Ra, M. (2019). Multi-Tier Caching Analysis in CDN-Based Over-the-Top Video Streaming Systems. IEEE/ACM Transactions on Networking

Bentaleb, A., Taani, B., Begen, A.C., Timmerer, C. and Zimmermann, R., 2018. A survey on bit-rate adaptation schemes for streaming media over HTTP. *IEEE Communications Surveys & Tutorials*

Li, W., Sharief, O., Fayed, M. and Hassanein, H.S., 2018, October. Bit-rate adaptation-aware cache partitioning for video streaming over Information-centric Networks. In *2018 IEEE 43rd Conference on Local Computer Networks (L.C. N)* IEEE

Li, X., Wang, L., Cui, J. and Zheng, B., 2016, December. A New Fragmentation Strategy for Video of HTTP Live Streaming. In *2016 12th International Conference on Mobile Ad- Hoc and Sensor Networks (M.S.N.)* IEEE

Osuga, T., Asakura, T. and Taniguchi, K., 2013, March. A Cache Replacement Method for Crowded Streaming Cache Servers Responding to Rapidly Changing Access Patterns. In *2013 IEEE 27th International Conference on Advanced Information Networking and Applications (A.I.N.A.)* IEEE.