# PERFORMANCE EVALUATION OF CACHING PLACEMENT ALGORITHMS IN NAMED DATA NETWORK FOR VIDEO ON DEMAND SERVICE

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**2016**

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# Abstrak

Tujuan kajian ini adalah untuk menilai prestasi algoritma penempatan caching (LCD, LCE, Prob, Pprob, Cross, Centrality, dan Rand) dalam 'Named Data Network' (NDN) untuk 'Video-on-Demand' (VoD) untuk meningkatkan kualiti dan akses kelewatan perkhidmatan yang disebabkanb oleh kekerapan muat turun yang rendah. Tambahan pula, masalah trafik video berat melambatkan prestasi VoD dalam kes skala besar 'Content- Centric Networks' (CCN). Dua peringkat aktiviti yang mengakibatkan hasil kajian: Yang pertama adalah dengan memeriksa aktiviti penyelidikan eksperimen untuk menentukan punca prestasi kelewatan dalam algoritma cache NDN yang digunakan dalam beban kerja VoD. Aktiviti kedua ialah pelaksanaan tujuh algoritma penempatan cache pada kandungan 'CloudTV' dari segi metrik prestasi utama (masa tunda, nisbah hit purata, jumlah pengurangan jejak rangkaian, dan pengurangan beban). Simulator NS3 dan topologi Internet digunakan untuk menilai dan menganalisis hasil setiap algoritma, dan untuk membandingkan keputusan berdasarkan saiz cache (1GB, 10GB, 100GB, 1TB). Oleh itu, kajian ini membuktikan bahawa pertamanya, sebab utama kelewatan disebabkan oleh lalu lintas video dengan permintaan pengguna yang berbeza. Selain peningkatan pesat dalam permintaan pengguna untuk video dalam talian, kapasiti simpanan juga akan meningkat dan seterusnya membuat replikasi data penyimpanan keseluruhan yang hampir tidak kelihatan. Kedua, hasil kajian membuktikan bahawa peningkatan kapasiti cache menyebabkan rangsangan ketara dalam nisbah purata hit, pengurangan dalam beban pelayan, dan pengurangan dalam jejak rangkaian, yang mengakibatkan mengurangkan masa tunda. Ketiga, berdasarkan keputusan yang diperolehi, didapati bahawa kepusatan secara algoritma penempatan cache tidak memuaskan, kerana ia menghasilkan nilai yang paling teruk dalam purata nisbah hit cache dan dalam jumlah pengurangan jejak rangkaian. Di samping itu, untuk video dalam talian, kapasiti simpanan juga akan meningkat dan seterusnya membuat replikasi data penyimpanan keseluruhan yang hampir tidak dapat dikesan. Selain itu, maklum balas yang berterusan kepada permintaan video pengguna dalam talian meningkatkan trafik video dan prestasi perkhidmatan VoD yang dipaparkan serta menjejaskan kandungan caching dalam router.

**Kata kunci:** Caching Placement Algorithms, Named Data Network (NDN), Video-on- Demand (VoD), Content-Centric Networks (CCN).

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# Abstract

The purpose of this study is to evaluate the performance of caching placement algorithms (LCD, LCE, Prob, Pprob, Cross, Centrality, and Rand) in Named Data Network (NDN) for Video on Demand (VoD). This study aims to increment the service quality and to decrement the time of download. There are two stages of activities resulted in the outcome of the study: The first is to determine the causes of delay performance in NDN cache algorithms used in VoD workload. The second activity is the evaluation of the seven cache placement algorithms on the cloud of video content in terms of the key performance metrics: delay time, average cache hit ratio, total reduction in the network footprint, and reduction in load. The NS3 simulations and the Internet2 topology were used to evaluate and analyze the findings of each algorithm, and to compare the results based on cache sizes: 1GB, 10GB, 100GB, and 1TB. This study proves that the different user requests of online videos would lead to delay in network performance. In addition to that the delay also caused by the high increment of video requests. Also, the outcomes led to conclude that the increase in cache capacity leads to make the placement algorithms have a significant increase in the average cache hit ratio, a reduction in server load, and the total reduction in network footprint, which resulted in obtaining a minimized delay time. In addition to that, a conclusion was made that Centrality is the worst cache placement algorithm based on the results obtained.



**Keywords**: Caching Placement Algorithms, Named Data Network (NDN), Video on Demand (VoD), Content Centric Networks (CCN).



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# Acknowledgements

In the name of Allah the Merciful Allah is the Light of the heavens and the earth. The example of His light is like a niche within which is a lamp, the lamp is within glass, the glass as if it were a pearly [white] star lit from [the oil of] a blessed olive tree, neither of the east nor of the west, whose oil would almost glow even if untouched by fire. Light upon light. Allah guides to His light whom He wills. And Allah presents examples for the people, and Allah is Knowing of all things. Surat Al-Nur / A-35

Firstly, for Allah, Alhamdulillah. My deepest gratitude is consecrated to my supervisors: Dr. Ahmad Suki Che Mohamed Arif and Dr. Adib Habbal, for their continuous guidance, fruitful feedback, moral support, and sharing of all their research experiences throughout these challenging years. They have eagerly provided a surplus of advices and constructive comments as well as optimism and encouragement at times when things were not looking sunny. Their detailed and constructive comments have helped me to better shape my research ideas.

Besides them, my gratitude to all my colleagues (School of Computing, Universiti Utara Malaysia) in the Master journey, among them is Professor Dr. Suhaidi Hassan, Dr. Mohd. Hasbullah Omar, Dr. Shahrudin Awang Nor, Dr. Mohammed K.M. Madi, Dr. Norliza Katuk, and Dr. Rohaida Romli, Dr. Massudi Mahmuddin, Dr. Nur Haryani Zakaria, and many others, specifically for the discussions on the best ways to perform research, to construct the research objectives and title, etc. They were not only contributing constructive ideas in my research work, but some of them have also read parts of my dissertation.

Finally, my heartiest gratitude goes to my family, to whom I give them my succesful as a gift, to my father late and to my soul (my mother), to my husband parents lates, to whom that they support me and suffer with me my respected husband (Msc. Sadaq Jebur), and deepest thanks to my intelligents sons (Jaafer and Osamah), and my nice and my lovely daughter (Tabarak), to who always believes me and prays for my successful and who are willing to extend a hand help, especially to my second father (The

Universiti Utara Malaysia

Engineer Tareq Saleem), to my friendly brother (Dr. Ahmed Saleem), to my lovely and my faithful sister (The Engineer Aula Saleem), and to my honest friends. Lastly, for Allah, Alhamdulillah.

Universiti Utara Malaysia

# Table of Contents



Universiti Utara Malaysia

Universiti Utara Malaysia

Universiti Utara Malaysia

# List of Tables




Universiti Utara Malaysia

# List of Figures



Universiti Utara Malaysia

Universiti Utara Malaysia

# List of Abbreviations

| | | |
|---|---|---|
| ABR | - | Adaptive Bit Rate |
| ADSL | - | Asymmetric Digital Subscriber Line |
| CCN | - | Content-Centric Networks |
| CDN | - | Content Delivery Network |
| CR | - | Content Router |
| CS | - | Content Store |
| FIB | - | Forwarding Information Base |
| HTTP | - | Hypertext Transfer Protocol |
| ICN | - | Information Centric Network |
| ID | - | IDentity |
| IP | - | Internet Protocol |
| IPTV | - | Internet Protocol Television |
| ISP | - | Internet Service Provider |
| LCD | - | Leave Copy Down |
| LCE | - | Leave Copy Everywhere |
| NAT | - | Network Address Translation |
| NDN | - | Named Data Networking |
| NS3 | - | Network Simulation version 3 |
| P2P | - | Peer-to-Peer |
| PC | - | Personal Computer |
| PIT | - | Pending Interest Table |
| Pprob | - | Path Probabilistic cache |
| Prob | - | Probabilistic cache |
| Rand | - | Random choice caching |
| RRT | - | Round Trip Time |
| TCP | - | Transmission Control Protocol |

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| | | |
|---|---|---|
| UCLA | - | University of California, Los Angeles |
| URL | - | Uniform Resource Locator |
| US | - | United State |
| VBR | - | Variable Bit Rate |
| VoD | - | Video on Demand |

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# CHAPTER ONE
# INTRODUCTION

This chapter provides an overview of the this research, including a background of the study, brief introduction of Named Data Networking (NDN) and its placement algorithms, and the online Video on Demand (VoD) architecture. The chapter also contains the research problem, research questions, and the research objectives. This will be followed by a brief explanation of the scope and significance of this research.

## 1.1 Background of the Study

The huge growth of the Internet has revolutionized the communication paradigms which include Named Data Networking (NDN), and an online video storage. The Internet Video on Demand (VoD) services use the existing and common Internet video architectures, such as HTTP and TCP [1, 2]. These are commonly used in YouTube, Vudu, and Netflix, due to their ability to stream video services to the third party commercial Content Delivery Networks or Content Distribution Networks (CDNs). The study of Psaras et al. [3] stressed that streaming of video over the Internet using HTTP has a lot of advantages: it is standardized across CDNs for portable video streaming service, it is universally accessible (CDNs had already made sure their service can reach through Network Address Translations (NATs) to end-hosts), and it is cheap (the service is simple, commoditized, and the CDNs competes on price). These benefits have made possible that the huge growth gives reasonable cost, high-quality movie and TV streaming, for the viewers' enjoyment [4].

The architecture of most commercial video streaming services is illustrated in Figure 1.1.

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The contents of the thesis is for internal user only

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