UNIVERSITÀ
DI PAVIA

EDI: Third/Fourth Lab Report

D. Ligari 518592[1]

[1] *University of Pavia, Department of Computer Engineering (Data Science), Pavia, Italy*
Contact: davide.ligari01@universitadipavia.it
Date: May 26, 2023

Abstract— This report examines the impact of web technologies on Page Load Times (PLTs) for commercial and institutional websites. It analyzes parallel connections, caching policies, and performance evaluation tools. The findings highlight the significance of parallel connections, the effects of caching policies on PLTs, and provide insights for optimizing website performance. The report also evaluates website performance under different conditions and explores the role of warm-up time.

Keywords—Web technologies • Performance • Web cache policies • HTTP • PLT • Apache HTTP server benchmarking tool • h2load

CONTENTS

1. WEB TECHNOLOGIES

In today's digital landscape, web technologies play a pivotal role in determining the performance and overall user experience of modern websites. As the internet continues to evolve and user expectations rise, it becomes increasingly crucial to understand the profound impact that these technologies have on Page Load Times (PLTs) for commercial and institutional websites.
This report aims to delve into various aspects of web technologies, exploring their effects on PLTs and providing valuable insights to optimize website performance.

a. Impact of parallel connections on PLTs

Analyze and discuss the impacts of the number of parallel connections set inside the browser on the Page Load Times of commercial/institutional websites. Did you notice any expected or unexpected behavior?

The impact of increasing the number of connections on page loading time is evident and consistent, as depicted in Figure 1. Experimental results clearly demonstrate that as the number of connections increases, the loading time consistently decreases, showcasing the advantage of parallel downloading. This effect can be attributed to the browser's ability to simultaneously download multiple files, resulting in an overall improvement in download speed.
However, it's important to note that the relationship between the number of connections and loading time is influenced by the size of the webpage. For smaller page sizes, exemplified by the website *www.pedranzini.it/*, the loading time remains relatively consistent regardless of the number of connections. This suggests that the page can be efficiently loaded with a limited number of connections due to its compact size. The downloading process for such pages is optimized, and further increasing the number of connections does not significantly impact the loading time.
Conversely, for larger page sizes, such as the case of *www.vallespluga.it/*, the loading time exhibits a significant decrease as the number of connections increases. This indicates that the page benefits from parallel connections to efficiently download its extensive content. As the page size increases, the impact of parallel connections on reducing loading time becomes more pronounced.
To provide additional context, the table below presents the websites used for the analysis, along with their respective characteristics.

Website	Page size(KB)	Cache policy	HTTP version	HTTPS
www.pedranzini.it/	180.40	Validation	1.1	Not supported
www.unica.it/	2570	Validation	1.1	Supported
www.uniss.it/	2540	Validation • Expiration	1.1	Supported
www.vallespluga.it/	20120	Validation	1.1	Supported

Table 1: Website used for the analysis

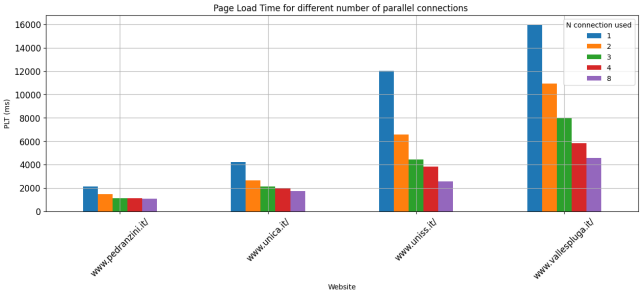

Fig. 1: Page load time vs number of concurrent connections for different sites

b. Impact of caching policies on PLTs

Analyze and discuss the impacts of caching policies implemented by different commercial/institutional websites on the Page Load Times. Consider websites that support HTTP/1.1, HTTP/2 and HTTP/3 (possibly with unsecure and secure connections). Did you notice any expected or unexpected behavior?

To provide a comprehensive answer, an extensive analysis was conducted on multiple websites with varying characteristics, which are shown Table 2. To ensure thorough testing, sites that supported multiple versions of the HTTP protocol were evaluated with each version.
Upon examining the results displayed in Figure 2, a notable observation is that websites supporting HTTP/2 or HTTP/3 exhibit faster loading times compared to those supporting only HTTP/1.1, regardless of the cache policy implemented. This observation underscores the performance benefits of newer versions of the HTTP protocol.
Furthermore, the analysis also shed light on the impact of different cache policies. Websites that support both validation and expiration cache policies were found to have shorter loading times compared to those supporting only the validation policy. This outcome can be attributed to the combined advantages of validating cached content and leveraging expiration times to minimize requests to the server. Conversely, websites without any caching mechanism displayed higher Page Load Times (PLTs), emphasizing the importance of effective caching in optimizing web performance.

Website	Page size(KB)	Cache policy	HTTP version	HTTPS
www.pedranzini.it/	180.40	Validation	1.1	Not supported
www.unica.it/	2570	Validation	1.1	Supported
www.uniss.it/	2540	Validation • Expiration	1.1	Supported
www.vallespluga.it/	20120	Validation	1.1	Supported
www.istat.it/	11200	Validation	1.1	Supported
www.unina.it/	2210	Validation	1.1	Supported
www.apache.org/	2010	Validation • Expiration	3	Supported
www.studiocamer.com/	3340	Validation • Expiration	2 • 3	Supported
www.off—white.com/	6790	Validation	1.1 • 2 • 3	Supported
www.google.com	2350	Validation • Expiration	1.1 • 2 • 3	Supported

Table 2: Website used for the analysis

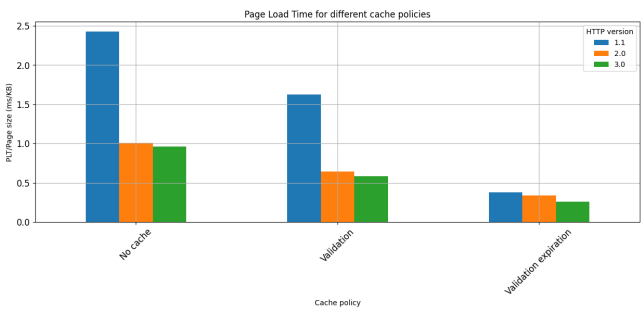

Fig. 2: Page load time over page size for different cache policies for different HTTP versions

c. Performance analisys using Apache HTTP server benchmarking tool

Analyze and discuss the performance of different commercial/institutional websites obtained under different conditions using the ab – Apache HTTP server benchmarking tool. Did you notice any expected or unexpected behavior?

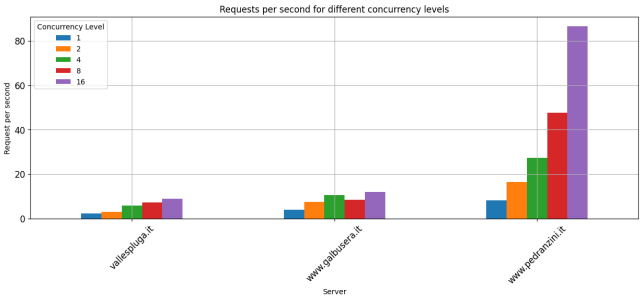

Fig. 3: Number of request per second for different number of concurrent connections for different sites

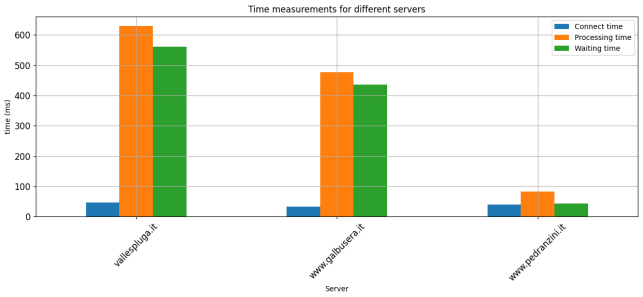

Fig. 4: Time spent for the connection, for processing and for waiting for different sites

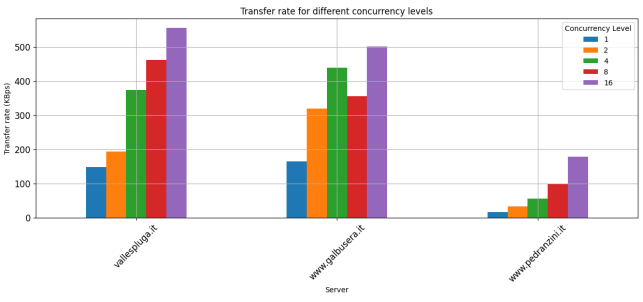

Fig. 5: Transfer rate for different number of concurrent connections for different sites

d. Performance analisys using h2load

Analyze and discuss the performance of different commercial/institutional websites obtained under different conditions using the nghttp and h2load tools. In the experiments with h2load analyze the role of the warm-up time. Did you notice any expected or unexpected behavior?

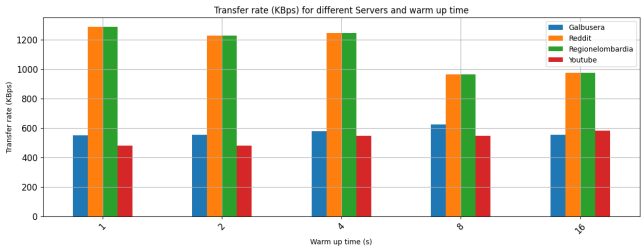

Fig. 6: Transfer rate for different warm up time for different sites

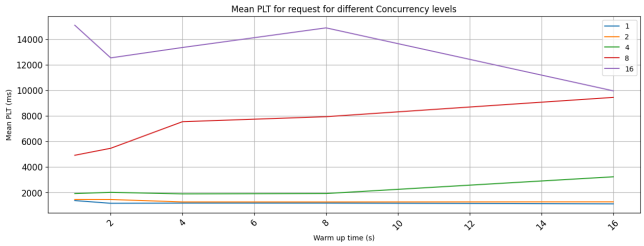

Fig. 7: mean time for different warm up time for different concurrent connections

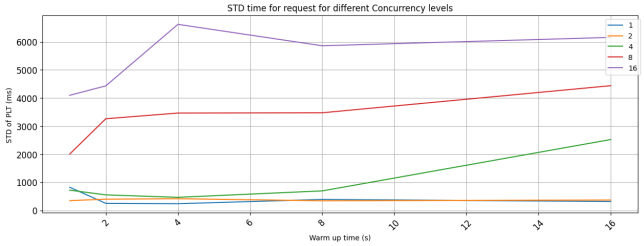

Fig. 8: Standard deviation for different warm up time for different concurrent connections

2. CONCLUSIONS