TECHNICAL SCIENCES

RESEARCH ON WEB PAGE LOADING OPTIMIZATION AND ITS IMPACT ON USER EXPERIENCE

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Abstract
At present, the loading speed of websites plays a pivotal role for users who expect instant results. More than half of the visitors close a web page if it takes longer than three seconds to load. This negatively impacts the user experience and leads to a decrease in a site's positions in search engine results. In this article, we will explore the significance of rapid website loading for users and search engines, present key optimization methods, and assess the impact of loading speed on conversion and search engine rankings. We will also discuss the factors influencing site loading speed and provide approaches to enhance loading speed and improve the user experience.

Keywords: website loading speed, conversion, indexing, ranking, website optimization, website performance.

Introduction

Modern search engines have become more complex and intelligent. They no longer assess web resources solely based on quantitative metrics, such as link mass or keyword frequency. Instead, website loading speed has become a key factor for optimizing user experience and achieving better positions in search engine results.

Contemporary internet users exhibit impatience when it comes to slow website loading and are prone to leaving a page if it takes longer than their expectations. This has a negative impact on both customer satisfaction and the ranking of the web resource in search engines. Therefore, optimizing website loading speed has become an integral part of the work of webmasters and site owners [1].

The Impact of Website Loading Speed

The loading speed of a website exerts a substantial impact on various aspects of its operation. In this section, we will examine the key areas in which the site loading speed holds significant importance [2].

Indexing

Indexing is the process of including information about a website in a search engine's database. Search engine robots systematically scan web pages, analyze their content, and incorporate them into search results. For website owners, it is crucial that their site is accessible to users and recognized by search engines. However, fast indexing is impossible without optimizing the site's loading speed.

The speed of indexing depends on various factors, including the presence of a correct robots.txt file and the absence of errors in the website's code. Effective optimization for mobile devices also influences indexing speed. High-performance and mobile-optimized web resources have an advantage, as they get indexed more quickly and, as a result, achieve higher positions in search engine rankings.

Ranking

Modern search engines aim to enhance the quality of internet services they provide, and one of the key aspects is the loading speed of web pages. Fast loading is especially crucial for mobile device users, where waiting is absent in the virtual realm.

Google has officially declared that site loading delays can lead to a decrease in their ranking system [3]. While other major search engines prefer not to make official statements, experts concur that speed is a significant factor in the ranking of web resources.

Conversion

A study conducted by Koli Lafran, the editor of Unbounce, in 2019, revealed the impact of page loading speed on conversion rates [4]. Approximately 70% of users acknowledged that the website loading speed influences the likelihood of making a purchase, and this is a factor that affects their decision. While 19% of marketers might perceive this effect as insignificant, Lafran's research confirms that delays in webpage loading have a negative impact on users' readiness to perform desired actions, such as watching videos, reviewing content, or making purchases.

Consequently, website loading speed exerts a significant influence on the processes of indexing, ranking, and conversion of web resources, underscoring its importance for a successful online presence [5].

What loading speed should be considered the norm?

The site loading standards:
- 1-3 seconds — good;
- 4-7 — acceptable, but optimization is recommended;
- 8-11 — very poor, users leave the site.

If a website neglects page load speed, up to 60% of users will start to leave (if the loading time exceeds three seconds).

Analysis of your website's performance

Website optimization places significant emphasis on page loading speed. There are tools available to measure a website's speed and performance. What metrics should one focus on? The optimal website loading time is 2-3 seconds; beyond this, users move on to the next site in their search. How can you check your website's speed? Here are a few tools that can help with that.

GTMetrix

An online tool for assessing web page performance. It provides an analysis of page loading speed and other key parameters that influence user experience. GTMetrix employs PageSpeed and YSlow algorithms in its operation to determine the site's structure and factors affecting its speed. This tool offers a comprehensive performance report, including page load time, request count, page weight, and optimization recommendations (Fig. 1).
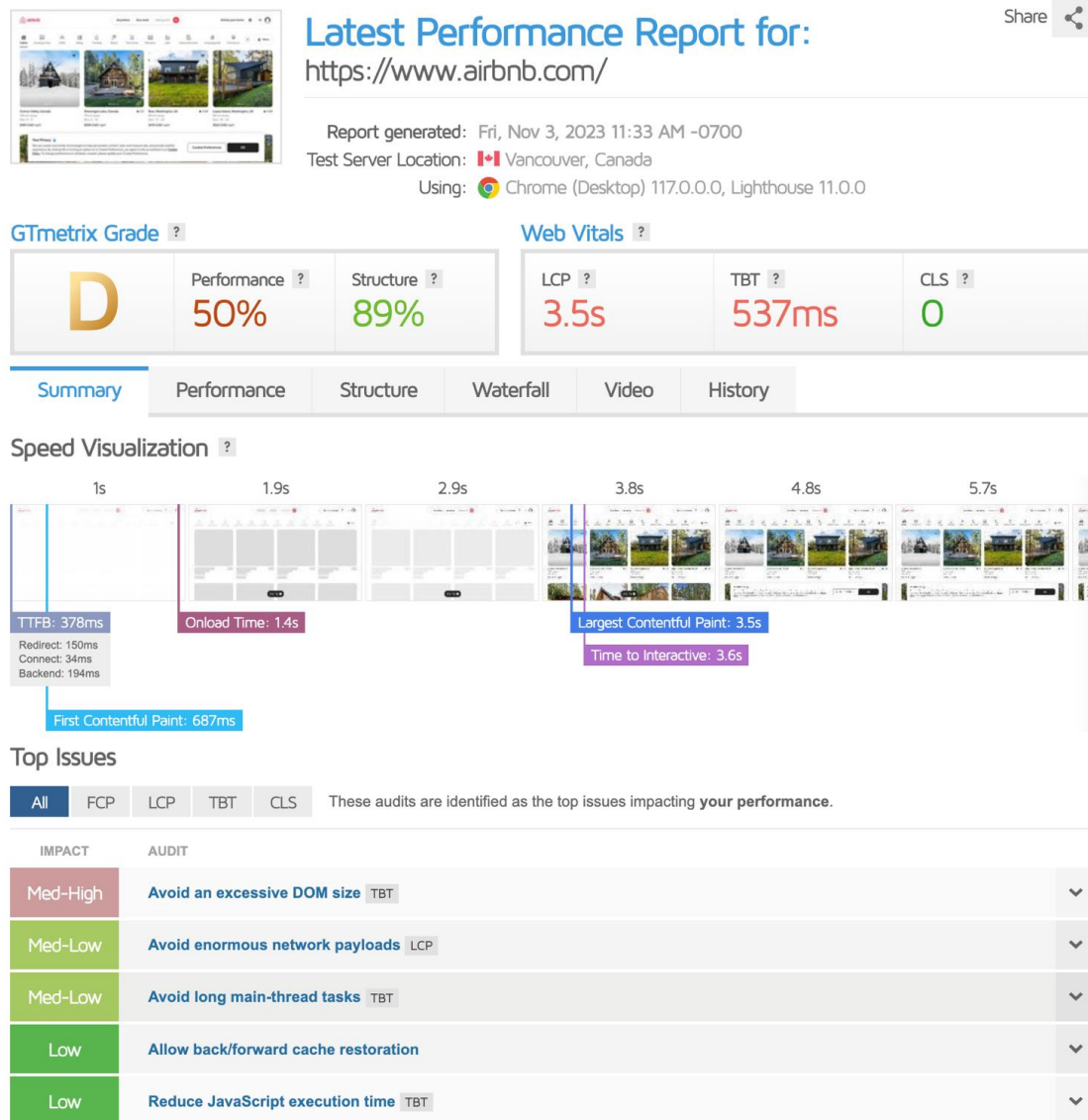

Fig.1. Performance report from GTMetrix.

Users can input their website's URL, and GTMetrix analyzes its performance, providing an assessment and recommendations for improving loading speed. Key parameters to focus on include page load time, loading speed, the number of requests, page weight, and PageSpeed and YSlow scores. Recommendations may encompass caching, image optimization, the utilization of compression, and other methods to enhance web page performance.

GTMetrix allows website owners to assess and optimize their websites to enhance user experience and speed up page loading. This tool is valuable for identifying factors influencing web page performance and provides recommendations for addressing them.

Pingdom Tools

The service provided by Pingdom AB allows measuring website performance and tracking its availability. This tool enables checking the speed of a website's operation from various servers located in different parts of the world. It provides detailed reports on the loading time of each element of a web page, such as images, CSS styles, JavaScript scripts, and other resources. It displays server response time and the total page size. These data will help identify areas of concern and determine which components of the page take more time to load (Fig. 2).
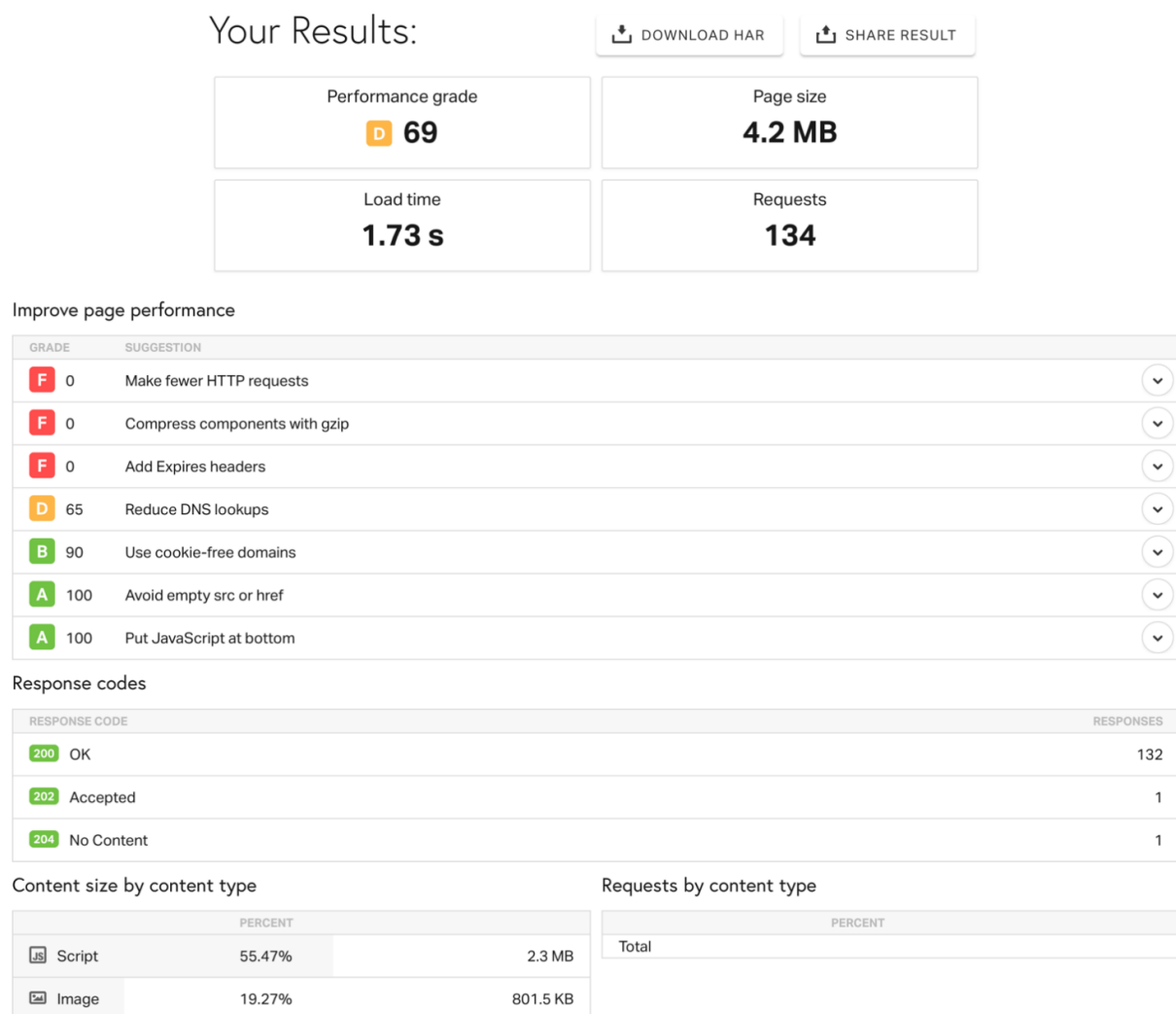
Fig. 2. Pingdom Tools report.

First, the user needs to enter the page's address into the input field and select the region from which requests to the website will be made. After that, you can proceed with the analysis.

The outcome will be a score assessment and a quality category ranging from A to F, where A represents the best result. Additionally, in the list of primary parameters, the system displays page size, loading speed, and the number of connection requests tested.

Next is the section 'Improve page performance,' in which clear recommendations will be provided for enhancing the page content from a code perspective, necessary for optimizing loading speed.

After testing, the Response Code 200, which is the response code of the page, is followed by a section indicating the weight of website elements by categories.

- scripts
- HTML
- fonts
- images
- CSS

There is also a table with the sizes of various categories of loaded pages and the number of interactions with content categories.

In conclusion, the user is introduced to the loading sequence of elements in the form of a diagram, where the loading time of each element is marked in seconds in chronological order.

Visual information, combined with detailed recommendations, makes the service one of the most valuable tools for analyzing website loading speed and improving performance.

WebPageTest

The launch occurs after specifying the page address, inputting geolocation, and selecting a browser.

An instrument for professional web analysts, developers, and optimizers. It provides detailed information on numerous specific metrics, among which page loading time and the number of requests are the least significant and amateurish.

The primary analytical tools are diagrams that display the sequence of loading all elements with a breakdown into stages. At a certain point, a purple vertical line is placed, representing the moment of complete rendering of the website. Subsequently, a blue line indicates the final loading. Their positions should not exceed the 2-3 second mark, respectively. These metrics are somewhat arbitrary and serve as a precaution against extreme cases. In general, it is advisable to minimize both of these times (Fig. 3).
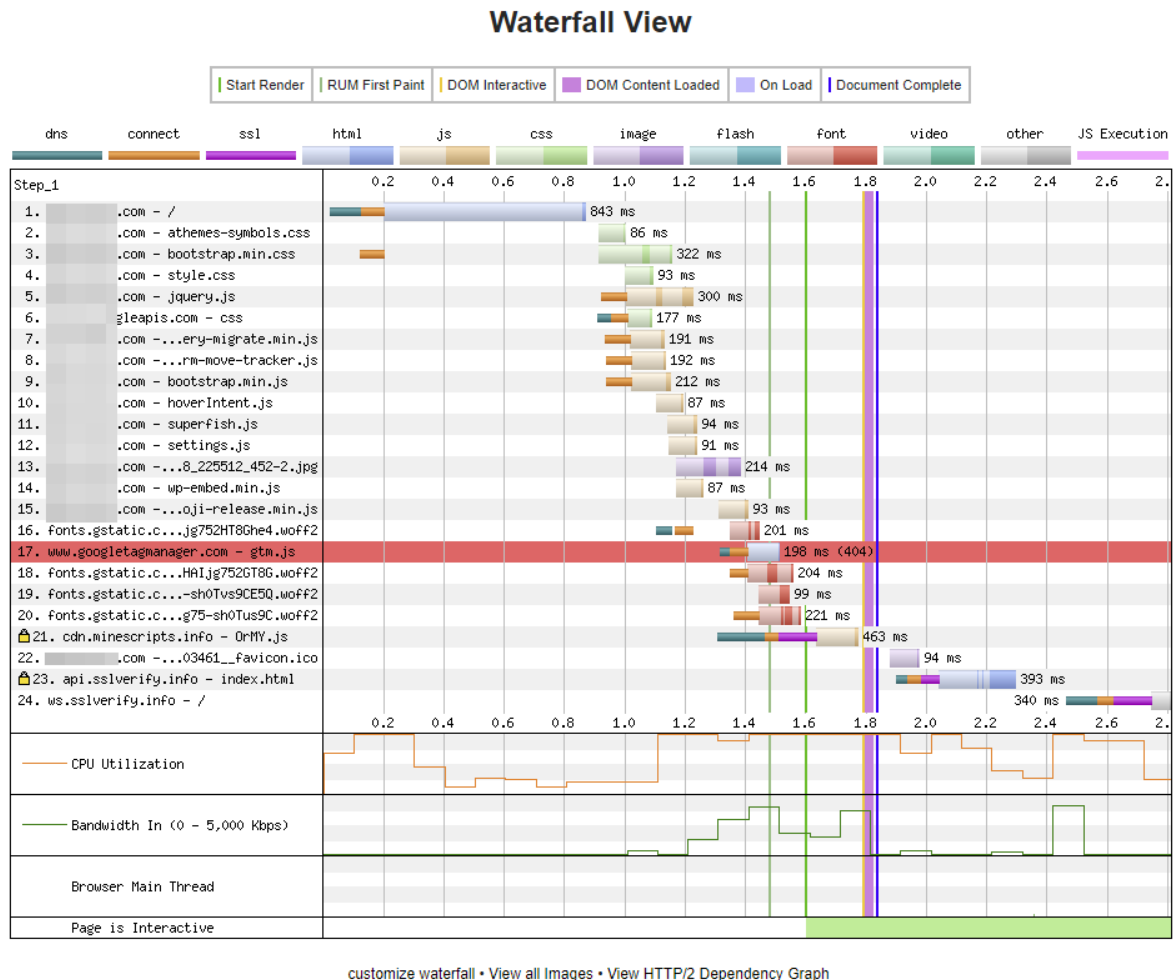
Fig.3. WebPageTest waterfall report.

A detailed analysis is provided for all queries, allowing us to examine the loading patterns dynamically rather than relying on averages. This approach helps us discern which queries reflect the real state of affairs and which ones deviate from the overall trend.

Other tools

We have listed the most sought-after and professional tools that yield the maximum benefit from their use. However, there are similar services, each with its own merits and drawbacks, which may pique the interest of users, such as Load Impact, PR-CY, and Monitis Tools.

Key Principles of Website Loading Optimization

1. Improving Server Performance
- *Content Caching:* Implementing caching mechanisms helps conserve resources and accelerate page loading by pre-storing content and reusing it.
- *Resource Compression:* Implementing data compression techniques, such as Gzip, enables the reduction of file sizes and shortens the data transfer time between the server and the client.
- *Minimizing HTTP Requests:* Reducing the number of HTTP requests, for instance, by consolidating CSS and JavaScript files or using sprites, helps accelerate page loading [6].

2. Image Optimization
- *Image Compression:* The use of image compression, both lossless and lossy, allows reducing file sizes without significant loss of quality.
- *Image Formats:* Selecting the optimal image format, such as JPEG, PNG, or WebP, based on the image type and desired quality.
- *Lazy Image Loading:* Implementing lazy loading technique allows deferring the loading of images until they become visible to the user [7].

3. Minimization and Concatenation of CSS and JavaScript
- *Removing Unused Code:* Eliminating unused CSS and JavaScript helps reduce file sizes and enhance loading performance.
- *Reducing the Size of CSS and JavaScript Files:* Applying compression and optimizing CSS and JavaScript code allows for a reduction in their size and speeds up their loading.
- *Merging Files to Reduce HTTP Requests:* Combining multiple CSS and JavaScript files into one enables a reduction in the number of HTTP requests and accelerates page loading.

4. Utilizing a Content Delivery Network (CDN)
- *Benefits of Using CDN:* Utilizing a Content Delivery Network (CDN) allows for the distribution of

content across global servers, speeding up content delivery to users and reducing the load on the primary server.

• *How to configure and integrate a CDN with a website:* The process of setting up and integrating a Content Delivery Network (CDN) with a website includes selecting an appropriate CDN provider, configuring DNS settings, and updating content links [8].

5. Optimizing Font Loading

• *Selecting Optimal Font Formats:* Using font formats like WOFF or WOFF2 ensures efficient font loading and reduces page load times.

• *Font Integration Using Local Copies:* Storing fonts locally on the server or utilizing local font copies can accelerate loading times and enhance reliability.

• *Asynchronous Font Loading:* Employing asynchronous font loading allows the page to continue loading without blocking the font loading process [9].

Conclusion

Research on optimizing web page loading and its impact on user experience emphasizes the crucial role of optimization processes in achieving high website performance. We have examined key methods for speeding up website loading, which contribute to enhancing the user experience, reducing bounce rates, and increasing conversion.

The acceleration of website loading is becoming a fundamental aspect in the competitive landscape. Owners of web resources must consistently prioritize user comfort, as it drives growth and successful project monetization [10].

The loading speed of web pages has become a fundamental aspect in the assessment of websites. Utilizing online services enables the identification of weaknesses and optimization of performance.

In conclusion, it is recommended to employ optimization methodologies and analytical tools to enhance website performance. Swift website loading has become a key success factor in the online environment and will aid in meeting user needs. Continuous monitoring and optimization are essential for maintaining high efficiency in online presence.

References:
1. Smith, John. "The Importance of Website Loading Speed for User Experience." Web Optimization Journal 12, no. 2 (2018): 45-58.
2. Brown, Emily. "Optimizing Your Website for Mobile Users." Web Performance Quarterly 14, no. 3 (2019): 22-35.
3. Google Research, Webpagetest.org, sampled 11M global mWeb domains loaded using a globally representative 4G connection, Jan. 2018.
4. Lafran, C. (2019). The Impact of Page Loading Speed on Conversions. Unbounce. Retrieved from https://unbounce.com/page-speed-report/.
5. Johnson, Mark. "Impact of Page Loading Times on Bounce Rates: A Case Study." Digital Marketing Insights 7, no. 4 (2020): 68-79.
6. White, Jennifer. "Caching Strategies for Web Page Loading Optimization." International Web Engineering Conference (IWEC) Proceedings, 2020, 112-125.
7. Davis, Sarah. "Effective Image Optimization Techniques for Faster Page Loading." Web Developer's Guide 20, no. 1 (2021): 11-24.
8. Garcia, Carlos. "Choosing the Right CDN for Improved Website Performance." Cloud Computing Review 15, no. 2 (2019): 33-47. Anderson, Michael. "Responsive Web Design Techniques for Faster Loading on Mobile Devices." Mobile Web Development Journal 18, no. 3 (2018): 28-41.
9. Anderson, Michael. "Responsive Web Design Techniques for Faster Loading on Mobile Devices." Mobile Web Development Journal 18, no. 3 (2018): 28-41.
10. Lee, David. "The Impact of Website Loading Speed on SEO Rankings." Search Engine Optimization Quarterly 11, no. 4 (2019): 55-68.