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BOOK 5

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VOLUME 12

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ASPECTS OF WEBSITE OPTIMIZATION

Georgi Dimitrov, Galina Panayotova

University of Library Studies and Information Technologies

Abstract: *The paper discusses some methods for optimization of Websites as most common practices have been pointed out. It shows which methods have the greatest impact for individual sites according to their purpose. The causes and the consequences of the slow loading site have been pointed as well. The objects for optimization: traffic, speed, conversion rates, sell-through, and ets are determined from the target and the use of the sites.*

Keywords: *Website optimization, objects for optimization, methods for optimizations, optimization is determined from the target and the use of the sites.*

INTRODUCTION

Consumers often measure a business by the quality of its website, and web-friendly writing and easy navigation encourage return visits. However, the content for the web involves more than just an appealing copy.

Recently it has been increasingly common for Websites to load slowly. It is also characteristic that, after a careful analysis of the structure and methods for retrieving data from the server, it is possible to significantly increase the speed of charging and hence to improve the “user’s experience”[1], [2].

ICT firm employs experts in most aspects of website optimization, including front-end speed optimization using the latest web standards and techniques, back-end optimization using server tuning, SQL query optimization, refactoring, and middleware tuning, search engine marketing, web design, and optimized marketing campaigns.

Observing the natural process of delay of Websites loading speed the Department of Information Technologies started research on methods of optimization of available resources. In this article we look at some options that could greatly assist developers in their efforts to increase the loading speed of websites. One of the main reasons for this is that developers do not pay enough attention to the ways of optimization in the development process, and in turn the owners of the sites understand this problem only when it is clear that visitors are unhappy with the service provided [4].

CAUSES AND CONSEQUENCES OF THE SLOW LOADING SITE

According to recent studies, the average consumer is willing to wait for the page to load for no more than 4 sec. and then this site goes into the “black list”. As a result, the likelihood of re-visiting this resource is reduced, which leads to loss of the target group [5], [6].

The most attractive looking sites have quite a complex structure and are based on the latest technology for building Internet sites, they have excellent vision, graphics and multimedia. In practice you can no longer meet a site that does not use JavaScript and Flash. As a result, the site is not only attractive, but also slow, and this in turn begins to “annoy” the visitor, due to the necessity of waiting for loading, especially in the initial steps until the content has been cached on the local computer.

The consequences are obvious: slow sites go further back in the charts of opening on Google, Bing and other Internet search engines. Due to unawareness of the reasons for the delay, many developers are trying to change the design. The cost of improving the appearance of the page increase and the results are not justified. Accordingly, low attendance rate means you go down in the charts [7].

Therefore, the development of sites requires investing significant efforts in optimization.

The charging time of web pages depends not only on the speed and quality of the connection, but also on the response time of the server and the volume of transmitted data. The reason for slow loading pages can generally be overloading the server, which at one point simply cannot cope with the flow of incoming and outgoing information. In turn, the load of the server depends on both the volume and the quantity of transmitted information. An additional factor is the number of http requests that the server processes per second. As a result, in case of queuing we receive the well-known message (Time Out).

WAYS OF OPTIMIZATION:

There are many ways to improve the loading speed of a website. At first glance, the easiest is to move the site to a more powerful server, but even in this case, you are not guaranteed to produce a better effect.

▪ Mathematical optimization

The most effective way is the optimization of the site and its individual components. It is defined as a set of methods aimed at reducing the time of loading of web pages. But because of the variety of tools for building sites, a standard classification of methods cannot be done. However, each of the methods has some contribution to the overall optimization of a website, and the set of applicable methods can lead to excellent results.

An optimization problem can be represented in the following way: [8], [9].

Given: a function $f: A \rightarrow R$ from some set A to the real numbers R . A is the set of objects for optimization:

$$x_1, x_2, \dots, x_n.$$

Sought: an element $x_0(x_{01}, x_{02}, \dots, x_{0n}) \in A$ such that $f(x_0) \leq f(x)$ for all x in A ("minimization") or such that $f(x_0) \geq f(x)$ for all x in A ("maximization").

Such a formulation is called an optimization problem or a mathematical programming problem (a term not directly related to computer programming). Many real-world and theoretical problems may be modeled in this general framework. Problems formulated using this technique in the fields of physics and computer vision may refer to the technique as energy minimization, speaking of the value of the function f as representing the energy of the system being modeled.

Typically, A is some subset of the Euclidean space, often specified by a set of constraints, equalities or inequalities that the members of A have to satisfy. The domain A off is called the search space or the choice set, while the elements of A are called candidate solutions or feasible solutions.

In mathematics, by convention optimization problems are usually stated in terms of minimization. Generally, unless both the objective function and the feasible region are convex in a minimization problem, there may be several local minima, where a local minimum x_0 is defined as a point for which there exists some $\delta > 0$ so that for all x such that

$$\|x - x_0\| < \delta$$

the expression

$$f(x_0) \leq f(x)$$

holds. That is to say, on some region around x_0 all of the function values are greater than or equal to the value at that point. Local maxima are defined similarly.

A large number of algorithms proposed for solving non-convex problems – including the majority of commercially available solvers – are not capable of making a distinction between local optimal solutions and rigorous optimal solutions, and will treat the former as actual solutions to the original problem. The branch of applied mathematics and numerical analysis that is concerned with the development of deterministic algorithms that are capable of guaranteeing convergence in finite time to the actual optimal solution of a non-convex problem is called global optimization.

Let's look at some objects for optimization in more detail [2], [3]:

1. Site structure optimization

Each HTML page is built based on the DOM (Document Object Model). Or in other words, has a hierarchical structure. The number of DOM elements and their use depends on the speed of the interpretation of the page in the browser. Processing of scripting languages also largely depends on the structure of the DOM.

For optimization of the DOM structure of the document, it is advisable to remove the large number of nested tags. For example, use DIV instead of tables can have a significant effect on the rate of loading.

2. Optimization of the graphic interface

Most often the change of the interface of the site involves changing the type of site, the CSS and algorithms of individual scripts. For example, one can combine much of the images in one image, thereby reducing the number of requests to the server.

3. Reducing the volume of traffic content

By 'exchanged' content in this case we can understand the information, contained in the various plug-ins, banners, external scripts and flash animation. Sometimes, the amount of this content can outnumber the base one. So business oriented information systems have reduced to a minimum the availability and number of detailed information. Optimization of the site in this case lies in the elimination of unnecessary elements and reducing the size of the others.

4. Optimization of server-side scripts

Generally, this means reducing the time required for execution of the script and minimization of the amount of memory required for the processing of the script.

5. Optimization of client side scripts

Practically no website exists without using client side scripts. They serve to create animation effects, improving user experience, etc. The opposite effect is that it takes up memory space. Sometimes, the total volume of the JS code can grow uncontrollably, especially when using poorly structured drop-down lists. An additional factor is the widespread use of ready frameworks, such as content management systems (CMS). For WEB developers it is often more advantageous to use CMS, which significantly reduces the time to develop the site.

In this case, optimization options are not too many—in fact either to rewrite the site, or to optimize the CMS system.

6. Optimizing scripts

Several “well-known” rules:

- do not create additional variables, without this being absolutely necessary;
- use simpler and therefore faster functions;
- minimize the number of operations in cycles;
- shut the indoor connections to the database;
- be aware that references to local variables are faster than to global ones;
- use static HTML code, when possible;
- cache the scripts
- have in mind that arrays are faster than classes, so where possible, avoid classes.

7. Optimizing SQL queries

Each site in one way or another uses a database. Note that each application takes time, which in turn depends on many parameters included in the application like:

- size of tables and the number of records;
- the amount of fields in SELECT;
- number of tables included in the SELECT;
- and many others.

In this case, the following actions are recommendable:

- if possible, use XML for example, not applications;
- use indexes;
- use caching results considering the specific shortcomings of caching, such as the inability to check changed records;
- reduce the used functions in the application;
- keep large volumes of text information in tables with a small number of fields;
- the use of aggregation functions had better happen in a separate query;
- consolidate applications with “UPDATE”, “INSERT”, etc.
- It is recommended that the number of queries in a single rendering be under 7-8.

8. Optimizing CSS

Using Cascading Style Sheets in itself helps reducing the HTML code. However, there are ample ways to optimize CSS. Combining CSS files into one will not only reduce the total number of HTTP queries, but it will provide additional opportunity for grouping classes and elements in them. As a result, it is possible to significantly reduce the CSS file.

9. Compressing data and caching

The use of compression algorithms together with caching significantly reduces incoming and outgoing traffic. A caching in client side of CSS and JS files can completely eliminate the need for their reintroduction.

10. AJAX (Asynchronous JavaScript and XML)

Ajax (Asynchronous JavaScript and XML) is an approach in web developing for creating interactive web applications.

The advantage of Ajax is that through its use web pages load faster. Through asynchronous exchange of small portions of “invisible” data information on the website can be changed only partially thus reducing the amount of information that is transferred

between the server and the client. Asynchrony eliminates the necessity to reload the whole page again. Thus interactivity, speed and functionality of the pages are increased.

▪ **Optimization is determined from the target and the use of the sites**

There are different ways of classifying sites based on characteristics such as strength, focus, purpose, use, design, etc. On the basis of the relationship between the target and the use of the sites (Fig. 1.1) can be defined 4 basic types of sites [2], [4]:

1. commercial products with optional use;
2. specialized Business Systems;
3. products with non-commercial purpose and compulsory use;
4. products with non-commercial purpose and optional use.

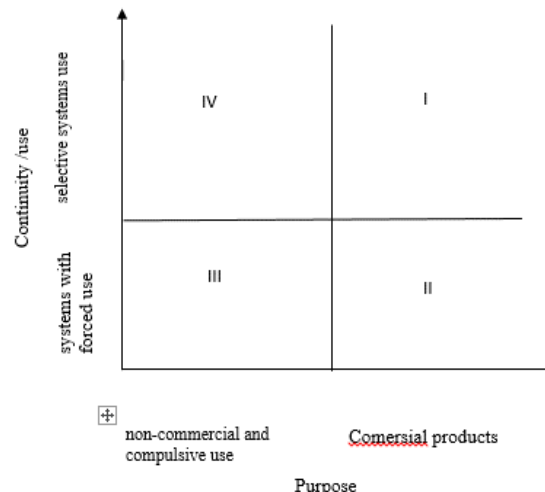


Fig.1. Types of web pages according to their purpose and use

In the first quadrant are commercial products available with optional use – they account for the main part of the websites and applications. Here good user experience is the most important since the purpose of the site is commercial, and the nature is optional, which means that the aim is to keep the maximum number of users. An example of this type of pages and applications are social networks, e-commerce sites, corporate sites and various online services. An important fact is that this quadrant covers not only the large and diverse range of sites, but also the largest and most visited ones – Google, Yahoo, Amazon, Facebook.

In the second quadrant fall the specialized business systems such as Sales Force, SAP, Oracle Products, etc. These are systems serving millions of users with low competition and often the decision to buy one or another product in this quadrant is taken by management and not by the actual users of the system. Due to the high price of the product, here the decision to buy the product is final, the major criterion is the capabilities of the system, not the user-friendliness.

The third quadrant includes products of non-commercial and compulsive use. Examples are various intercompany products for timing and tasks, allocation of resources and information, etc. Here the user experience is of minor significance, the goal is to maximize an effective system with minimum inputs. The disadvantage of working in this quadrant is often poor architecture and deteriorating usage leading to low efficiency of users' work. Examples are the long time or the unnecessarily complicated process in the performance of certain tasks.

The fourth quadrant can come as just over third in the use of optimization methods of usability and user experience. This is due to the optional nature of its use. Although we

speak about internal systems here, the user's convenience is just as important in the list of requirements to the product. An example of this might be to create a system for sharing best practices in the company. Since we are not talking about mandatory, but rather information of recommendatory character, it is relied on the willingness of users to share their knowledge with each other. The complicated process of entering or searching for information in the system would lead to putting off users.

The table 1 below lists the most effective, according to the authors, optimization methods to each group of sites.

Table 1. The list of the most effective, according to the authors, optimization methods to each group of sites.

	Commercial products of optional use	Specialized business systems	Products of noncommercial purpose and compulsory use	Products of non-commercial purpose and optional use
Reducing the number of HTTP queries	x			x
Reducing the exchanged content	x			x
Minimizing the page rendering time	x	x	x	x
Optimizing the site structure: error correction, reducing the number of DOM elements, changing the location of separate elements	x	x	x	x
Server script optimization (PHP, PERL, ASP);	x	x	x	x
Client side script optimization (JS, VBS, ActionScript);	x	x	x	x
Database query optimization (SQL);		x	x	
Cascading Style Sheets optimization (CSS);	x			x
Content compression	x		x	x
Caching results of script performance and SQL server queries;		x	x	
Caching client side components of loading page;		x	x	
Using asynchronous methods for loading page (AJAX)		x	x	

▪ Another methods

Below is a list of possible methods [1], [2], [5]:

- reducing the number of HTTP requests;
- reducing the exchanged content;
- reducing waiting time;
- minimizing the time to render the page;
- optimization of the structure of the site: correcting errors, reducing the number of elements of the DOM, changing the location of the components;
- optimization of server scripts (PHP, PERL, ASP);
- optimization scripts on the client's side (JS, VBS, Action Script);
- optimization of queries to the database (SQL);
- optimization of Cascading Style Sheets (CSS);
- compressing content;
- caching the results of running scripts and SQL queries on the server side;
- caching component of load pages by the client;
- the use of asynchronous methods for loading the page (AJAX).

The methods described above may be used alone or in combination. The choice of methods for optimization depends on many factors, such as site structure, content, and last but not least the purpose of the site – whether it be a presentation site or a site to exchange business data (CRM, ERP, etc.).

It is recommended that the set of optimization method be applied depending on the type of your site.

CONCLUSION

Web site optimization produces highly competitive web sites that out-perform on every measure; traffic, speed, conversion rates, sell-through, and, most importantly, return on your investment.

In conclusion, we can say that optimization can take different time each and every month, depending on the architecture and the complexity of the site and especially the use of the site. However, the reduction of the loading time would mean that the server operates more effectively and the user experience will be more complete, resulting in the more efficient activity and performance of the organization.

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АСПЕКТИ НА ОПТИМИЗАЦИЯ НА WEB САЙТОВЕ

Георги Димитров, Галина Панайотова

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Резюме: В статията за разгледани някои методи за оптимизация на WEB сайтове, като са изведени най-често срещаните практики. Посочено е кои методи имат най-голям ефект за отделните видове сайтове според тяхното предназначение. Посочени са причините и последиците от бавното зареждане на сайта. Оптимизацията на сайта се определя от целта и използването на обектите.

Ключови думи: Оптимизация на web сайт, обекти за оптимизация, методите за оптимизации; оптимизация се определя от целта и използването на обектите.

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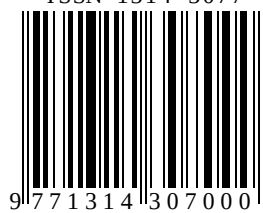
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