Web Service Performance Analysis using the GTMetrix Web Monitoring Tool

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Abstract: In this paper, delivering a high-level Quality of Service (QoS) has emerged as one of the top priorities for any web service provider as a result of the increasing use of the Internet. With the support of a performance monitoring tool, many factors affecting the performance of web services are examined. Different web services are routinely monitored to determine the different factors that affect their ability to provide services to an enormous number of users. The performance evaluation parameter used is the web service's load time. When the same web service is monitored at various times, the variation in load times is carefully analyzed to determine the factors that lead to this variation and how they affect the performance of any web service.

Keywords: GTMetrix, Page Size, Load Time, web performance monitoring, Web Service Monitoring Tool

1. Introduction

Nowadays, the majority of businesses have a substantial digital footprint, and some of these businesses significantly rely on their online applications to serve their clients and generate revenues. However, it is not sufficient to ensure that the web service is accessible round-the-clock in this competitive technological economy. To provide a better experience, businesses must regularly optimize their web pages.

A web service is a generic term for an interoperable machine-to-machine software function that is hosted at a network addressable location [1]. A web service has an interface that conceals the implementation details, enabling users to access it regardless of the hardware, software platform, or programming language used to develop it. This flexibility enables the use of cross-technology, loosely linked, component-oriented web service-based applications. To complete a complex aggregate or a commercial transaction, web services can be utilized independently or in conjunction with other web services.

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The web service model consists of three entities, the service provider, the service registry, and the service client [2][3]. Figure 1 shows a graphical representation of the web services publish-discover-bind and invoke model.

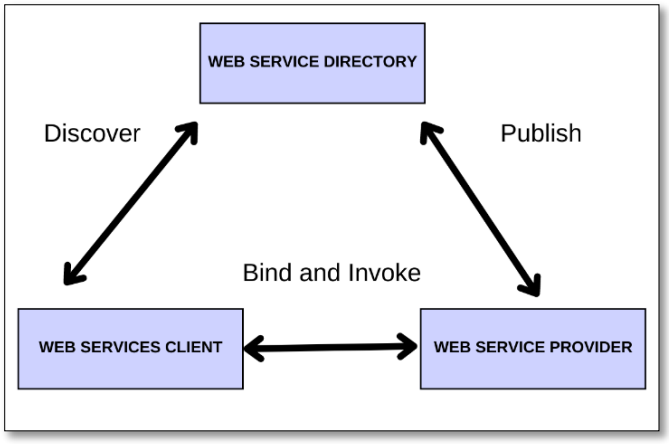

Figure 1. The Web Services Publish-Discover-Bind and Invoke Model

In the Web Services Publish-Discover-Bind and Invoke paradigm, the service providers register their services in a public registry. This registry is used by consumers to find services that match certain criteria and contains information about the service provider [4]. If such a service is found, the registry then provides the consumer with a contract and an endpoint address for that service [5][6]. The web service client retrieves the information from the registry and uses the service description obtained to bind to and invoke the web service.

Today, the Quality of Service (QoS) is used to describe the nonfunctional characteristics of a Web service to respond to and perform the expected requests at the performance level that corresponds with the mutual expectations of both its provider and its customers [7][8]. QoS can be seen as providing assurance on a number of quantitative properties in the context of Web services. Implementation and deployment issues, as well as other crucial service characteristics like service metering as well as cost, performance indicators, system security, integrity, reliability, scalability, and availability, can all be used to define these [9][10]. These properties can also be categorized as important both functional and non-functional service quality properties.

The evaluation of the web services performance is a forthcoming area that needs consideration [11]. This paper deals with the analysis on the performance of web services using monitoring tools. Ten web service providers will be evaluated using the GTMetrix Web monitoring tool [12].

The remainder of this paper is organized as follows: Section 2 outlines the system environment that includes the methodology and the performance monitoring tools being used; Section 3 provides the discussion on the results of the performance monitoring analysis; and Section 4 concludes the study.

2. System Environment

This section outlines the methodology of the study and monitoring tool to be used in evaluating the web service performance.

2.1 Methodology

The researcher used the top 10 web service providers in the Philippines posted on www.glassdor.com [13], a worldwide leader in insights about jobs and companies. These selected web service providers are

then evaluated by monitoring them on a regular basis using the GTMetrix web monitoring tool. The load time of web services, and the distribution of load time are the outcomes of the GTMetrix web monitoring tool. The difference in the load time of the same web service when tested multiple times can be attributed to a variety of reasons. The various causes of the web service's load time variance are then determined. The factors are thoroughly examined based on the load time.

2.1 Monitoring Tools Used

The GTMetrix web monitoring tool is used for the analysis of the performance of the web services [12][14]. It examines all parts of a web page including the page load times, file sizes, and other details about every single component of a web page such as JavaScript, HyperText Markup Language (HTML), Cascading Style Sheets (CSS) files, videos, images, *etc*. These audits are identified as the top issues impacting the performance bottlenecks. By combining a large number of performance-related statistics based on the test result, it automatically gives an overall web performance overview. These performance overviews can be traced over a period of time to evaluate the variations in the performance of the web service. It enables testing of the web service from various geographical locations. The various elements of the load time include the load time, web visualizations, Domain Name System (DNS) of the web service, web vitals, performance metrics, and structure, which represent how well the page is built for optimal performance, are found using this tool. Figure 2 depicts a screenshot of a performance report of the Zomato website [15] using GTMetrix web monitoring tool.

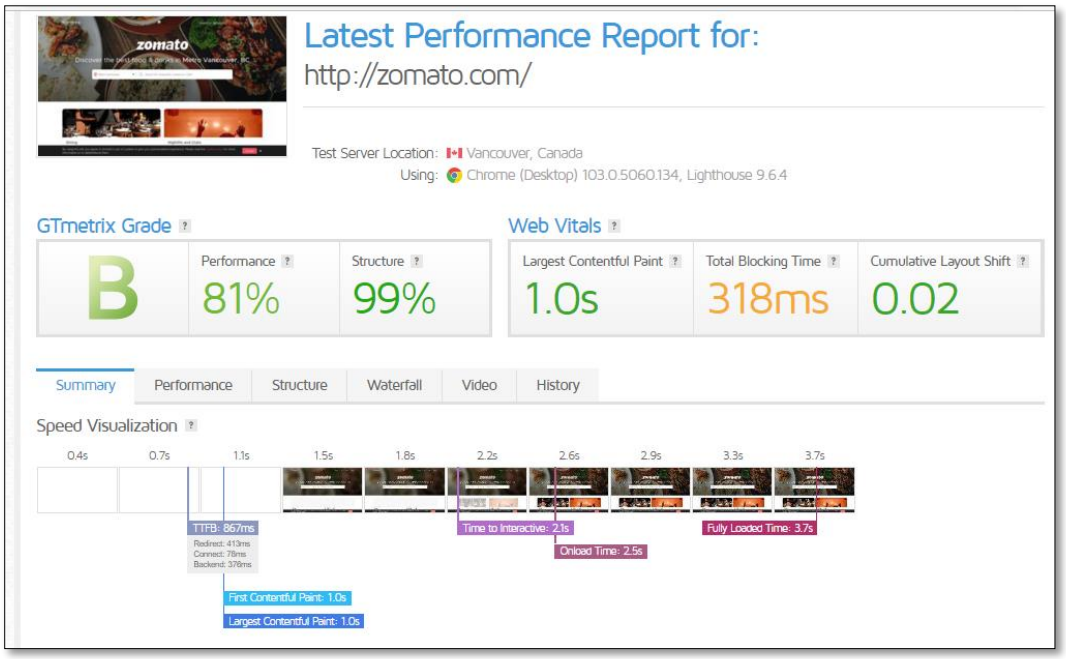

Figure 2. Page Analysis of the Server Response Code using GTMetrix

The www.nslookup.io [16], the web based DNS client that queries DNS records for a given domain name are used to retrieve the Internet Protocol (IP) address of the web service [17]. These IP addresses are required in order to determine the web service's IP location, which is then required in order to determine how far apart the client and server are from one another.

The IP-based Geolocation [18] is used to map an IP address or Media Access Control (MAC) address of a web service to the real-world geographical region of an Internet-connected computing or personal devices. This location is required to determine the distance between the server and the client’s location.

The actual physical distance between the locations of the client and server is determined using the Distance Finder or Calculator [19]. The distance is specified in kilometers (kms). Based on the overall load time, it is used to determine how the distance affects the web service's performance.

3. Results and Discussions

The performance of the various web services is checked on a regular basis, and work out the issues affecting their performance. The factors that affect the performance of web services are identified and analyzed to study their impact on the load time.

3.1 Performance Evaluation Parameters

The performance evaluation parameter is the load time. It represents the typical time it takes for a page to appear on the screen. It is estimated from the point of beginning (*i.e.*, when a user clicks on a page link or types in a Uniform Resource Locator (URL)) until the point of completion (*i.e.*, when the page is fully loaded in the browser). Seconds (s) are used to measure the load time.

3.2 Result and Analysis

This section identifies and assesses the non-functional characteristics that have an impact on the load times of the monitored web services. The web services are checked on at predetermined, regular intervals. For three days, the web services are monitored three times each day to observe how the load times vary in each situation. A thorough analysis of the load times revealed the factors listed below to have an effect on the performance of the web services.

3.2.1 Distance

The actual physical distance between the client's and server's locations is the primary factor that leads to variation in the load time value. To determine the effect of distance on the load time value, the web service host position is periodically changed using a web monitoring tool. The load time of the web services is impacted by the change in the distance between the host and the server since it takes much longer to establish a connection between them. When separate servers located at various geographic distances are monitored, this causes a difference in the load time value of the web services.

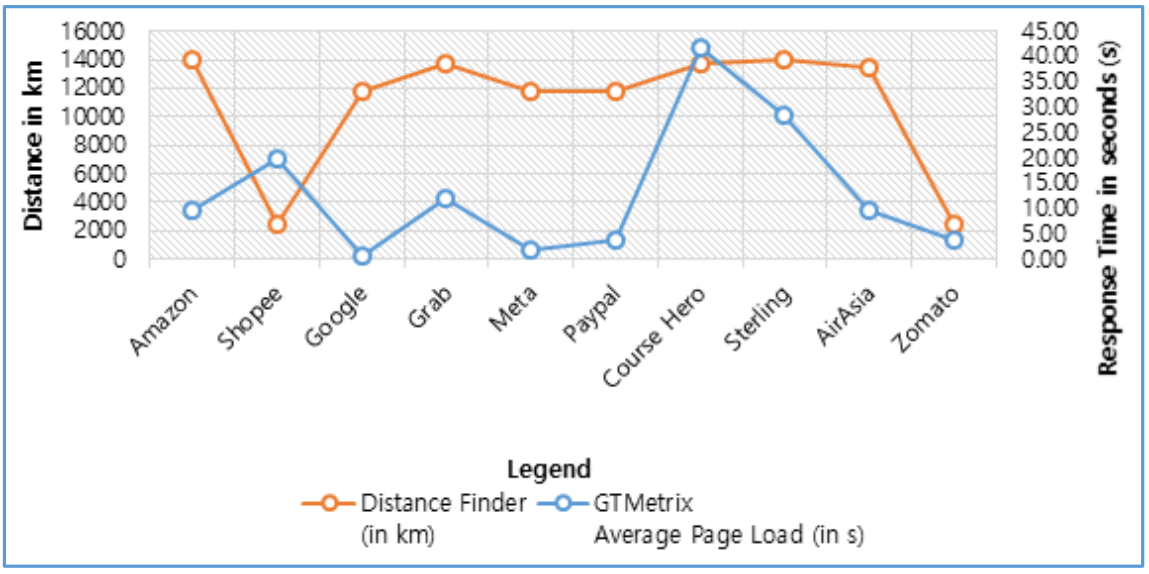

Figure 3. Effect of Distance on Load Time of the Top 10 Web Service Providers in the Philippines

The impact of distance on regularly monitored web services is depicted in Figure 1. It is found that as the distance between the web server and the host increases, the load time also increases. This can be attributed to the cases of Zomato and Shopee Philippines, wherein their servers are located in Singapore. While in some cases, the load time may not always vary with distance, this variance can sometimes be explained by other factors.

3.2.2 Size

The size of the web page that the host requests also affects how fast that web service loads. Longer loading times are associated with heavier pages. The size of the requested web page also emerges as a significant factor when studying the differences in the load time values for the same web service over nine instances. The webpage is made up of numerous connections to numerous other pages, as well as photographs, videos, and other online elements. The size of the web page may be significantly influenced by the size of these individual components.

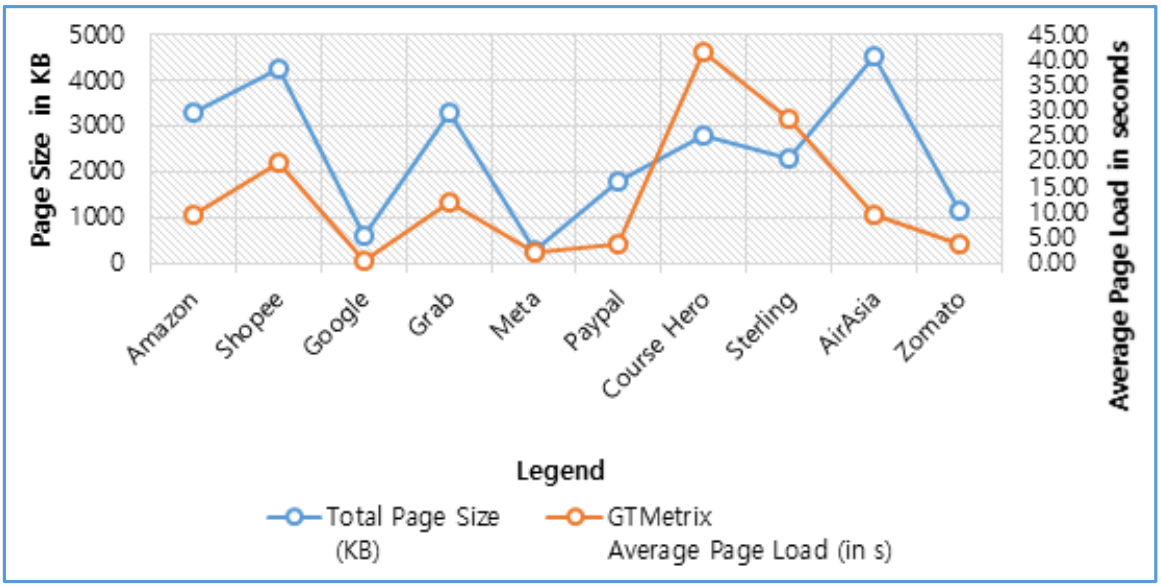

Figure 4. Effects of Page Size on Average Page load of the Top 10 Web Service Providers in the Philippines

In Figure 4, it is clear that while examining the speed of the web page, the size of the web service page is also a crucial factor that has to be taken into account. It is clear from web service providers like Meta, whose pages only weigh 262 KB, and Google, whose pages weigh 599 KB. By deleting the large embedded music and video files, optimizing photos, and adding lightweight elements all together, the size of the website can be changed. As a result, altering the size of the web page might enhance the efficiency of any web service.

3.2.3 Time

When monitoring web services at various intervals, the time of the day during which the monitoring is done also has an impact on the performance of the web service. The purpose of the variation in load time when web services are monitored over different time sessions of the day is to reflect the variation in the load on the server during different time intervals. The capacity of the server depends upon the number of requests to be served by the server. These requests may vary regularly over the different time sessions of the day.

Table 1. Summary of Page Load Times for the Top 10 Web Service Providers in the Philippines

Web Service Provider	Morning (Average Page Load in second(s))	Afternoon (Average Page Load in second(s))	Evening (Average Page Load in second(s))
Amazon	10.03	8.80	9.85
Shopee	19.73	19.80	20.10
Google	0.53	0.65	0.65
Grab	12.17	12.00	12.20
Meta	1.80	2.20	1.90
Paypal	3.80	3.95	3.85
Course Hero	33.37	33.55	62.60
Sterling	34.00	19.15	28.70
AirAsia	9.20	9.65	10.00
Zomato	3.80	3.90	3.90

Table 1 indicates that there is an effect of the time of day on the page load time. The page load of the Course Hero web service provider is very high at night with 62.60 seconds. This may be attributed to the fact that many users are accessing the page during the night.

This leads to the identification of the three primary non-functional parameters that have a significant impact on the performance of the web services: the physical distance between the server and the host; the size of the web services; and the time of day. Therefore, these elements can be taken into account while assessing the performance of web services. By taking corrective action in accordance with the performance-impacting issues, the QoS of the web services can be ensured. Thus, the primary goal of offering QoS to clients can be achieved.

4. Conclusion

In this paper, the performance of the web services is checked using a web monitoring tool to identify the factors that affect the web service performance. The frequency of web performance monitoring has resulted in the division of these web services into different categories. The performance evaluation metric utilized is load time, which is calculated as the time it takes to send a request and receive a response. The load time for the same web service has been closely and thoroughly examined, and the results show that the server distance and the host, the size of the web page, and the time of the session all have a significant impact on the performance of any web service.

In the future, other parameters in evaluating the QoS performance of web services will be considered. In addition, optimization methods to compensate with the limitations on the performance of web services will be identified to provide better services and guarantee a high-level QoS for the users.

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