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The empirical study of Joomla CMS map extension and location performance

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Abstract: Thousands of extensions can be installed on the Joomla CMS with various functions. One of them is the map and location extension, which is useful for meeting the needs of content that display information in the form of visual maps and locations. The Phoca Maps and MX Maps extensions are two of the many map and location extensions available on the Joomla Extension Directory website, downloadable and widely used. This study aims to provide a reference for Joomla CMS users in terms of managing content related to maps and locations through empirical studies of the performance of Phoca Maps and MX Maps extensions. In measuring extension performance, Google Lighthouse is used to audit all quality aspects that support the performance of a web application. The research results found that, in general, the desktop and mobile performance of the Phoca Maps and MX Maps extensions was unsatisfactory. This can be seen from the performance testing results for First Contentful Paint, Speed Index, Largest Contentful Paint, Time to Interactive, Total Blocking Time, and Cumulative Layout Shift.

Keywords: CMS Joomla, extensions, google lighthouse, Phoca Maps, MX maps

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Introduction

In its use, a website has a very potent role in conveying various information sourced from various agencies, educational institutions, companies, and other organizations. The purpose of the information provided can be various, such as information for communication, entertainment content, and trade, such as offering services, introducing company profiles, marketing, and selling products, providing news, or just sharing tips and tricks. Access to public information is given without distance and time limitations so that whenever and wherever everyone can access it. Not only limited by one type of device, but various devices such as smartphones, tablets, laptops, and personal computers can access it.

Many factors make website information content convey well to visitors. These factors include various aspects such as internet network infrastructure support, device specifications, browser applications, to good website quality. One way of assessing the quality of a good website is through its performance. Good website access speed performance means that visitors don't need a long time to see the entire page content. On the other hand, performance is one of the reasons for consideration for visitors to visit a website [1]. Because web application performance plays a key role in satisfying end users [2], organizations must think of effective and efficient ways to build high-performance websites.

Today the development of programming languages is increasingly encouraging website programmers to create various applications that are safer and easier to use by personal and organizational users. The application accommodates the needs of users who have different backgrounds needs. One of the popular products resulting from the website application development is Joomla. Joomla is a free, open-source application that can be used as a content management system (CMS) to publish website content [3]. Through Joomla, website developers are given a lot of convenience in managing content because it has good features for managing content [4]. With a CMS, the website development workflow becomes simpler without having to require previous experience and knowledge [5], having special technical knowledge [6], and without the

need to worry about having abilities in terms of coding [7]. Complex website development processes will be simplified, significantly reducing development time.

Developers can add many extension options to a Joomla CMS-based website. No less than 4800 extensions [8] for various needs can be downloaded and installed on the website. Among the many extensions is the map and location extension (Maps & Locations). This category type is used specifically for the needs of processing map content and locations. One of the benefits is that it allows Joomla users to place markers on the map on each article or page of a website. By embedding maps and locations on the website, developers can expand the functions of the website to be built. The map is useful for making it easy to share information about a business or office's location, see routes, or explore roads virtually.

Many factors will be considered in designing a website based on maps and locations to produce a quality website. In this case, Joomla developers need to consider the most appropriate extension. One of the benchmarks is the accuracy in selecting extensions with good performance. Extensions must be able to run with maximum performance both through mobile and desktop access.

In this regard, in this study, the authors will conduct an empirical study regarding the map extension's performance and the Joomla extension's location. The method to be used in this research consists of three stages: extension data collection, performance testing, and analysis of performance testing results. This research aims to explore and find out the performance of the map and location extensions used in the Joomla CMS. At the same time, the research results are expected to be a reference for Joomla website developers to choose and determine which map extension and location are more appropriate to use.

Methodology

The research stages shown in Figure 1 provide a function as a reference for achieving research objectives. This stage consists of four stages: literature study, observation and extension data collection, performance testing, and analysis of performance testing results.

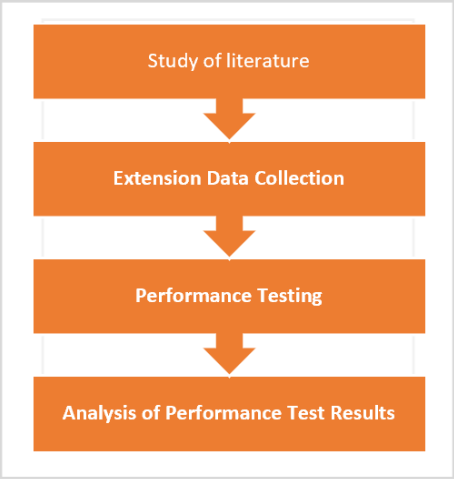

Figure 1. The research stages

Study of literature: At this stage, a search for materials and information relevant to the research problem is carried out to serve as a guideline for problem-solving approaches. Literature sources used as references in this study are electronic journals and technical documents from extension providers that will be used.

Extension Data Collection: At this stage, data is collected regarding each extension regarding requirements specifications (map support and Joomla compatibility), features (multimap), licenses, extension types (components, modules, plugins), and technical documentation support. Data regarding extensions are needed to support the stage of the performance testing process.

Performance Testing: At this stage, performance testing uses Google Lighthouse. The test results will be displayed in the form of a matrix to show measurements of First Contentful Paint (FCP),

Speed Index, Largest Contentful Paint (LCP), Time to Interactive (TTI), Total Blocking Time (TBT), and Cumulative Layout Shift (CLS). Performance measurement tests will be carried out more than once and use aggregation values because the results of single-run tests can be misleading and not representative [9].

First Contentful Paint (FCP)

FCP marks the time when text or images were first recorded [10]. FCP captures performance related to how quickly visitors can view content from a website [11]. FCP equals the time in milliseconds until the first element is drawn on the white screen that is first displayed in the browser [12]. The FCP Score in Table 1 below shows this performance variable's assessment.

Table 1. FCP score

FCP Time in Second	Color Code
0 – 1.8	Green (fast)
1.8 – 3	Orange (moderate)
Higher than 3	Red (slow)

Scores with a duration of 1.8 seconds or less (represented by a green color code) mean fast performance and good value. Scores with a duration of more than 1.8 seconds and less than 3 seconds (depicted by the orange color code) mean that the performance is moderate and needs improvement. A score with a duration higher than 3 seconds (depicted by a red color code) means poor performance, so improvement is needed [10].

Speed Index

Speed Index shows how fast the page content appears to be filled or the content is displayed visually during page load. The Speed Index is a gauge of how quickly a website shows information visually during page load [13]. It is done by recording a video of the page loading in the browser and then calculating the visual progress between frames [10]. Assessment of speed performance is shown through the Speed Index Score in Table 2 below.

Table 2. Speed index score

Speed Index in Second	Color Code
0 – 3.4	Green (fast)
3.4 – 5.8	Orange (moderate)
Higher than 5.8	Red (slow)

Scores with a duration of 3.4 seconds or less (depicted by a green color code) mean fast performance. Scores with a duration of more than 3.4 seconds and less than 5.8 seconds (depicted by the orange color code) have a moderate performance meaning. At the same time, a score with a duration higher than 5.8 seconds (depicted by a red color code) means poor performance [10].

Largest Contentful Paint (LCP)

The LCP is Another indicator that influences a site's performance [14]. It has a special role in research because it complements the FCP by measuring the perceived loading speed when the main content of a page has loaded [15]. The LCP marks and measures the time interval [16], the time that the largest text or image was printed [17] when the user enters the web [18]. The largest image or block of text visible in the viewport is will be reported for its render time from the first time it is loaded. Websites with LCP times below 2.5 seconds or less will provide a good user experience, while it will be bad if the value exceeds 4.0 seconds.

Time to Interactive (TTI)

TTI is the amount of time it takes for a page to load [19] until the page is fully responsive to interactions [20]. TTI measures website responsiveness when the website loads a website page [10]. Assessment of TTI performance is shown through the Time to Interactive Score in Table 3 below.

Table 3. Time to interactive score

TTI in Second	Color Code
0 – 3.8	Green (fast)
3.9 – 7.3	Orange (moderate)
Higher than 7.3	Red (slow)

Scores of 3.8 seconds or less (represented by a green color code) mean fast performance. Scores with a duration of more than 3.8 seconds and less than 7.3 seconds (depicted by the orange color code) have a moderate performance meaning. At the same time, a score with a duration higher than 7.3 seconds (depicted by a red color code) means poor performance [10].

Total Blocking Time (TBT)

TBT measures how much time is blocked in response to user input [20], such as keyboard presses, mouse clicks, and screen taps or keyboard taps [21] on the device during page loading [11]. TBT evaluates task responsiveness by quantifying how long a page is non-interactive until it becomes reliably interactive [22]. Total TBT is calculated by adding the blocking portion of all long tasks between TCP and TTI. TBT measures task responsiveness, as it helps measure the severity of how non-interactive a page is before it becomes reliably interactive. In other words, TBT measures the time between FCP and TTI [15]. The TBT score table can be seen through the Total Blocking Time Score in Table 4 below.

Table 4. Total blocking time score

TBT in Second	Color Code
0 – 200	Green (fast)
200 – 600	Orange (moderate)
Higher than 600	Red (slow)

Scores with a duration of 200 seconds or less (represented by a green color code) mean fast performance. Scores with a duration of more than 200 seconds and less than 600 seconds (depicted by the orange color code) have a moderate performance meaning. At the same time, a score with a duration higher than 600 seconds (depicted by a red color code) means poor performance [10].

Cumulative Layout Shift (CLS)

CLS measures the movement [10] or shifts in the layout of visible elements within the field of view on the page when the website loads [11]. CLS can occur between when the page starts loading and when its lifecycle state changes to hidden [23]. The CLS variable was introduced in content analysis because it measures layout visual stability [24] and provides a decision of the analyzed page in terms of the frequency of unexpected display changes [15]. The score is considered good if the value is below 0.1, and the score is considered bad if the value is above 0.25 [11].

Analysis of Performance Test Results: This stage is the final stage, where an analysis will be carried out on performance testing results for desktop and mobile devices.

Results and Discussions

The following is information on the feature comparison of each extension based on data collected via the Phoca Maps [25], MX Maps [26], and the official Joomla Extension site [27]. Table 5 below shows information regarding the feature Comparison of Phoca Maps and MX Maps Extensions.

Table 5. Comparison of phoca maps and MX maps extensions

Information	Phoca Maps	MxMaps
Map Support	Google Maps, OpenStreetMap	OpenStreetMap
Joomla compatibility	Joomla Versions 3 and 4	Joomla Versions 3 and 4
Multiple Maps and Locations	Yes	Yes
Map Style	No	Yes (9 Maps Styles)
License	GPLv2 or later version	GPLv2 or later version
Paid Version	No	Yes
Extension Type	Components & Plugins	Module
Documentation	Yes	No
Technical Support	Yes	Yes

The performance testing of the Phoca Maps and MX Maps extensions is carried out under the following conditions:

1. Hardware specifications using AMD A10 -5745M APU with Radeon HD Graphics 2.10 GHz processor, 8 GB RAM, and 256 GB SSD.
2. Windows 10 Pro Edition operating system software, Joomla Version 3.9, Google Chrome browser application Version 105, and Google Lighthouse Version 100.
3. Internet uses a wireless connection with a downstream speed of 17.4 Mbps and an upstream of 19.9 Mbps (connection speed is measured using https://speedtest.cbn.id/).
4. Webserver Apache 2.3.47 (win32), PHP 5.6.40, and Database Server MariaDB 10.1.37.
5. CMS Joomla version 3.8 with additional template styles.
6. The map extension is placed into an article and uses five map markers (OpenStreetMap).

So that empirically the results of performance measurement get representative results, the performance test is carried out five times [9]. Performance testing is carried out in several stages, namely testing Phoca Maps for desktop and mobile performance, then proceeding with testing MX Maps for desktop and mobile performance. Phoca Maps testing for desktop performance is shown in Figure 2 below.

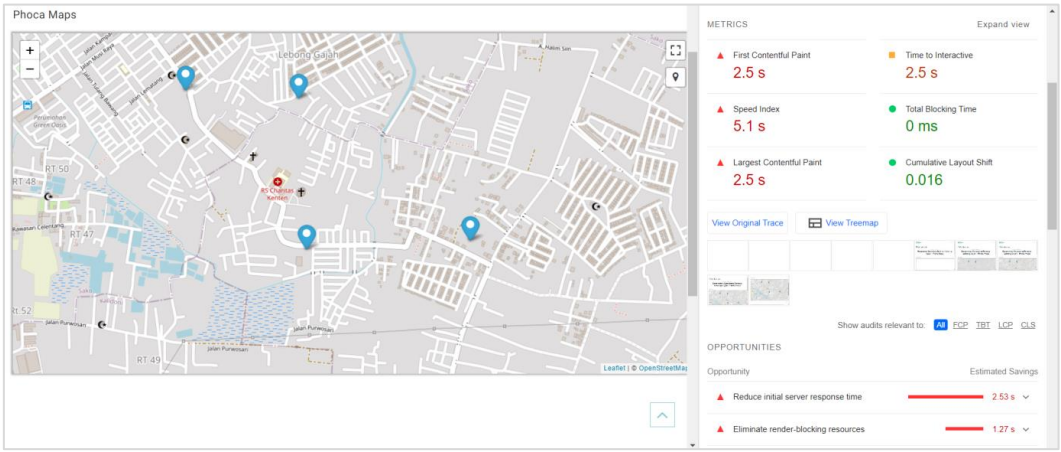

Figure 2. Phoca Maps Desktop Performance Testing

The detailed results of the Phoca Maps desktop performance test are shown in Table 6 of Pho-ca Maps Desktop Performance Testing below.

Table 6. Table of phoca maps desktop performance testing

PERFORMANCE TESTING	Test result					Average
	P1	P2	P3	P4	P5	
First Contentful Paint	2.5 s	1.7 s	5.8 s	6.6 s	4.2 s	4.2 s
Speed Index	5.1 s	5.1 s	6.6 s	7.4 s	6.2 s	6.1 s
Largest Contentful Paint	2.5 s	1.8 s	5.9 s	7.4 s	4.2 s	4.4 s
Time to Interactive	2.5 s	2.5 s	5.9 s	6.6 s	4.6 s	4.4 s
Total Blocking Time	0 ms	100 ms	0 ms	20 ms	360 ms	96 ms
Cumulative Layout Shift	0.016	0.014	0.008	0.006	0.008	0.010
SCORE	67	75	49	47	38	55.2

Phoca Maps testing for mobile performance is shown in Figure 3 below.

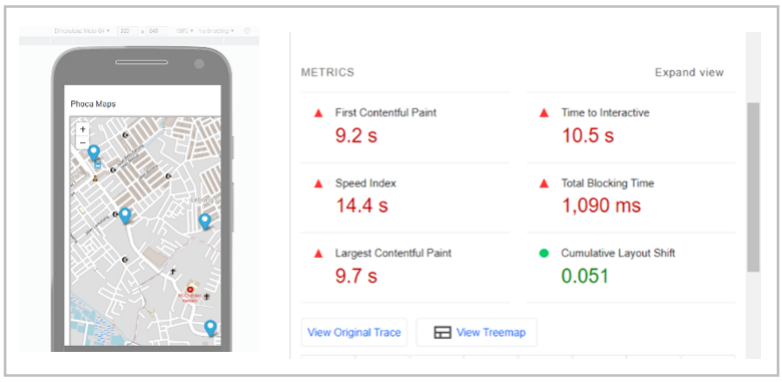

Figure 3. Phoca maps mobile performance testing

The detailed results of mobile Phoca Maps performance testing are shown in Table 7 of Phoca Maps Mobile Performance Testing below.

Table 7. Table of phoca maps mobile performance testing

PERFORMANCE TESTING	Test result					Average
	P1	P2	P3	P4	P5	
First Contentful Paint	4.8 s	5.0 s	6.9 s	4.9 s	4.4 s	5.2 s
Speed Index	14.2 s	14.7 s	13.0 s	14.1 s	12.9 s	13.8 s
Largest Contentful Paint	4.9 s	5.0 s	6.9 s	4.9 s	4.4 s	5.2 s
Time to Interactive	9.6 s	11.6 s	8.6 s	9.9 s	10.3 s	10.0 s
Total Blocking Time	1.850 ms	4.530 ms	1.420 ms	1.880 ms	2.590 ms	2.4540ms
Cumulative Layout Shift	0.05	0.05	0.05	0.05	0.05	0.05
SCORE	29	24	25	29	30	27.4

Figure 4 below shows testing MX Maps for desktop performance.

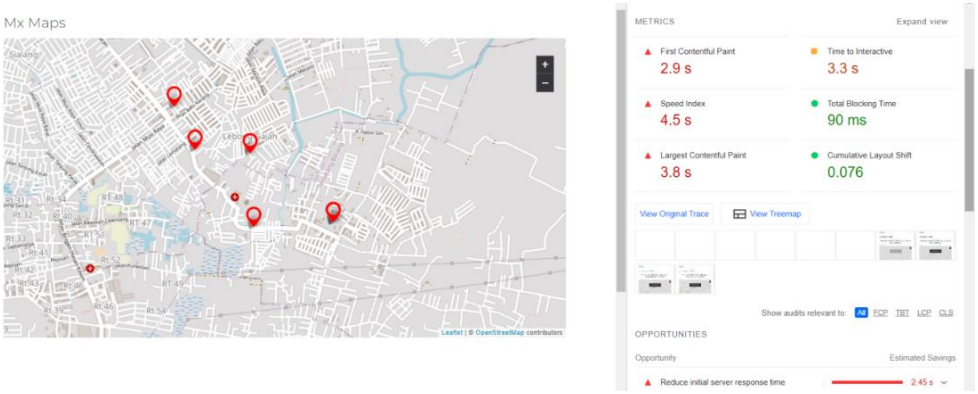

Figure 4. MX maps desktop performance testing

The detailed MX Maps desktop performance test results are shown in Table 8 of MX Maps Desktop Performance Testing below.

Table 8. Table of MX maps desktop performance testing

PERFORMANCE TESTING	Test result					Average
	P1	P2	P3	P4	P5	
First Contentful Paint	13.1 s	9.1 s	7.9 s	11.1 s	7.9 s	9.8 s
Speed Index	23.0 s	17.5 s	17.1 s	19.3 s	15.0 s	18.4 s
Largest Contentful Paint	13.1 s	9.1 s	8.7 s	11.1 s	8.1 s	10.0 s
Time to Interactive	22.3 s	16.2 s	15.3 s	19.6 s	13.8 s	17.4 s
Total Blocking Time	7.390 ms	5.680 ms	5.670 ms	7.340 ms	3.410 ms	5.898 ms
Cumulative Layout Shift	0.052	0.051	0.051	0.051	0.051	0.051
SCORE	15	16	16	15	17	15.8

Testing MX Maps for mobile performance is shown in Figure 5 below.

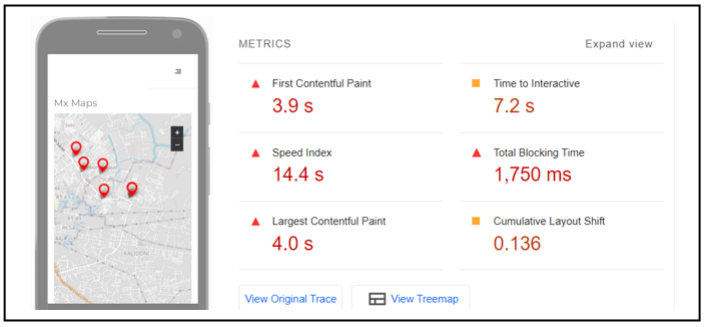

Figure 5. MX maps mobile performance testing

The detailed results of mobile MX Maps performance testing are shown in Table 9 of MX Maps Mobile Performance Testing below.

Table 9. Table of MX maps mobile performance testing

PERFORMANCE TESTING	Test result					Average
	P1	P2	P3	P4	P5	
First Contentful Paint	3.9 s	6.9 s	5.0 s	7.0 s	6.9 s	5.9 s
Speed Index	14.4 s	12.2 s	12.7 s	14.5 s	13.3 s	13.4 s
Largest Contentful Paint	4.0 s	7.5 s	5.5 s	7.6 s	7.1 s	6.3 s
Time to Interactive	7.2 s	8.9 s	8.7 s	8.9 s	11.8 s	9.1 s
Total Blocking Time	1750 ms	1060 ms	2380 ms	1120 ms	4050 ms	2072 ms
Cumulative Layout Shift	0.136	0.044	0.043	0.044	0.043	0.062
SCORE	29	27	26	26	19	25.4

Analysis of the performance test results for FCP, Speed Index, LCP, TTI, TBT, and CLS for desktop Phoca Maps performance testing is shown through Results of Phoca Maps Desktop Performance Analysis in Table 10 below.

Table 10. Results of phoca maps desktop performance analysis

Performance Testing	Average Score Test Results	Performance Conclusion
First Contentful Paint	4.2 s	Slow
Speed Index	6.1 s	Slow
Largest Contentful Paint	4.4 s	Bad
Time to Interactive	4.4 s	Moderate
Total Blocking Time	96 ms	Fast
Cumulative Layout Shift	0.010	Good

Based on the performance test of Phoca Maps Desktop, it can be concluded that FCP has a slow performance because it has an average score of 4.2 seconds. This score is at the lowest score position in the performance assessment table, which is higher than 3 seconds. Speed Index has a slow performance because it has an average score of 6.1 seconds. The score is at the lowest score position, which is higher than 5.8 seconds. LCP has a bad performance with an average score of 4.4 seconds because it exceeds the lowest limit score of 4 seconds. TTI has moderate performance with an average score of 4.4 seconds. The score position is in the medium performance score range, which is between 3.9 seconds and 7.3 seconds. TBT has fast performance with an average score of 96 microseconds. This score is at the highest score position with a duration of less than 200 seconds. CLS has good performance with an average score of 0.010. This score is in a good performance assessment position with a value of less than 0.1.

Analysis of the results of testing the performance of FCP, Speed Index, LCP, TTI, TBT, and CLS for Phoca Maps mobile performance testing is shown through the results of Phoca Maps Mobile Performance Analysis in Table 11 below.

Table 11. Results of phoca maps mobile performance analysis

Performance Testing	Average Score Test Results	Performance Conclusion
First Contentful Paint	5.2 s	Slow
Speed Index	13.8 s	Slow
Largest Contentful Paint	5.2 s	Bad
Time to Interactive	10.0 s	Slow
Total Blocking Time	2454 ms	Slow
Cumulative Layout Shift	0.05	Good

Based on the Phoca Maps Desktop performance test, it can be concluded that FCP has a slow performance because it has an average score of 5.2 seconds. This score is at the lowest score position in the performance assessment table, which is higher than 3 seconds. Speed Index has a slow performance because it has an average score of 13.8 seconds. The score is at the lowest score position, which is higher than 5.8 seconds. LCP has a bad performance with an average score of 5.2 seconds because it exceeds the lowest limit score of 4 seconds. TTI has a slow performance with an average score of 10 seconds. The score position is in the lowest performance score position, which is higher than 7.3 seconds. TBT has slow performance with an average score of 2454 microseconds. This score is at the lowest score position with a duration of more than 600 seconds. CLS has good performance with an average score of 0.05. This score is in a good performance assessment position with a value of less than 0.1.

Analysis of the performance test results of FCP, Speed Index, LCP, TTI, TBT, and CLSfor MX Maps desktop performance testing is shown through the results of MX Maps Desktop Performance Analysis in Table 12 below.

Table 12. Results of mx maps desktop performance analysis

Performance Testing	Average Score Test Results	Performance Conclusion
First Contentful Paint	9.8 s	Slow
Speed Index	18.4 s	Slow
Largest Contentful Paint	10.0 s	Bad
Time to Interactive	17.4 s	Slow
Total Blocking Time	5898 ms	Slow
Cumulative Layout Shift	0.051	Good

Based on the MX Maps Desktop performance test, it can be concluded that FCP has a slow performance because it has an average score of 9.8 seconds. This score is at the lowest score position in the performance assessment table, which is higher than 3 seconds. Speed Index has a slow performance because it has an average score of 10 seconds. The score is at the lowest score position, which is higher than 5.8 seconds. LCP has a bad performance with an average score of 17.4 seconds because it exceeds the lowest limit score of 4 seconds. TTI has a slow performance with an average score of 10 seconds. The score position is in the lowest performance score position, higher than 7.3 seconds. TBT has a slow performance with an average score of 5898 microseconds. This score is at the lowest score position with a duration of more than 600 seconds. CLS has good performance with an average score of 0.051. This score is in a good performance assessment position with a value of less than 0.1.

Analysis of the results of testing the performance of FCP, Speed Index, LCP, TTI, TBT, and CLS for MX Maps mobile performance testing is shown through Results of MX Maps Mobile Performance Analysis in Table 13 below.

Table 13. Results of MX maps mobile performance analysis

Performance Testing	Average Score Test Results	Performance Conclusion
First Contentful Paint	5.9 s	Slow
Speed Index	13.4 s	Slow
Largest Contentful Paint	6.3 s	Bad
Time to Interactive	9.1 s	Slow
Total Blocking Time	2072 ms	Slow
Cumulative Layout Shift	0.062	Good

Based on the MX Maps Mobile performance test, it can be concluded that FCP has a slow performance because it has an average score of 5.9 seconds. This score is at the lowest score position in the performance assessment table, which is higher than 3 seconds. Speed Index has a slow performance because it has an average score of 13.4 seconds. The score is at the lowest

score position, which is higher than 5.8 seconds. LCP has a bad performance with an average score of 6.6 seconds because it exceeds the lowest limit score of 4 seconds. TTI has a slow performance with an average score of 9.1 seconds. The score position is in the lowest performance score position, which is higher than 7.3 seconds. TBT has a slow performance with an average score of 2072 microseconds. This score is at the lowest score position with a duration of more than 600 seconds. CLS has good performance with an average score of 0.062. This score is in a good performance assessment position with a value of less than 0.1.

The following summarizes the desktop and mobile performance test results of the Phoca Maps and MX Maps extensions shown in Table 14, the Performance Conclusion Summary Table.

Table 14. Performance conclusion summary

Performance Testing	Objective	Performance Conclusion			
		Phoca Maps		MX Maps	
		Desktop	Mobile	Desktop	Mobile
First Contentful Paint	Measures the speed of visitors in viewing web content.	Slow	Slow	Slow	Slow
Speed Index	Measures the speed of the web in displaying information visually during page loading.	Slow	Slow	Slow	Slow
Largest Contentful Paint	Measures the time interval text and images are printed when a user enters the largest web.	Bad	Bad	Bad	Bad
Time to Interactive	Measures website responsiveness when the website loads a page.	Moderate	Slow	Slow	Slow
Total Blocking Time	Counts how long it takes a non-interactive page to become reliably interactive.	Fast	Slow	Slow	Slow
Cumulative Layout Shift	Measures the movement or shift of the layout of visible elements within the field of view on the page when the website loads.	Good	Good	Good	Good

Conclusion

Google Lighthouse makes it easy to measure the performance of extensions on Joomla CMS-based websites. The ease of use indicates this, the interface display, along with the information displayed. Desktop performance for First Contentful Paint, Speed Index, and Largest Contentful Paint extension Phoca Maps on Joomla CMS has unsatisfactory results. Performance Time to Interactive has moderate performance, Total Blocking Time has fast performance, and Cumulative Layout Shift has good performance. On the mobile performance side, the results of First Contentful Paint, Speed Index, Largest Contentful Paint, Time to Interactive, and Total Blocking Time had unsatisfactory results. Meanwhile, good results are obtained only from the performance of the Cumulative Layout Shift. Desktop performance for First Contentful Paint, Speed Index, Largest Contentful Paint, Time to Interactive, and Total Blocking Time for the MX Maps extension on CMS Joomla had unsatisfactory results. There is one good performance, namely in Cumulative Layout Shift. Meanwhile, on mobile performance, the results for First Contentful Paint, Speed Index, Largest Contentful Paint, Time to Interactive, and Total Blocking Time had unsatisfactory results. There is one good performance, namely the Cumulative Layout Shift.

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