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# Getting Started With Website Monitoring

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## **Author**

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David Johansson  
*davidjo2@kth.se*

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# 1 Introduction

The way in which people seek out information fundamentally changed with the introduction of the internet. Previous limitations has been evaporated as people suddenly has a seemingly unlimited amount of websites at their disposal, more than 1,5 billion to be more precise [1]. These websites serves the purpose of providing information to their visitors through different web pages. However, the significantly increased availability of information has put severe expectations on these websites as they are, most of the time, intended to be accessible at all times. Making sure that these types of user expectations are being met can be difficult but website monitoring tools can be utilized in order to ease this burden. In this essay, we will give an introduction to the field of website monitoring by going through some of the main practices to abide by as well as taking a look at some specific tools currently available. By the end of the essay, the reader should have gathered enough information to get started with website monitoring on their own.

## 2 Background

The following section will more closely define what the concept of monitoring entails. Furthermore, its relation to DevOps as well as its importance will be outlined.

### 2.1 Definition

Monitoring is the act of observing different aspects of a system's performance. These aspects can significantly vary depending on which domain is being monitored. However, it will primarily be centered around providing feedback from the production environment to aid in the engineering process. One key component of varying types of monitoring is time to detect (TTD). TTD is minimized by utilizing good monitoring practices so that the development team can be notified of a potential issue as quickly as possible. These developers can, subsequently, try to solve the problem to the best of their abilities in order to minimize the time to mitigate (TTM) [2]. When the problem has been taken care of, all affected processes go back to normal and the development of new features can, once again, be prioritized.

Website monitoring primarily serves the purpose of ensuring that the website at hand is available to all users and that the performance is optimized. Ensuring availability is primarily centered around minimizing the total amount of downtime that the website experiences. However, one less obvious indicator worth monitoring, that does not relate to availability, is to audit the usage of your application. This can, for instance, give you insight into how well different design requirements are being fulfilled. The information gathered from monitoring usage could, subsequently, be the driving factor behind certain business decisions [2].

## 2.2 DevOps

The topic of DevOps revolves around different practices that help bridge the gap between Development (Dev) and Operations (Ops). These practices assist in shortening the development life cycle as inconveniences relating to the delivery process of different releases are negated [3]. The process of delivering new software is usually depicted as containing 7 different stages that all different DevOps tools, in one way or the other, adhere to. One of these stages is monitoring as it plays a crucial part in detecting issues with certain releases. This information can then be taken into consideration when working out the kinks of future releases which helps shorten the overall development life cycle.

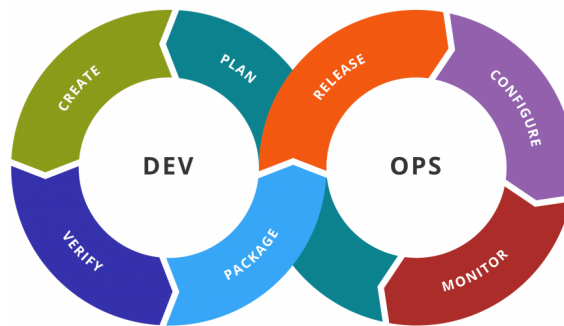


Figure 1: The different stages of DevOps with monitoring falling under the Ops part [4]

## 2.3 Importance

In the competitive online landscape, ensuring availability of your website can be very important in order for them to stay competitive. There are significant costs associated with your website going down which can be divided into two different categories. The first one are costs relating to *intervention*. This includes the expenditures that are caused by having your team spend time attending to the issue at hand. The second category is referred to as *downtime* costs and correlates to expenses caused by having to slow down production on other important engineering objectives. The consequences of shifting focus might include, for instance, the quality of other objectives being reduced. This could be caused by the team having less time to ensure quality as time was lost preventing downtime instead [5].

Several attempts have been made to estimate the costs caused by websites experiencing downtime. A number that is often being referenced is \$5600 per minute which is based on industry surveys carried out by Gartner [6]. However, there is a large amount of variance involved in estimating these numbers as they highly depend on what type of business the website is running. For instance, when users of Amazon experienced downtime back in 2013, it is estimated that the e-commerce retailer lost around \$66 000

per minute [7]. An average is primarily difficult to measure due to a lot of unpredictable factors being involved such as stock prizes [5].

Other than preventing downtime, ensuring that the website performs well can also significantly affect potential revenues. If the performance is slow, the user experience gets hampered drastically which can lead to the overall user retention being lowering and, subsequently, sales being lost. One less obvious factor which relates to visibility is the fact that the speed of a website is regarded as a key factor used by Google's search algorithm to rank websites [8].

### **3 Practices**

There are several different practices to employ within the field of website monitoring. They are important to consider in order to ensure that your monitoring becomes effective. Some of the most vital ones will be outlined in the following section.

#### **3.1 Identifying key performance indicators**

Measuring different performance parameters can give a good indication of the overall performance of your website. However, with so many different parameters to measure, it can be quite challenging to decide which ones are of most benefit for you. Making this distinction is essential as taking in too much noise can cloud your judgment regarding the overall health of your website. Some *Key Performance Indicators*, also referred to as KPIs, include the following:

##### **3.1.1 Uptime**

Ensuring uptime is a consistent theme throughout many monitoring practices and it is no coincidence that it gets mentioned first. However, tracking uptime can become challenging as it has to be carried out for all different components of your website. Furthermore, with website architectures becoming more advanced, the number of different components to monitor increases. It is not sufficient to simply monitor a home page as this will not give an authentic representation of the overall health of your website. By, instead, being thorough in collecting uptime data for all different components, the process of identifying weak spots within your website gets facilitated [9].

##### **3.1.2 Bounce rate**

Bounce rate is a lesser-known KPI but can be useful for many reasons. It refers to the percentage of visitors who decide to continue browsing the site after only viewing one page. The bounce rate could indicate whether the initial exposure to the website is driving users away. If this is the case, it could be because the speed of loading in the initial web page is not up to par. Furthermore, bounce rates can give you insight into how well your website manages to engage the visitor. If the rate ends up being low, it

can give you a reason to reevaluate your strategy in order for the website's content to become more engaging for your target audience [10].

### **3.1.3 Complete page load time**

As previously mentioned, the time to load a website can play a crucial part in retaining first-time visitors. If the page load ends up being too long, the risk of visitors leaving increases at an exponential rate. The difference between the load times being acceptable and deal-breaking can differ in only a few seconds. It is also important to take into consideration that users from different parts of the world with different setups available will experience varying load times. Knowing that only a subset of your user base in a specific region experiences good load times is not sufficient in terms of ensuring that your website stays competitive. Therefore, load times need to be measured with different regional circumstances in mind [9].

## **3.2 Internal and external monitoring**

A key distinction can be made regarding the type of website monitoring. This relates to the monitoring being either internal or external. They differ in the sense that internal monitoring is being carried out inside the firewall of a company while external monitoring takes place outside. The key benefits of internal monitoring consist of being able to monitor aspects relating to your own servers such as memory usage and page load times. It can help expose flaws within, for instance, the codebase or your own infrastructure. However, only making use of internal monitoring is not sufficient as the monitoring software is running alongside the corporate server. Therefore, a server outage would result in all monitoring capabilities becoming inaccessible if only internal monitoring was performed [11].

With the possibility of a server outage in mind, we need to also make use of so-called external monitoring. As previously mentioned, external monitoring takes place outside the corporate firewall. This enables it to monitor, among other aspects, response times and customer experiences by tracking how they traverse the website. Considering that external monitoring will continue to work through server outages, it can act as a safety net by sending notifications in the case of downtime. These notifications can become extremely crucial in order to act fast and, thus, minimize the previously mentioned TTD. Considering that both internal and external monitoring serves different purposes, the key principle to abide by is to take advantage of both types. This makes it possible to monitor the website continuously while also correlating different discoveries regarding observed issues with your own infrastructure [12].

## **3.3 Application performance management**

Application performance management (APM) revolves around the act of managing the performance and availability of software applications. APM monitors different aspects of your application such as the speed of which transactions between the end-user and

your application are made. They often take the form of different services which are capable of providing an overview of the website's overall performance as well as uncover hidden bottlenecks within your system [13]. The market for different website monitoring services has grown increasingly saturated with countless of different options available, an amount that has exceeded 150 [14].

Three examples of different techniques that APM services apply include *URL Monitoring*, *Content Monitoring* and *Synthetic Transaction Monitoring*. URL Monitoring serves the purpose of notifying whether the website is experiencing downtime or not. This is achieved by sending requests to the website at certain intervals that make sure whether a positive response is being sent back from the server. Furthermore, it can be used to measure response time which is another KPI that was previously highlighted [15].

Content Monitoring can work as a countermeasure for preventing certain attacks from adversaries, more specifically website defacement attacks. These types of attacks change the visual appearance of websites by adding malicious content [16]. Statistics for defacement attacks over the years are illustrated by figure 2. Without effective monitoring practices in place, these attacks can be difficult to detect. Content monitoring simply monitors the content of your website in order to detect any unwarranted changes to the HTML elements of different pages. Lastly, Synthetic Transaction Monitoring simulates the end-user experience by sending synthetic request to the server. These requests are similar to what a typical user of the website would send. Thereafter, the APM service monitors that these requests happens seamlessly which, hopefully, ensures that the user experience ends up being seamless as well [15].

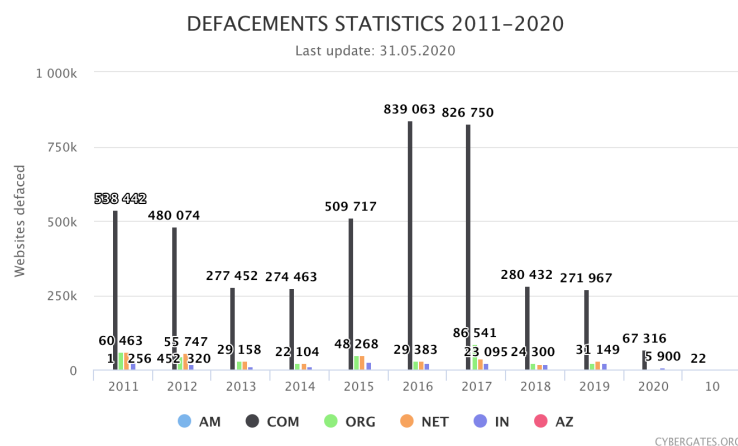


Figure 2: Amount of reported defacement attacks between 2011 and 2020 for different top-level domains [17]. The statistics depict more than 250 000 defacement attacks being carried out in 2019.

## 4 Tools

With there being countless of available options for website monitoring, it can be a quite overwhelming task to pick out a specific one to make use of. Therefore, the following section will highlight some of the more established options available when it comes to website monitoring.

### 4.1 Pingdom

Pingdom has been regarded as one of leading services when it comes to website performance and availability monitoring for an extended period of time. The service is available as on their website where you pay a monthly fee in order to get access to its features. You are able to decide which features you want to get a hold of by subscribing to different plans [18]. Pingdom provides a plethora of different features that can be linked to the aforementioned KPIs. This includes, for instance, measuring the uptime (section 3.1.1) of different web pages. This is accomplished through synthetic monitoring which was brought up in section 3.3. Pingdom's synthetic monitoring is based on simply commissioning different servers referred to as *probes* which will simulate user activity [19]. This simulated user activity can be in regard to important requests that play a huge role in affecting the initial impression of the website such as logging in.

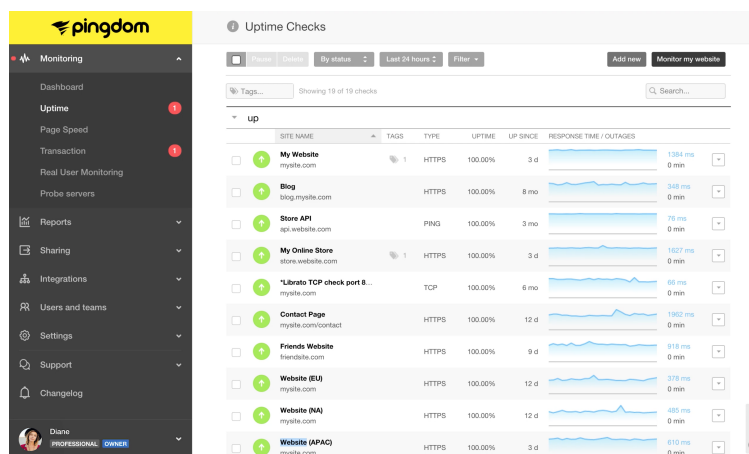


Figure 3: Pingdom uptime dashboard where the user is able to specify different URLs to be monitored as well as the fixed intervals in which the probes will send requests after. These intervals can be set to 1 minute in order to ensure frequent checks of your webpages are being performed [18]

The uptime monitoring of Pingdom is capable of sending transaction requests over different types of internet protocols such as HTTP, UDP and DNS [20]. This can help pinpoint the specific root cause behind arising uptime issues and whether various features



of the website works as intended. If Pingdom notices that one of these transactions are not being completed, it is possible to get notified in several different ways including email, SMS and push notifications. This ensures that the developers behind the website can swiftly react to the issue at hand. Furthermore, the commissioned probes are placed all around the world in order to test that the website is accessible by different demographics [19]. This goes in line with the KPI regarding "Complete page load time" brought up in section 3.1.3 as you need to take different prerequisites into consideration.

## 4.2 Site24x7

Site24x7 offers a comprehensive package in regard to website monitoring. This package includes the option to simulate user experiences. Once again, this is accomplished through synthetic monitoring in which certain critical user flows are recreated. This could, for instance, be a multi-step transaction which includes selecting and adding different items to a shopping cart [21]. The importance of monitoring the overall user experience becomes evident by the fact that it can help shed a light on how well difference design requirements are being fulfilled as brought up in section 2.1. Realizing that some business-critical transaction is being hampered due to, for example, slowness can be crucial to detect so that potential customers do not get lost. Furthermore, site24x7 also makes it possible to monitor from different locations from around the world.



Figure 4: Example of a multi-step transaction on an e-commerce website that can be monitored using Site24x7 [21]

### 4.3 Fluxguard

Fluxguard is a website monitoring tool specifically aimed towards notifying defacement attacks which was brought up in section 3.3. The service accomplishes this type of monitoring by providing multiple different types of change detection. These includes, for instance, comparing the rendered HTML between different visits to the webpage as well as extracting user-visible content such as text that could be changed through defacement attacks. If these detection mechanisms notices an anomaly, the owner behind the website can get notified immediately through email or SMS. If a change has been detected in regard to the HTML, Fluxguard will send a report which details the HTML code before-and-after the attack [22].

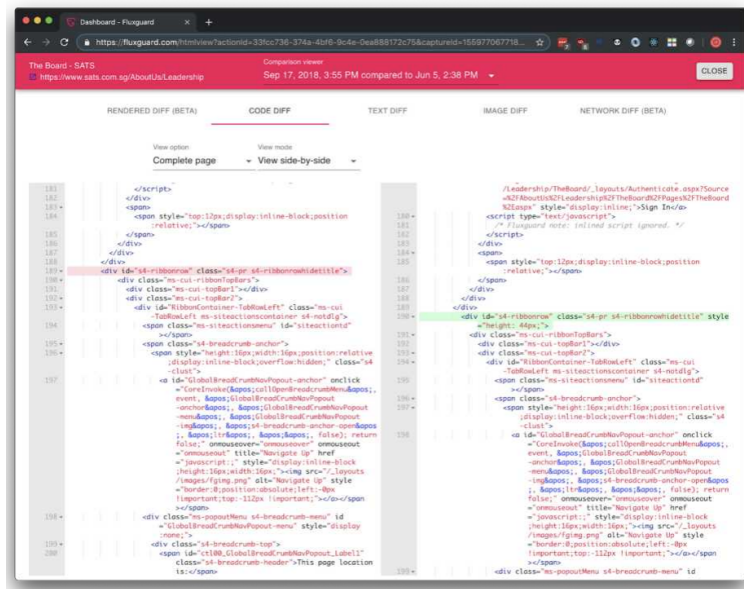


Figure 5: Example of a Fluxguard report giving detailed information regarding changes made to HTML elements.

Fluxguard also provides more advanced options when it comes to noticing defacement attacks. One example of this is monitoring changes being made on a pixel-level through so called automated visual regression testing. This technique involves taking screenshots of different web pages in order to detect potential changes in, for instance, images. Simply monitoring the HTML would not be sufficient when noticing changes made to images as the adversaries can employ subtle changes to the CSS that prevents noticeable changes to HTML elements. This type of monitoring can come in handy as monitoring text elements only ensures detection of "visible" changes to your web pages [23].

## 5 Conclusions

One overarching challenge in regard to website monitoring is the availability of countless different performance indicators to monitor. It can, therefore, be difficult to decide which type of information we deem to be most important as monitoring an abundance of different factors would introduce too much noise. Measuring the aforementioned KPIs in section 3.1 should be sufficient for someone starting out. They will provide you with a comprehensive overview of website's health.

One separate challenge relating to website monitoring is keeping all performance issues in check as many of them even fall outside the boundary of what you are capable of preventing. For instance, you cannot affect bandwidth limitations in different regions of the world which might put a significant toll on the overall user-experience. Even if that is the case, we can try to counteract these issues to the best of our ability by utilizing effective monitoring practices for our websites.

An abundance of choices is also apparent when it comes to different available monitoring tools. In terms of the aforementioned tools in section 4, the first two options would most likely be the most viable for someone looking for quite a comprehensive coverage as they provide a lot of different features. Fluxguard might excel at specifically detecting defacement attacks but this danger might not be that prevalent for everyone. One possible alternative that you should most likely consider is to sign up for a free trial. This trial period will most likely give you enough time to make a judgment about whether the tool at hand fulfills all your needed requirements.

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