Monitoring the Big Picture

A Modern Approach for Web Application Monitoring

OmniTI

availability . resilience . performance . scalability

Introduction

The complexity of today's web applications have gone far and beyond the capabilities of "traditional" monitoring tools and approaches. Keeping tabs on simple metrics such as hits, uptime and page load speeds, is not enough to provide a complete picture of application performance, nor is it sufficient to troubleshoot the increasingly complex technical and business issues that can affect web application performance. While major technical issues such as web outages have obvious impact on business performance, more subtle technical issues may have even larger impact despite the appearance of successful operations on the surface. For example, a coding error may prevent a small percentage of web application users from completing a purchase. Unless this error is noted and reported by users or identified through monitoring efforts, it may persist for months, leading to a more substantial loss of revenue than would occur from a widespread, but short, outage.

Most of these firms strongly believe that their current monitoring efforts are sufficient to run their businesses successfully. However, most of them are wrong

Although business and technical issues are intertwined in web businesses, monitoring efforts are frequently isolated and uncoordinated. Focused on their own objectives, administrators, developers and business personnel rely on different metrics and tools to assess the success of a web application's operations. The situation is reminiscent of the parable of the blind men and the elephant: upon encountering an elephant, each man touches one part in an attempt to understand the elephant as a whole. Needless to say, the man touching the elephant's trunk extrapolates a very different creature than the man touching the leg or the man feeling the tusk. Each perspective may be correct, but unless mapped together, the team supporting the web application has difficulty visualizing the elephant they must jointly manage.

This paper makes the case for taking a broader, deeper and more coordinated approach to monitoring. Its goal is to provide technical and business managers a greater understanding of the role and importance of monitoring in managing their web businesses. It will illustrate how a holistic, multi-disciplinary monitoring program can solve complex issues that cross business and technical boundaries and drive real improvements in business performance.

M erging technical and business monitoring efforts delivers significant synergies, enabling organizations to obtain a cohesive view of how their web applications affect their business.

What is Monitoring?

For the purposes of this paper, we define monitoring as the set of tools, processes and disciplines that collect, detect, diagnose and report on the performance of web applications and their environments. Monitoring provides fault detection and alerting, as well as trend analysis for post-mortem studies and long-term planning.

Currently, most organizations separate their efforts into two broad categories:

Technical Monitoring – Which ensures web systems are up, running and performing well, and collecting data for capacity planning and other technical strategies. Usually performed by systems engineers, administrators and managers within operations units and overseen by the VP of Technology or CTO.

Business Monitoring – Which ensures business processes are functioning as expected and the underlying applications are meeting business objectives. Usually performed by individuals such as business analysts, marketers and product managers within business units and overseen by the CEO, CMO and other senior business executives.

As the remainder of this paper will illustrate, merging technical and business monitoring efforts delivers significant synergies, enabling organizations to obtain a cohesive view of how their web applications affect their business. Thus, monitoring goes beyond simply reporting on the state of your systems to provide insight into the state of your business.

M onitoring matters. It is the best way to know that your web applications—and the business processes they support—are continuing to operate as intended. Focusing on the word, "continuing" is critical. Unexpected issues will arise: software breaks, hardware fails, performance lags, third-party applications go down. An application that was working perfectly a few moments ago may be costing your company business a few moments later. Whatever the reason, the results impact your customers and affect your business.

Seven Reasons Monitoring Is Important

1 Software is never perfect

Despite the best efforts of its designers, architects, developers and testers, application software is never entirely bug free or predictable. Requirements can be missed or misinterpreted; errors can be introduced during design and coding; and application users may use the software in unexpected ways. Potential impacts on a web application's ability to achieve its business objectives can range from minor to catastrophic. Even when properly performed, testing is unlikely to catch all defects; 100% testing is impossible for complex applications operating in complex environments and in most cases, testing efforts are constrained by time, resources and budget. While catastrophic errors are quickly apparent, monitoring provides valuable insight for identifying more subtle issues and minimizing their business impact.

2 Things change

Applications, their environments and users are constantly changing. System and environment modifications can affect performance, create bottlenecks or compromise previously functioning application components. Application enhancements can have unanticipated impacts on customer web behaviors. Evolving customer technology preferences result in a slow decline in the use of certain web application features. A new marketing strategy causes an unexpected change in buying patterns, shifting trans-

Monitoring is more than overseeing uptime and page load rates. A broad and effective monitoring program increases control, reduces risk, speeds issue resolution and, ultimately, improves business performance

action flow and volumes. Change may be inevitable, but without a baseline for comparison, it can be hard to assess and react properly to its impact.

3 You don't control your entire environment

Customers judge your business by your website user experience. But that experience depends heavily on the third parties your site relies on for functionality, advertising, data, computing capacity and a myriad of other services.

That experience may also be impacted by hackers and other malicious third parties. Third parties may be beyond your control, but your site's users consider them your issue. Monitoring can provide crucial notice of third-party issues as well as insights on how to decrease future issue impact.

4 Proactive is better than reactive

Monitoring gives you the ability to identify and address potential issues before they impact your business. The worst and mostly costly way to

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Case 1: The Impact of Ineffective Monitoring

A retailer's website displays content-appropriate ads sourced from an ad network on its product pages. Business analysts monitor the number of completed sales transactions, while operations monitors uptime and server performance. Due to inefficient application design, these ads load ahead of the retailer's own content as the page builds. This design is not an issue as long as the ad network is performing well. But one day, the business analysts notice a sharp drop in completed transactions. A quick call to the systems administrator reveals that it's not an operations issue; the web and application servers are up and performing properly. The underlying problem is that performance issues on the part of the ad supplier are slowing page loads to the point that buyers are abandoning transactions. *(see Figure 1)* Unfortunately, this aspect of performance is not monitored. The website appears operationally fine, but the retailer is losing revenue.
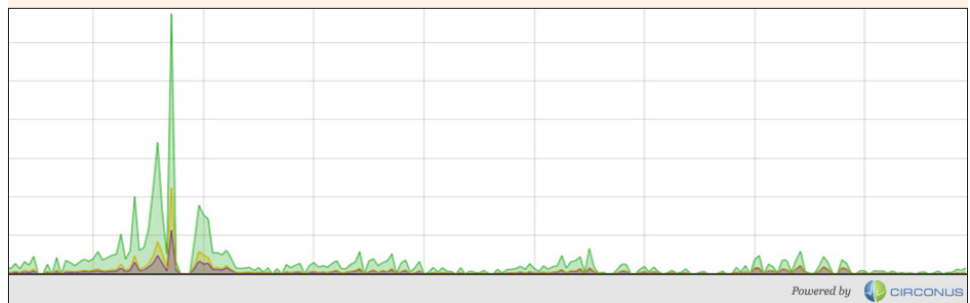

Figure 1: Effect of third-party ad service latency on website load time

Case 2: Identifying problem before it happens

One of the world's largest entertainment websites was relying on third-party software to power its customer support workflow. The vendor released a minor patch to the software, and IT performed a routine upgrade to the system. After the installation of the patch, all the regression tests passed, validating software readiness and functionality. However, looking at the monitoring dashboard, the trends showed that the database connections from the upgraded software significantly increased the load on the database, running a risk of impacting other business core operations in the near future, if running at the same rate. *(see Figure 2)* Tens of millions of users could be affected, and significant portion of the revenue could be lost as a result. Following its contingency plan, IT rolled back the patch and notified the vendor about a critical bug in the software. The patch was hot-fixed, correcting the issue, and went to production without impacting any of the end users.
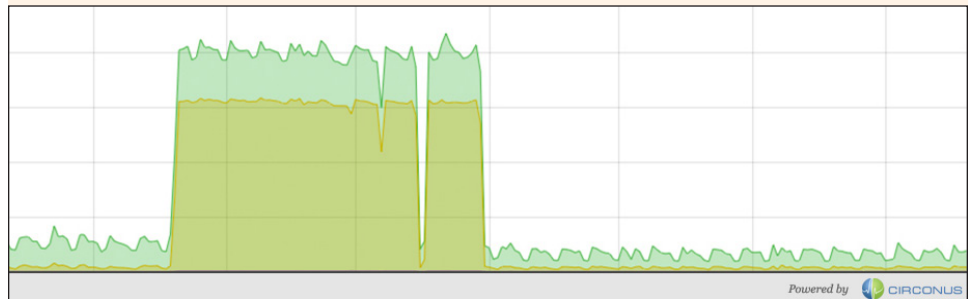

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Figure 2: Increase in database load cause by the software upgrade

discover an issue is to have it found and reported by your customers/users. At that stage, the issue is already impacting your business and brand reputation and your organization has to scramble to make corrections as quickly as possible. In contrast, monitoring current performance and activity levels against baseline trends provides advance notice that an issue is likely to occur, thereby enabling your organization proactively to avoid business impact entirely by taking the necessary preventative steps.

5 **Some situations can only be identified through monitoring**

Monitoring is the only method for identifying web site issues that are revealed by deviations from expected baselines or through trend analysis. Obvious examples include monitoring network and storage use against available capacity and tracking performance attributes, such as web page loading speed. However, monitoring can catch more subtle and complex issues, especially if multiple metrics are collected and compared. For example, a software error that affects only a small percentage of web site

CUSTOMER VIEW

Perception: Website is too slow

Actions: Abandon transaction, Buy product from competitor

TECHNICAL VIEW

Technical Monitoring Reveals:
• Page load times spiking upward
• Shift in exit pages

Asks:
• Do we have capacity issues?
• Is there a technical bottleneck somewhere?

BUSINESS VIEW

Business Monitoring Reveals:
• Abandonment rate rising
• Completed transaction dropping

Asks:
• Is there something wrong with our pricing?
• Are our terms turning off potential customers?

BUSINESS IMPACT

Reduced revenue (hard $)
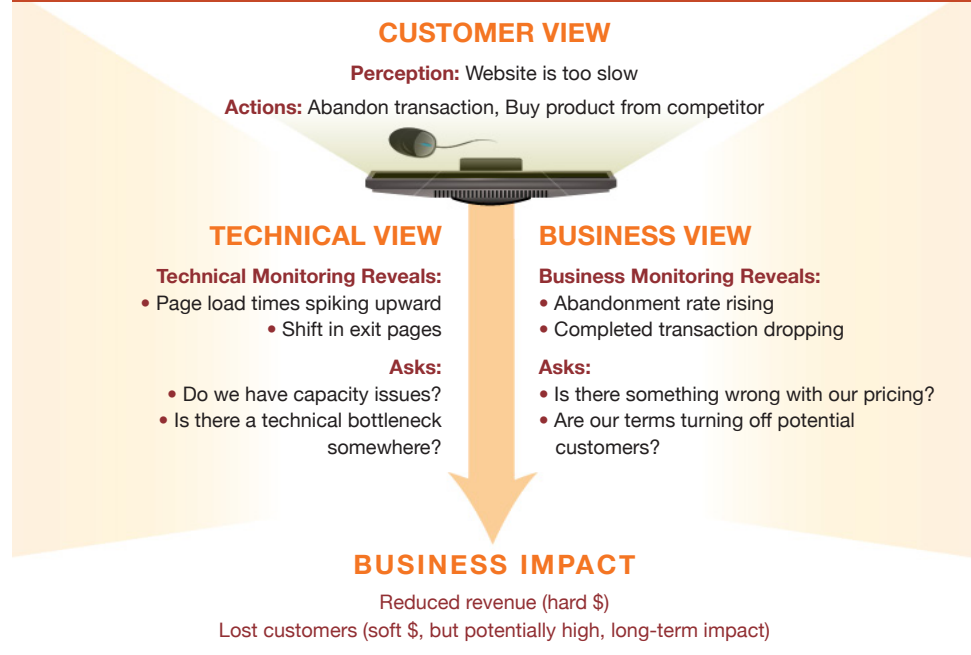Lost customers (soft $, but potentially high, long-term impact)

Figure 3: The Relationship Between Monitoring Metrics and Organizational Views

users may only become obvious when analyzing changes in historical usage patterns.

6 Monitoring produces invaluable information to assist troubleshooting

Given the complex, dynamic nature of today's websites, having as much information as possible is critical for effective troubleshooting. For instance, if revenue for a web marketed product declines by 10% over a given month, is it a performance issue (such as slow load times leading to higher abandonment), technical issue (a linkage issue that leads fewer prospects to the product), marketing issue (a change in the product's descriptive text made it slightly less attractive) or seasonal variation in buying patterns? Investigating each of these possibilities individually would be time-consuming, effort intensive and potentially wasteful. However, efforts could be directed to the most likely candidates by comparing multiple business and technical metrics using a monitoring dashboard.

7 Monitoring improves business performance

The most important reason for an effective monitoring program is to improve business performance. The ability to quickly identify and react

to issues and opportunities presented during web site operations helps companies get and keep customers, boost revenue and build brand reputation. It minimizes negative impacts by enabling faster correction when issues occur and maximizes opportunities by providing information to guide planning (such as capacity requirements for entering new markets) and strategy development (such as identifying which marketing campaigns and presentation methods are most effective).

Seeing the big picture: A holistic view of monitoring

Every web-based application is part of a much broader ecosystem; it is an integral component of a larger business, operates within a highly complex and interconnected technical environment, and aspects of its management are dispersed across multiple organizational units. It is designed and built by developers, and operated by systems administrators to meet specific objectives set by the business. Determining that the application is operating effectively within this environment requires a monitoring strategy that meets the needs of multiple constituents and goes beyond simply tracking technical metrics for uptime, response times and capacity.

Challenge 1: Aligning Objectives

In many businesses, multiple organizations oversee the operation of a given web application. Systems administrators manage the health of the system environment, developers are responsible for application health and business analysts ensure business goals are met. Each of these areas has its own focus and objectives, relies on its own metrics to monitor that goals are met, and may have very little insight into how its activities impact other aspects of the application's management. For instance, systems administrators in the operations area may have little knowledge about the application-specific functionality or how changes to the systems environment could affect that functionality. Similarly, business personnel seeking to better achieve their own goal, such as increasing registrations, may unleash a promotional campaign that overwhelms system capacity. More importantly, as shown in Case 1, ensuring the application is operating to one organization's goal does not necessarily mean the application is meeting its larger business objectives. Unless monitoring efforts are aligned, the end result is inefficient teamwork and cross-departmental fingerpointing.

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While collecting basic capacity, network traffic and application performance metrics are essential for effectively managing a web application, these metrics provide only a partial picture of the application's true status to its constituents and are rarely truly actionable on their own. For example, if the volume of hits for a given web page suddenly goes up or down; what does that mean? Does that change have any business impact? Is it indicative of a technical issue or the effects of a social media campaign? Is it merely interesting or does it require immediate attention? And if so, what is the proper course of action? Answering these questions

Case Study 3: Holistic Troubleshooting in Action

A large e-commerce company operating a very complex system with multiple revenue generation points, supporting 80 million users and 1 billion annual transactions, discovered that revenue dropped lower then the projected trend. Fortunately, the company's monitoring software supplied sufficient data to target troubleshooting. Reviewing a trend graph of revenue showed a clear drop in revenue beginning on a specific date. Combining this graph with web traffic trends showed a simultaneous drop in traffic. *(see Figure 4)* This information indicated that the revenue drop was associated with the traffic drop, rather than to application or payment processor issues that prevented customers from completing transactions.

The next step applied trend data on load times, database health and CPU usage. These metrics did not deviate from their norms, enabling the troubleshooter to eliminate the underlying platform as an issue without the need to perform deep dives into the health of individual components. With systems issues eliminated, the next action was to evaluate marketing campaign performance.

The company sends out tens of millions of emails a day to attract new users, and subsequently, generate new conversions. If the campaigns are ineffective or the emails fail to reach their targets, traffic to the site slows, leading to a decrease in the number of transactions. Examining a trend graph of email bounce rates showed that bounce rates skyrocketed at the same time as the drops in traffic and revenue occurred. Closer investigation revealed that one of the major ESPs accidentally blocked the company's delivery domain, preventing the emails from reaching their intended recipients. The issue was resolved (after some discussions with the ESP) and the trends returned to the expected level. The ability to merge and compare trends across business and technical domains enabled rapid resolution of the issue and with little wasted effort across teams.
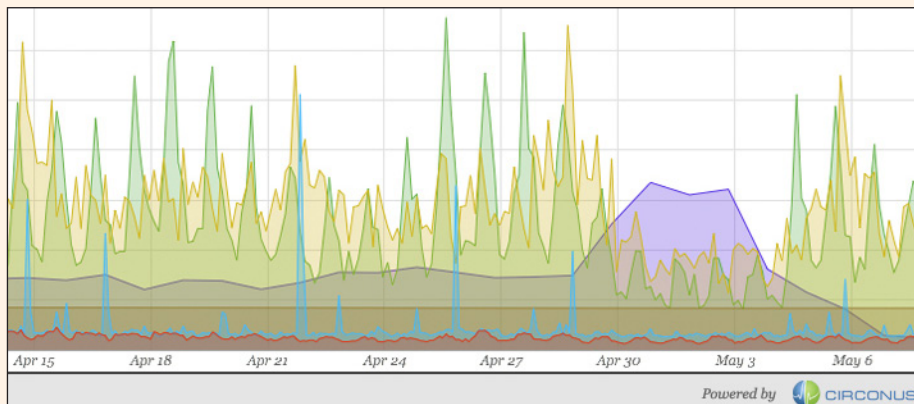

Figure 4: Holistic view of system performance

requires context that can be supplied by other monitored metrics. Knowing that the network, server and storage environments were operating properly at the time, that applications modifications were deployed just prior to the change, and that completed business transactions simultaneously dropped, supplies the necessary context to quickly answer these questions.

Challenge 3: Focusing on the Right Information

Collecting multiple business and technical metrics helps to ensure the necessary information is available when needed for troubleshooting or to follow trends. On going monitoring can, and should, collect large volumes of data for analysis. Further, any metric worth reviewing should also be used for graphing and trending. Correlations between events are not always obvious in real time, but become apparent when viewed historically. Access to historical data also presents a clear picture of what "right" looks like, making it far easier to determine when and what is going wrong. Understanding the relationships between business and technical metrics helps to determine which metrics truly matter. Further, it accelerates troubleshooting by enabling issues identified through a business metric to be mapped to the related technical metrics (and vice versa). More often than not, as shown in Figure 4, interpreting the reason behind a change in one metric requires following a chain of impact through multiple metrics.

The first step toward establishing an effective monitoring program is to collect and combine business and technical monitoring metrics

Solution

An effective monitoring program addresses the challenges described above by taking a holistic view of web applications, their environments and the businesses they serve. It does so by capturing, relating and displaying metrics relevant to its multiple stakeholders in a way that provides a "big picture" of overall performance as it impacts the business. This approach supports the individual needs of developers, network engineers, administrators, business analysts and executives, while providing the context to align their actions to a common set of business objectives. Whether merging existing initiatives or launching a new monitoring program, the following four steps will enable web businesses to significantly increase the value gained from their monitoring efforts.

Broaden the scope of your monitoring program

The first step toward establishing an effective monitoring program is to collect and combine business and technical monitoring metrics. Expanding existing technical monitoring programs to include full coverage of critical business metrics ensures your web-enabled business, as well as the technology that supports it, is functioning properly. For example, a web business that relies on site registration (beta sign-up pages, membership sites), may want a business check to make sure the hourly number of registrations does not drop below a set threshold. Similarly an e-commerce application could benefit from a business metric that monitors credit card transaction success vs. failure ratio to ensure the sales process works as expected. Metrics such as these not only support monitoring and troubleshooting efforts, they supply considerable business intelligence to enhance decision-making and optimize business performance going forward.

Set business objectives

The primary focal point of a holistic monitoring initiative is ensuring that web applications are efficiently and effectively achieving their business goals. Clearly identifying these objectives establishes priorities, enables monitoring metrics to be evaluated based on the contributions to the business, and aligns organizational actions to a common goal. It focuses discussions about applications, servers, web properties and other infrastructure/systems, first and foremost on making sure that business goals are satisfied.

Questions to ask when determining an application's business objectives include:

What specific benefits/results is the application supposed to deliver for the business? Build a list of objectives

How do you determine if those benefits/results are being achieved? Identify measures for each objective

What are the current and future performance expectations for each objective? Set monitoring and trend targets

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Map business and technical metrics

Once the business objectives are determined, the next step is to identify the technical metrics that affect the associated business metrics. Mapping the relationships between technical metrics and business objectives adds context and highlights the mutual impacts. For instance, the credit card transaction success vs. failure ratio measured by an e-commerce business depends on the availability of the application server, connectivity to a third-party authorization service, and availability and performance of that service itself. If an outage of the authorization service occurs, it will translate into a higher ratio of card transaction failures. Conversely, a higher ratio of card transaction failures may be caused by an issue highlighted by one of the associated technical metrics. Complete this step by determining the sources for the metrics to be monitored. They may be available from one or more existing monitoring tools or may require obtaining a new tool or monitoring service.

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Implement a dashboard

The final step in the process is to assemble a dashboard to support effective monitoring. To create a holistic view, pick the most important business and technical metrics to display together. Seeing multiple metrics simultaneously provides a quick view of overall system health as well as supplying the context needed to rapidly chase down issues. *(see Figure 5)* Following the previous example, seeing an increase in card transaction failures along with network connectivity issues with the third-party authorization service prioritizes and directs remediation efforts by quickly ruling out other potential issues. Using charts and graphs on the dashboard to display trending information provides additional means to identify and remediate issues. For example, rising transaction rates over time can provide early notice of future capacity constraints. Or knowing that a web application averages 200 transactions an hour on a typical day with a normal range between 110 and 350 transactions will trigger an analyst to research a spike of over 500 transactions in a given hour.
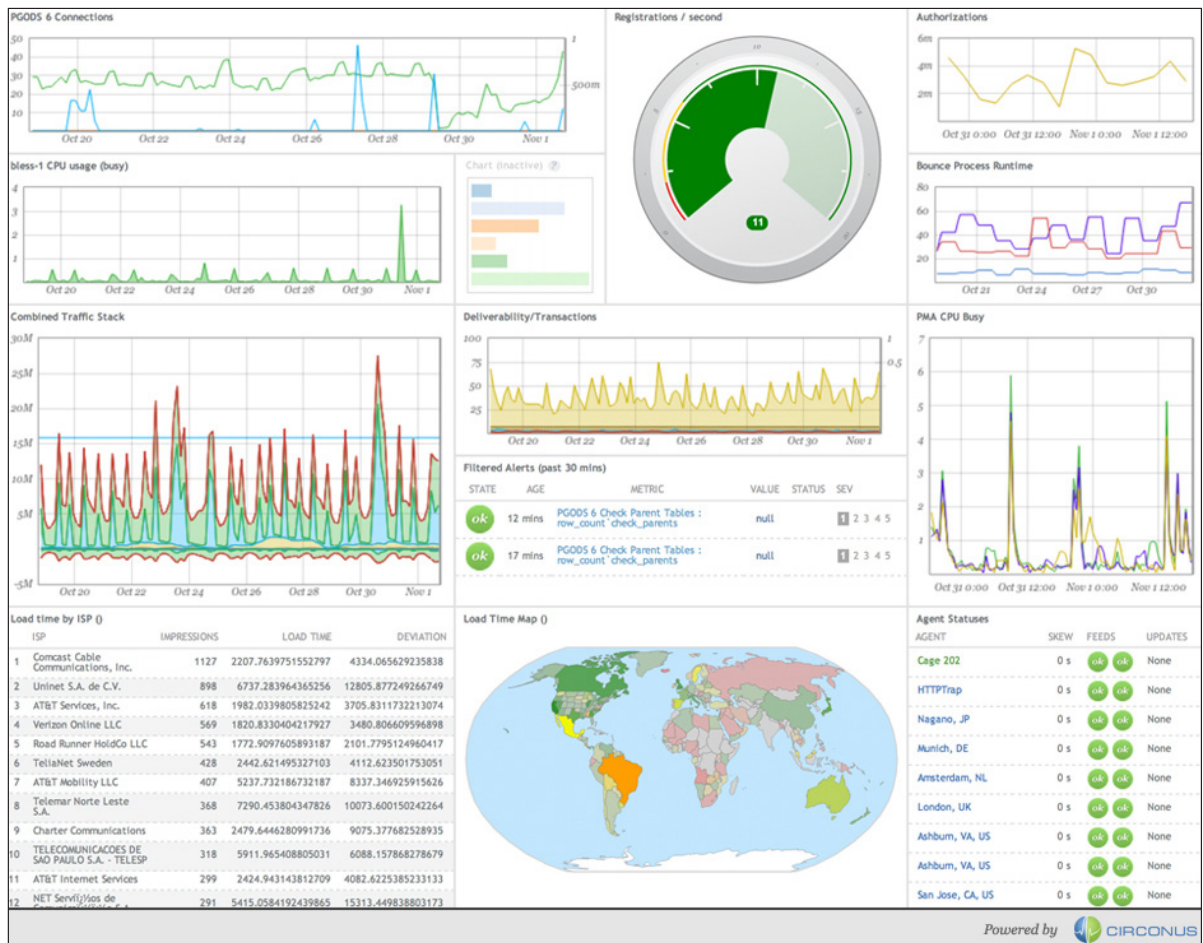

Figure 5: A Holistic Monitoring Dashboard

Conclusion

Effective monitoring is essential for running a successful web business. It improves business performance by accelerating response to issues and opportunities that arise from web application operations, helping your company get and keep customers, boost revenue and build brand reputation.

Regardless of their role, everyone responsible for the success of the business needs the ability to assess its status at any given point. Adopting a holistic approach to monitoring that integrates business and technology goals, and metrics provides executives, analysts and engineers with a clear picture of how the entire business is operating. It also provides invaluable data on trends and component interactions to guide planning, troubleshooting and strategy optimization. While system engineers don't need to understand the details of marketing, they should be aware of their company's marketing objectives and how the web applications they support contribute to, and are affected by, those objectives. Likewise, the CEO doesn't need to know how the web applications work in the background, but should be able to correlate the importance of key operating metrics, such as email bounce rates for an e-commerce marketing business, and their impact on costs, revenue and market perception.

While almost all web businesses perform some level of monitoring, companies would benefit by adopting a broader, more sophisticated and proactive monitoring strategy. Use the approach recommended in this paper to determine the business objectives, measures and thresholds that define the success of your web application and will drive your monitoring strategy. Create a dashboard that combines this business and technical information to produce a visually impactful, holistic view of your web business performance. Review existing web applications to ensure monitoring is sufficient and used effectively. If your current sources of monitoring data are insufficient, research, acquire, learn and deploy the right set of monitoring tools to support your new guidelines. When developing new web applications, incorporate the design and construction of business and functionality monitors within the scope of the projects to focus efforts on the most important success measures and maximize the benefit of monitoring efforts once the application is deployed.

A holistic, business-oriented approach to monitoring doesn't supplant the need for detailed metrics to support drilldown into specific components, rather provides a framework for seeing those metrics as part of a larger picture. With the right monitoring tools, the blind men described in the introduction could correctly understand the elephant and, certainly, assess its overall health!

OmniTI Leadership Team

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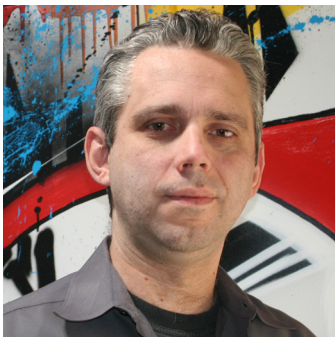
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