

# Innovative Approaches to Efficiency Evaluation and Oversight in Web 2.0 Applications

SATINDER KAUR<sup>1</sup>, AMANDEEP KAUR<sup>2</sup>

<sup>1</sup>Department of Computer Science & Engineering, Guru Nanak Dev University, Regional Campus, Sathiala.

<sup>2</sup>Dept. of Computer Science and Applications, Guru Nanak Dev University College, Jalandhar

*Abstract— The World Wide Web continues to evolve, providing enhanced customer experiences and greater application utility over the internet. The term “Web 2.0,” albeit vague, denotes the most recent and exemplary instances of this evolutionary progression. Numerous enterprises are currently embracing Web 2.0 technology and design methodologies to facilitate the development of more dynamic and engaging interactions. However, to be effective, the resultant apps must be considerably more intricate than conventional websites, hence complicating performance management and imposing additional demands on performance assessment tools. This paper examines the obstacles presented by the transition to Web 2.0 and elucidates how Keynote is tackling these issues within its Test and Measurement solutions package.*

*Index Terms- Rich Internet apps, accessibility, functionality, Keynote*

## I. INTRODUCTION

The Internet and the Web have emerged as the principal medium for business communications, evolving to supplant and replace antiquated technology. As software innovations use consistent advancements in Internet hardware, the Web continues to progress, providing enhanced user experiences and greater application functionality. In recent years, the term “Web 2.0” has arisen as a comprehensive designation representing both the present condition of this technical advancement and the most recent and exemplary instances of its implementation[1].

### *Characteristics of Web2.0 [2]*

The Internet as a Platform: Applications are exclusively provided via a browser located on a portable device, such as a PDA or mobile phone.

A Collaborative Environment: Unlike traditional websites that merely disseminate material, numerous

Web 2.0 platforms serve as a nexus for content exchange.

Social networking: Numerous Web 2.0 applications incorporate functionalities that link individuals with shared interests.

Hybrid Applications (Mashups): Standard web protocols and interfaces facilitate the integration of data and functionalities from existing applications by third-party developers.

Rich Media Interfaces: In contrast to the initial notion of the Web as a compilation of HTML hypertext documents, user interfaces have evolved to be more dynamic and interactive, integrating diverse media such as audio and video streams, as well as voice interactions.

Richard Monson-Haefel of the Burton Group characterizes Web 2.0 as an architecture of participation that emphasizes its interactive nature, constructed upon the World Wide Web.[3][HAE1]

This paper commences with a succinct introduction to the properties of Web 2.0 and RIA architecture. Section 2 addresses the parameters for website effectiveness and delineates the assigned roles. Sections 3 and 4 present issues associated with measuring Web 2.0, along with proposed solutions. Section 5 presents the conclusion.

The most sophisticated illustration of the Web becoming into a platform is the rich Internet application (RIA). The RIA architecture signifies the progressive evolution of Web applications.

Transitioning from a basic thin-client web browser to a more sophisticated distributed-function paradigm that emulates desktop behavior within a client/server approach. Enhanced user experiences are being realized through the utilization of "client-engine" technologies such as Flash, Ajax, and Java, employing standard Internet and Web protocols.

#### Assessing RIA Performance

This architecture complicates performance assessment, which aims to comprehend the customer's experience. In a Rich Internet Application (RIA), the duration required to finish a Web page download may no longer align with user perception of significance, as the client engine may be prefetching certain downloaded content for subsequent utilization. Conventional technologies that assess the duration of Web page downloads may yield deceptive data for Rich Internet Applications (RIAs). In certain instances, the client engine may refrain from initiating any normal Web page downloads at program launch, relying solely on asynchronous background interactions for all server queries.

To successfully use RIAs, organizations must reassess their performance management strategies. Rather than depending on the specification of physical Web pages to dictate the segmentation of application response times, RIA developers or tool users must decompose the application into logical pages. Measurement instruments must identify significant application milestones or markers that indicate logical limits of relevance for reporting, and categorize the application's reaction time accordingly.

#### 1. Web Performance Management:

The majority of business leaders assess the effectiveness of a Web application by examining performance measures, including income, expenses, and customer happiness. The significance of those KPIs may differ depending on whether an application is designed for customers, partners, organizational members, or staff. Regardless of its audience or purpose, the efficacy of every website or application should be evaluated by a universal standard—how well does it accomplish its objectives?

In the context of a Web application, effectiveness entails achieving the established design and delivery

objectives, providing online experiences that result in customer satisfaction, and so accomplishing the intended business performance targets. The objective of a website is to convert potential customers into actual purchasers, which hinges on two critical components: initially attracting a sufficient number of potential customers, followed by successfully converting a significant portion of them into buyers. This study concentrates on the second essential factor—the conversion rate of a site—which relies on providing an efficient service to the clients who access the site. To do this, a site or application must satisfy the four specific requirements illustrated in Figure 1: availability, responsiveness, clarity, and utility, all of which are critical to its success. The Web 2.0 ecosystem presents novel methods to attain these objectives, while simultaneously introducing new problems.



Figure 1. Four dimensions of application effectiveness Common Goals, Divided Responsibilities and tools

In many organizations, responsibility for these four aspects of effectiveness is divided among four groups or departments.

- **Utility:** Business experts provide the content are specify the behaviour that are the site's purpose. Web analytics tools focus on it.
- **Clarity:** Design and usability professionals specialize in making it easy for customers to navigate the site. It is measured by User Experience (UX) tools.
- **Responsiveness:** Site developers build the site in ways that determine download speed. Measurement ad testing tools measure responsiveness and availability.
- **Availability:** IT Staff manage the systems that keep the site up and running while maintaining a consistent level of performance. Performance monitoring and reporting tools track availability and consistency.

Such an approach allows people to specialize—an essential division of labour, since few have the necessary skills in all four areas. But effectiveness depends on all four aspects, and on their relationships. Application utility is tied to user behaviour, which is driven by the clarity of the site, the design of the user interface, and the responsiveness of interactions between client and server components. The design and implementation of those components ultimately also determines application availability.

Thus the division of labour and responsibilities introduces the need for more coordination while the application is being developed, more measurement and testing as a precursor to deployment, and more monitoring and tracking after deployment to ensure its success.

#### 1. Measurement Challenges of Web 2.0

Just as development skills and responsibilities are divided, so too are the capabilities of measurement tools. The characteristics of Web 2.0 applications highlighted earlier—the network as a platform, collaborative environment, social networking, mashups, and rich media interfaces—create several additional challenges for all measurement tools. In increasing degree of complexity, these are:

- Measuring an increasingly diverse customer community
- Measuring the quality of collaborative interactions, in which customers both upload and download information.
- Measuring applications that incorporate a much richer variety of media and interfaces.
- Measuring application phases that no longer correspond to one (or more) HTML pages.
- Reporting data in ways that provide insight into Web 2.0 applications.

#### Getting the Right Data

To sum up the importance of these issues, consider the popular saying coined by Tom DeMarco: You can't control what you don't measure. Measuring the wrong things, or basing key management decisions on reports that contain incomplete data, is as bad, if not worse, than not measuring at all. So it's not wise to measure Web 2.0 applications using only the tools and approaches developed for traditional Web sites. Inaccurate data undermines the effectiveness of any

program of systematic performance management and causes performance-tuning skills and resources to be applied in ways that are not optimal. It can also lead to unproductive interdepartmental conflicts and disputes over service-level agreements with internal or external service providers when staff question the accuracy of the data, or discover discrepancies in data from different sources.

#### 2. Keynote Web Performance Management Solutions:

To maintain effective and optimal online business performance you need to address the Five Performance Management Challenges presented in the sidebar. Success in every one of these five performance management activities depends crucially on an organization's ability to gather and report meaningful, timely, and accurate measurement data with the focus on the right metrics. Since a key idea of Web 2.0 is enhancing the user's experience, it is vital to measure actual customer experience proactively. Keynote is the only vendor offering a complete set of performance monitoring solutions that meet the many new challenges posed by Web 2.0 applications. This section describes how Keynote's products address Web 2.0 performance management requirements.

##### 2.1 Measuring the Diverse Customer Community

On Web 2.0 sites, personalization options allow customers to tailor their experience of a site to their individual preferences, and sites are carefully designed to download and display contents efficiently and successfully in all major browsers. Because customers' experience depends on their Internet connectivity, sites may even adjust their content based on the browser's connection speed. Measurement data must reflect this diversity.

##### Keynote support for all types of connectivity

Keynote's global agent network reflects this, collecting measurements from a wide range of environments. For Keynote users who want to measure and track their site's upload or download experience for a diverse population of business customers and consumers, Keynote agents can measure sites over fiber, broadband (cable, DSL), dial-up, or 3G cellular networks.

##### Keynote support for browser diversity

Although statistics show that the vast majority of Web users still use Internet Explorer on Windows, usage of other browsers (Firefox, Safari, Opera, etc.) and other operating system platforms (Mac OS X, Linux) is increasing. For customers who wish to measure an application's performance on multiple platforms, Keynote's agents can identify themselves as any desired browser version or release. In keeping with its commitment to providing an accurate measurement of user experience on the predominant platform, Keynote plans to include Windows Vista OS platform support in the near future.

#### Keynote support for cached and uncached measurement

Browsers offer a variety of caching options. For example, some users may elect to disable caching for security or other reasons. For any site visited regularly, disabling the browser cache causes additional downloads and longer transaction response times. Most sites are designed with caching in mind to optimize responsiveness. However, Keynote can measure cached and uncached experiences separately for organizations wanting to understand and track both. Keynote's test and measurement products allow customers to track the fully cached user experience, and they provide the capability to exclude completely any subset of the cacheable content elements from the reported measurements. Keynote test and measurement services can be also configured to enable or disable caching between transactions.

#### 2.2 Measuring Upload and Download Performance

In traditional Web applications, customers consume content, so all performance measurement efforts have focused on download times as the key metric. But as Web 2.0 applications add collaboration and social networking features, customers also supply content. To ensure the quality of a customer's experience, it's therefore necessary to measure and report upload performance as well. For example, the user of a collaborative application might navigate to a product or member directory, complete a login or authentication dialog, search for a certain subject or interest area, browse the results, select a particular area of interest, proceed to an upload page or dialog, complete a browse dialog to select content to be uploaded from their laptop or desktop, entering some

additional descriptive metadata as appropriate for the application, and click the Upload button. Throughout this interaction download activities are minimal, and may respond rapidly. But if, after all this work, the upload stage is painfully slow, or fails altogether, because of congestion at the server end, that customer may be lost forever. For an organization needing to measure and ensure the quality of its customers' experience when contributing content to a collaborative or social networking application, Keynote's agents can measure both downloads and uploads.

#### 2.3 Measuring a Richer Variety of Media Keynote support for streamed content

The performance of streamed audio and video must be considered separately from that of other Web application content, because its delivery infrastructure and the Internet protocols it uses are different. Keynote has dedicated streaming agents that can measure the customer experience for applications having streamed content as a significant component.

#### Keynote support for mobile applications

A growing Web 2.0 trend is for companies to create mobile versions of some Web applications to support the growing handheld device community. Because of the platform and content differences involved, the performance of such a mobile application must be tracked and managed separately from that of Web users. If mobile users are a significant customer segment for any application, Keynote has a network of mobile agents that can measure and track their experience.

#### 4.4. Measuring Logical Web Pages

Traditional Web applications can be viewed as a series of Web pages, each of which requires a distinct download, initiated by an HTTP GET request. This model has been characterized as the Web page paradigm. Rich Internet applications deviate from this model, moving some processing to the client and introducing additional asynchronous server communications to support a more responsive user interface. In a hybrid or "mashup" application, some of those communications may be with third-party sites. To understand Web 2.0 application performance, an analyst may need to measure the performance of transactions (page sequences), single pages, individual

page elements, or selected groups or subsets of those page elements that comprise a “logical page” experienced by the customer.

#### Keynote support for AJAX transaction recording

Keynote measurement agents measure a Web transaction by invoking predefined scripts that represent usage scenarios (“clickpaths”) for a Web application and timing every detail of the resulting server communication for every element downloaded (or uploaded). Keynote customers create measurement scripts using a script recorder application, stepping through the application and capturing the desired navigation path and user actions. Because scripts for RIAs that use AJAX technologies may trigger downloads that do not affect the response time experienced by customers, a second phase of the recording process shows the user a complete list of page elements, letting them specify the subset of components to be included in “logical pages” and the boundaries between those logical pages. Complementing this feature, in addition to the former options of waiting until all downloads complete, or waiting for a specified number of seconds after a specified object is downloaded, the customer can specify complex selection logic to determine page completion during measurement. For example, a Measuring and Monitoring Web 2.0 Applications 10 user visiting the first page of a site may cause four video files to be downloaded. One is needed immediately; the others will be played later as the user navigates. Script logic can be used to record the user’s response time when the first file download completes, even though the Web page download is not complete. For AJAX-based RIAs, these features let customers measure and report on logical pages that are entirely different from the underlying physical page or pages. To confirm that the measurements produced by the recorded script will properly reflect a customer’s intent, a Transaction Tester feature permits interactive recording and testing of AJAX scripts.

#### Keynote support for logic within transaction scripts

Transaction scripts for Keynote’s measurement agents can include JavaScript logic, generating client inputs that include data derived from prior server responses. This capability may be needed (for example) when responding to complex application interactions that

ask a variety of questions to authenticate a user during a login step.

#### Keynote support for transaction tagging

One special use for JavaScript within a script is to inspect server responses and detect application-specific “tags”—distinct content fields inserted as markers. Site developers may choose to embed such tags in application pages solely to pass data to Keynote measurement agents. Keynote agent scripts can also recognize tags that developers have inserted for other purposes, such as to permit tracking by a Web Analytics tool or service. Regardless of their original purpose, such tags or markers can be recognized by Keynote’s transaction recorder and agents and used to define logical page boundaries. The content of a tag (or other HTML statement) can also be saved within the Keynote measurement data, then used to segment measurement results during reporting. Such data might, for example, be the identity of the server that served a page or content element.

#### Keynote support for Adobe Flash applications

For Web applications created using Adobe’s Flash technology, Keynote’s transaction recorder and script logic can be used to reproduce observed client-side behaviour and inputs. Because Keynote’s agents invoke and measure the behaviour of a standard IE browser, they render and measure all externally visible Flash application interactions. As Adobe creates and delivers more open Web 2.0 interfaces to its Flash technology, Keynote will exploit those APIs to capture more internal details (such as background server interactions) of RIAs implemented using Flash.

#### 4.5 Reporting More Than Web Page Metrics

Keynote support for analysis and reporting at all levels Using Keynote’s reporting tools (MyKeynote and Keynote Performance Scoreboard) the performance of a Web application can be viewed at many levels of detail. Overall transaction response can be broken down into pages (logical or physical). Below the page level, the download times of content elements and server interactions are available, and these times in turn can be broken down into many distinct response-time components (see Table 1).

The User Experience Time component helps customers identify and trend client-side processing

delays in Web 2.0 applications. It records client-side processing and rendering time and the time required to download client-side application code or browser plugins.

DNS lookup time
TCP connect time
SSL time
Redirection time
Request time
First-byte download time
Base-page download time
Content download time
Client time
User experience time

Table 1. Components of response time

Keynote support for component-level reporting and alerting

To further support detailed performance tracking and problem isolation, every measured component can be reported and graphed separately for use as input to Keynote’s alerting service.

Keynote support for selective exclusion of page content from reports

When reporting at the page level or transaction level, Keynote’s tools permit selective exclusion of content elements. A common use is for pages that include embedded advertisements. When the measurement goal is to assess the overall customer experience, reported times can include the ad delivery time. But if the goal is to monitor performance of the host Web server infrastructure, the response time of third-party ad content is irrelevant and can be excluded. This feature can be used for any similar purpose, but is particularly useful when monitoring hybrid Web 2.0 applications or “mashups” that include third-party content.

Custom components for reporting

When reporting transactions, Keynote’s tools also permit aggregate response time components to be defined at the transaction, page, or object level. Keynote can report and generate alerts on these custom aggregates.

Statistical analysis of measurement results

For the performance analyst investigating, tracking, or reporting on any of Keynote’s Web measurement data at any level of detail, Keynote’s tools offer several statistical analysis options (see Table 2).

Raw measurement data can also be downloaded regularly for inclusion in local analysis using Keynote’s data feed and data pulse APIs.

<b>Statistics:</b>
<input type="checkbox"/> Average
<input type="checkbox"/> Geometric mean
<input type="checkbox"/> Standard deviation
<input type="checkbox"/> Median
<input type="checkbox"/> Inter-percentile range
<input type="checkbox"/> Trimming of large or small outliers
<b>Displays:</b>
<input type="checkbox"/> Time histories
<input type="checkbox"/> Histograms
<input type="checkbox"/> Dashboard view

Table 2. Statistical analysis options

## CONCLUSION

When considering the need for Web testing and measurement, it can be tempting to view a Web application simply as a collection of Web pages. Adopting that simplifying view makes performance measurement and reporting tasks easier. But doing so ignores the dimension of Web performance most affected by Web 2.0, and maybe the most important feature of a Web application—the paths taken by Web users. For every Web application, a user’s ability to navigate smoothly through a relatively small set of business transactions—the “money paths”—is the key to business success. It is only by completing these key transactions that visitors are converted into customers, triers into buyers. Therefore, in addition to tracking key performance indicators like conversion rate, most organizations consider it essential to identify, track, and measure their key business transactions. By doing so, they can better understand and improve each application’s conversion rate—the second key to site effectiveness and therefore the health of the business. Keynote’s test and measurement products are designed to capture accurate and actionable information about transaction performance in the latest Web 2.0 technology environments. They measure and report at every possible level of detail you may need to test, measure, track, investigate, and manage Web application effectiveness.

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