

LABVANTAGE® ARCHITECTURE

DOCUMENT PURPOSE AND SCOPE

This document provides an overview of the LABVANTAGE hardware and software architecture. It is written for the audience that is familiar with basic internet and architecture concepts and is intended to provide the reader with a general understanding of the LABVANTAGE architecture.

LABVANTAGE ARCHITECTURE OVERVIEW

LABVANTAGE has, as its foundation, a web-based architecture that has been developed by LABVANTAGE for over a decade. This scalable architecture provides LABVANTAGE users, both internal and external to the laboratory, with the ability to access all authorized functionality within LABVANTAGE from virtually any connected device.

Figure 1 on page 2 illustrates the components of LABVANTAGE's architecture – end-user client, application server, web server, database server, and optionally, a report server. The various layers interact and connect seamlessly to create a scalable, high-performance environment. This environment allows

multiple application servers to perform in a cluster with the load balanced across each server. LABVANTAGE also leverages standard corporate infrastructures by enabling the open flow of information between internal and external systems and by enabling the integration of 3rd party applications.

End-User Client

LABVANTAGE supports access from any connected device running Microsoft® Internet Explorer, Apple® Safari, and Google® Chrome. This browser/server architecture greatly simplifies enterprise application deployment and administration with no plug-ins, downloads or applets required on the end-user client.

Application Server

The application server hosts the business layer of the LABVANTAGE architecture. Business layer objects are written as standard Java EE (formerly J2EE) Enterprise Java Beans (EJBs) and manage all requests for data and services. Using industry standard Java EE development techniques, LABVANTAGE can operate on Red Hat JBoss Enterprise Application Platform 5.1.0,

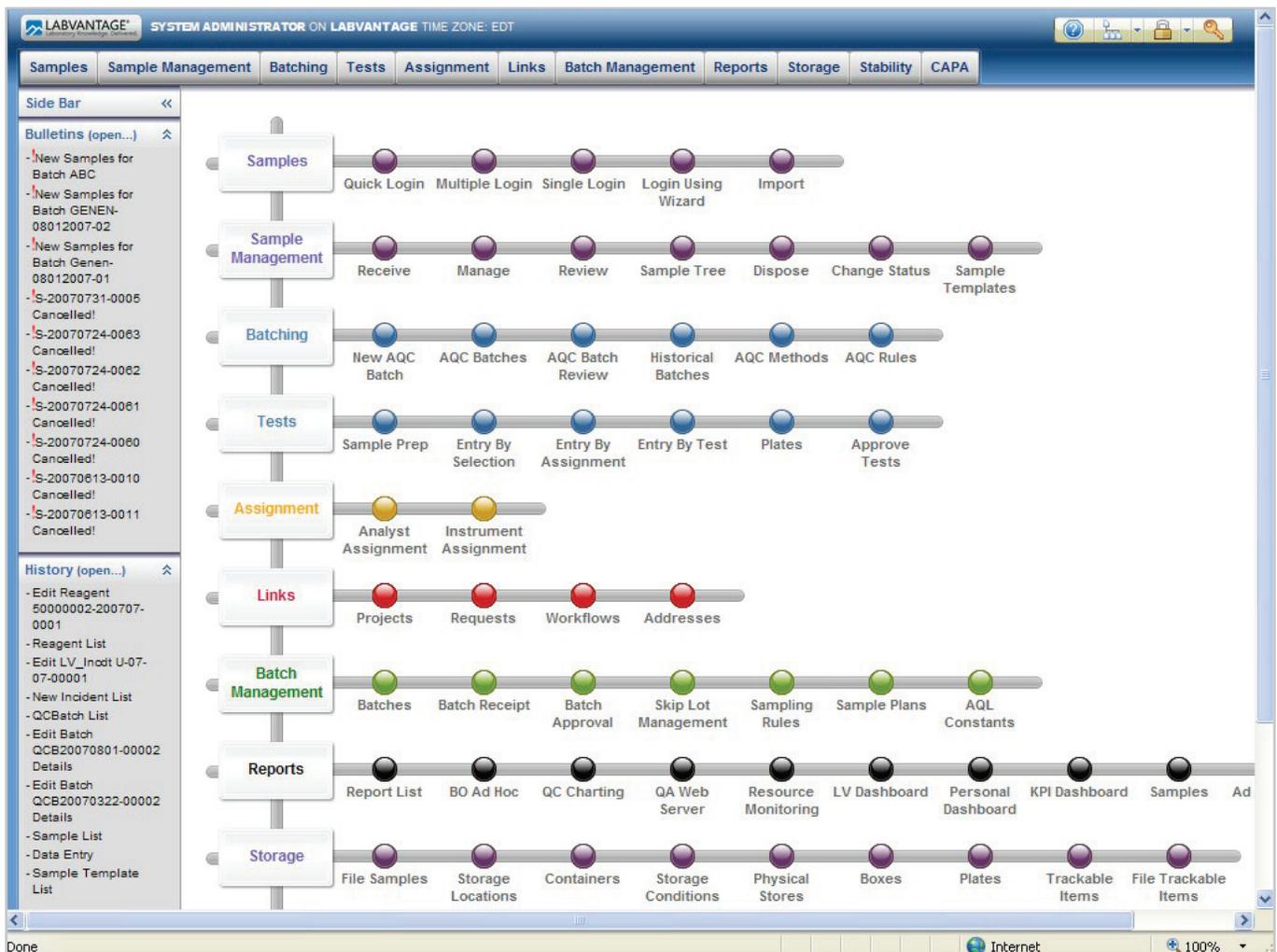
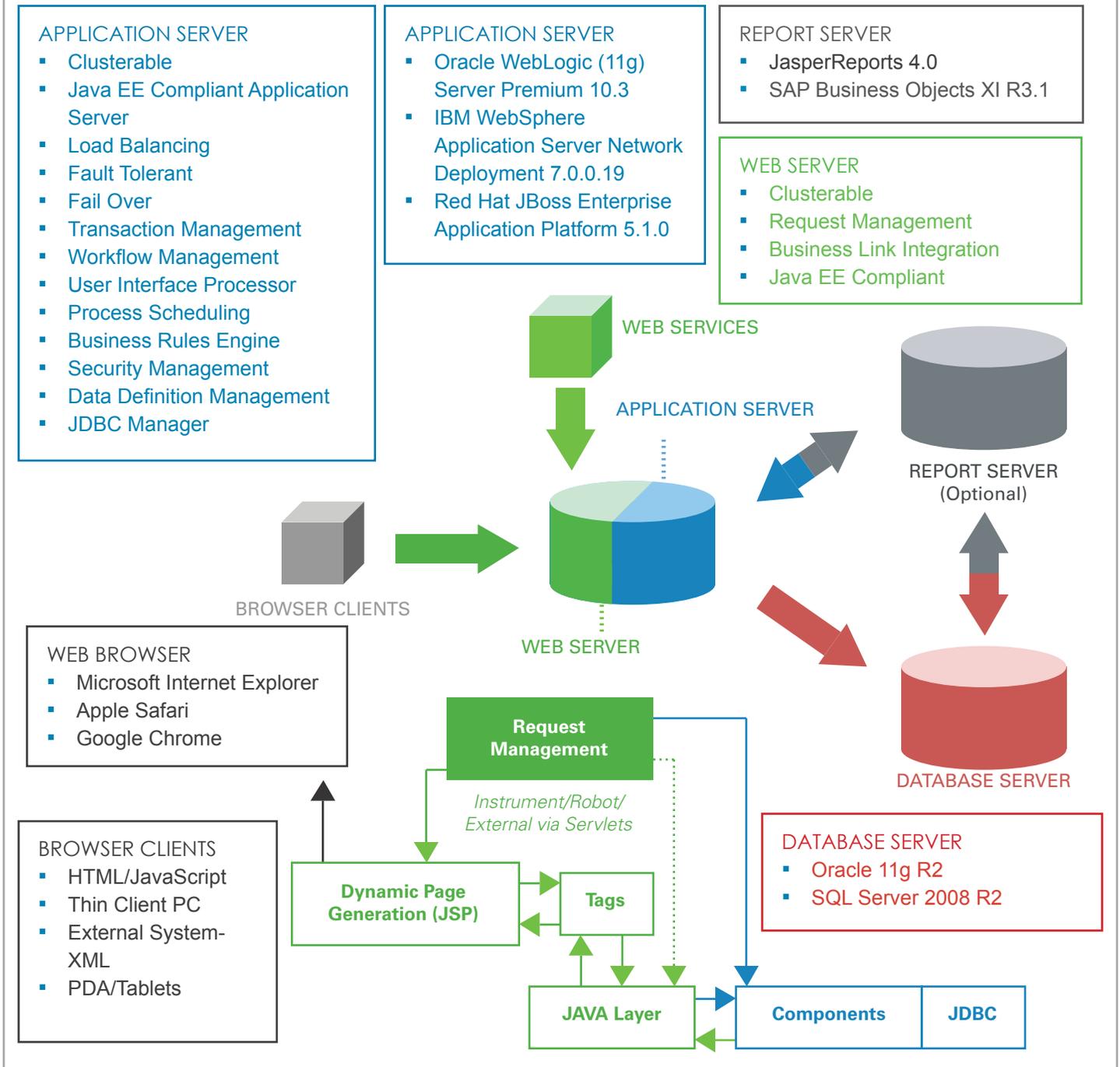


FIGURE 1: LABVANTAGE Internet Architecture



Oracle WebLogic (11g) Server Premium 10.3, and IBM WebSphere Application Server Network Deployment 7.0.0.19.

Web Server

End-user clients communicate with the web server – which is integrated into the application server – using standard HTTP requests via a request controller servlet. The servlet manages all requests by redirecting control to the appropriate service. Services may be authentication requests, web pages, attachment

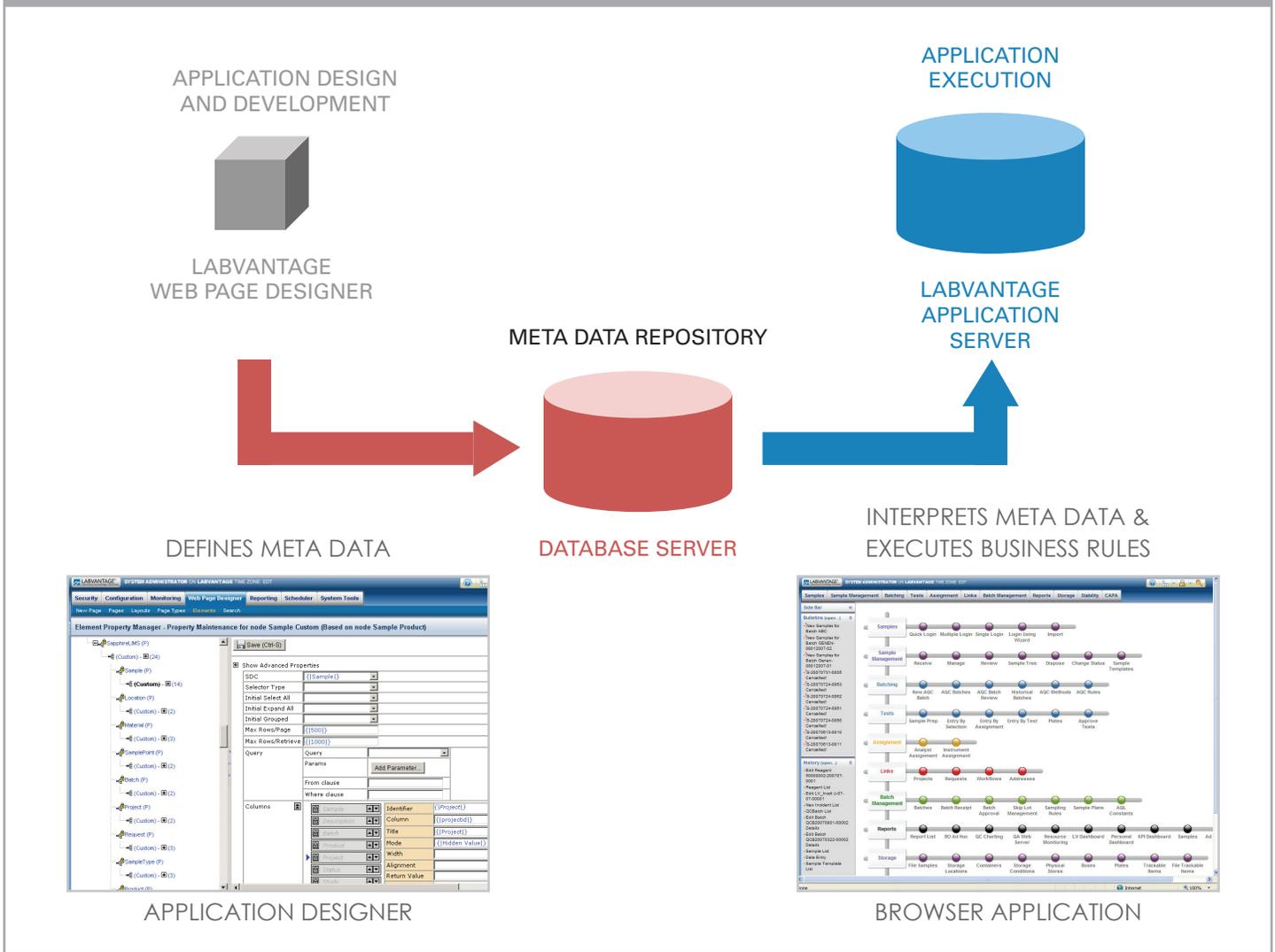
downloads, reports or other atomic operations, such as Asynchronous JavaScript and XML (AJAX) requests.

Pure HTML LABVANTAGE web pages are generated using Java Server Pages (JSPs). LABVANTAGE custom tags and Java APIs facilitate the generation process by communicating directly with the LABVANTAGE application server.

Database Server

The LABVANTAGE database is the repository for all

FIGURE 2: Meta Data Driven Internet Architecture



LABVANTAGE information, including application data, web-page metadata, and end-user data. LABVANTAGE can operate on Oracle 11g R2 and Microsoft SQL Server 2008 R2 databases.

The LABVANTAGE Web Page Designer provides an environment to rapidly create lab- and user-specific configurations without custom software application programming. The Web Page Designer metadata is used to drive the generation of LABVANTAGE web pages at runtime. When Web Page Designer saves an application object, it saves this definition to the Web Page Designer metadata repository within the Database server (see figure 2).

Report Server (Optional)

LABVANTAGE provides on-demand reporting and data visualization. Powered by JasperReports, a 100% Java solution, LABVANTAGE enables fast design and deployment of both operational and management

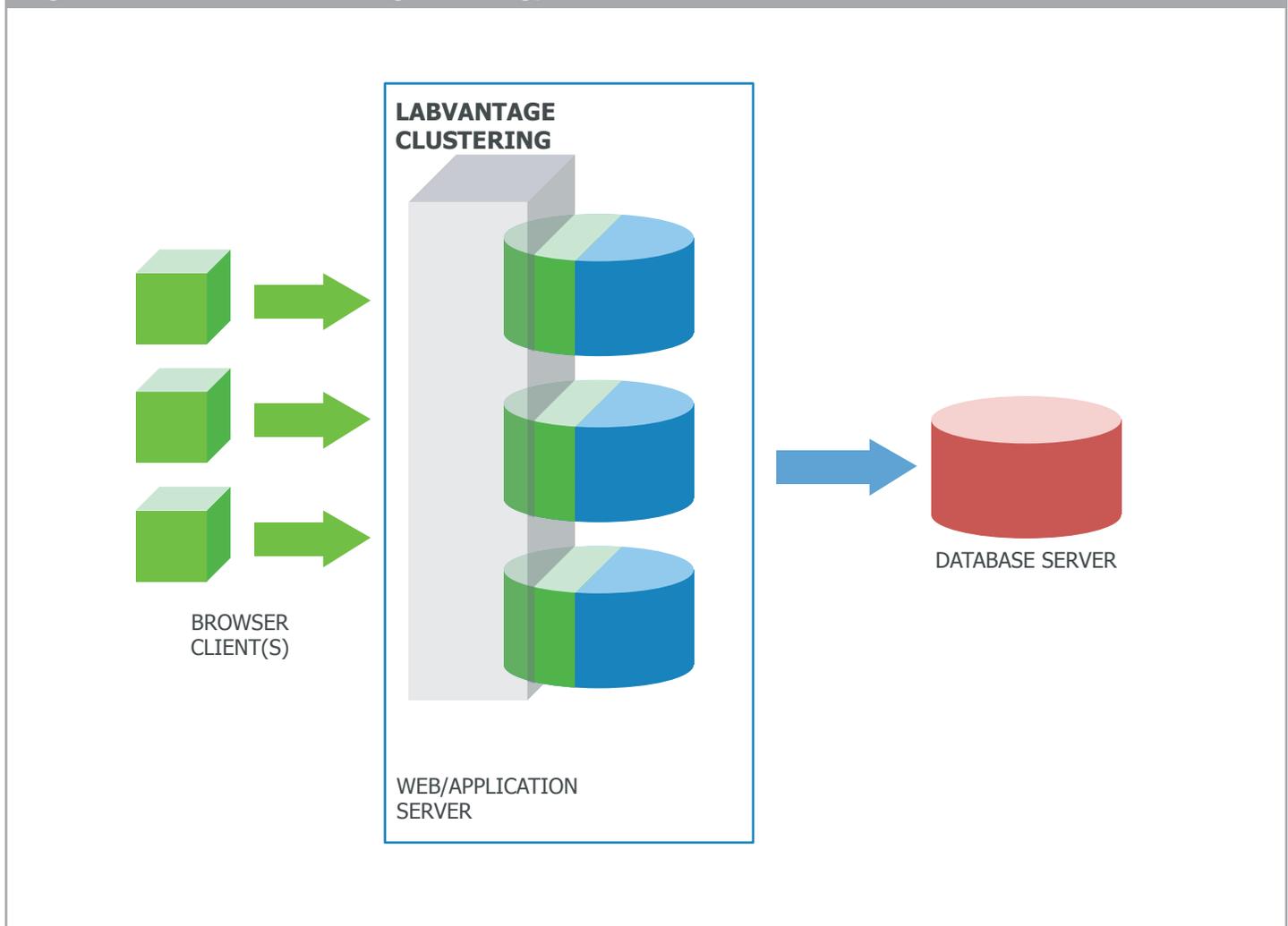
reports such as Certificates of Analysis, Stability Study Reports, Sample Pick Lists, Work Lists, and more. With LABVANTAGE and JasperReports, no additional report server is required.

LABVANTAGE also interfaces with SAP Business Objects™ XI R3.1 for the analysis and reporting of data. In this configuration, the BO Report Server hosts the BO software, as well as associated data and programs. For more information about how LABVANTAGE enables decision support, please refer to the Reporting & Analytics Brochure.

Extensibility and Integration

Although LABVANTAGE is a robust, pre-configured solution out-of-the-box that is configurable-off-the-shelf (COTS) software, it is extensible and may be both configured and customized via extensions to the data model, user interfaces, authentications, and business rules. LABVANTAGE’s extensibility may be achieved

Figure 3: LABVANTAGE Clustering Technology



through:

- Configuring the user interface through Web Page Designer, which also permits tailored presentations to meet a laboratory's or end-user's unique needs
- Extending the LABVANTAGE data model via the Data Definition Tool Kit incorporated into Web Page Designer, permitting the configuration of database objects to meet specific requirements
- Authenticating users and securing access to both the application and repository data, by integrating with Lightweight Directory Access Protocol (LDAP) systems
- Integrating with other systems or applications (e.g., authentication and business rules) or writing custom java actions that leverage LABVANTAGE's rich Java APIs accessible via web services

Scalability & Redundancy

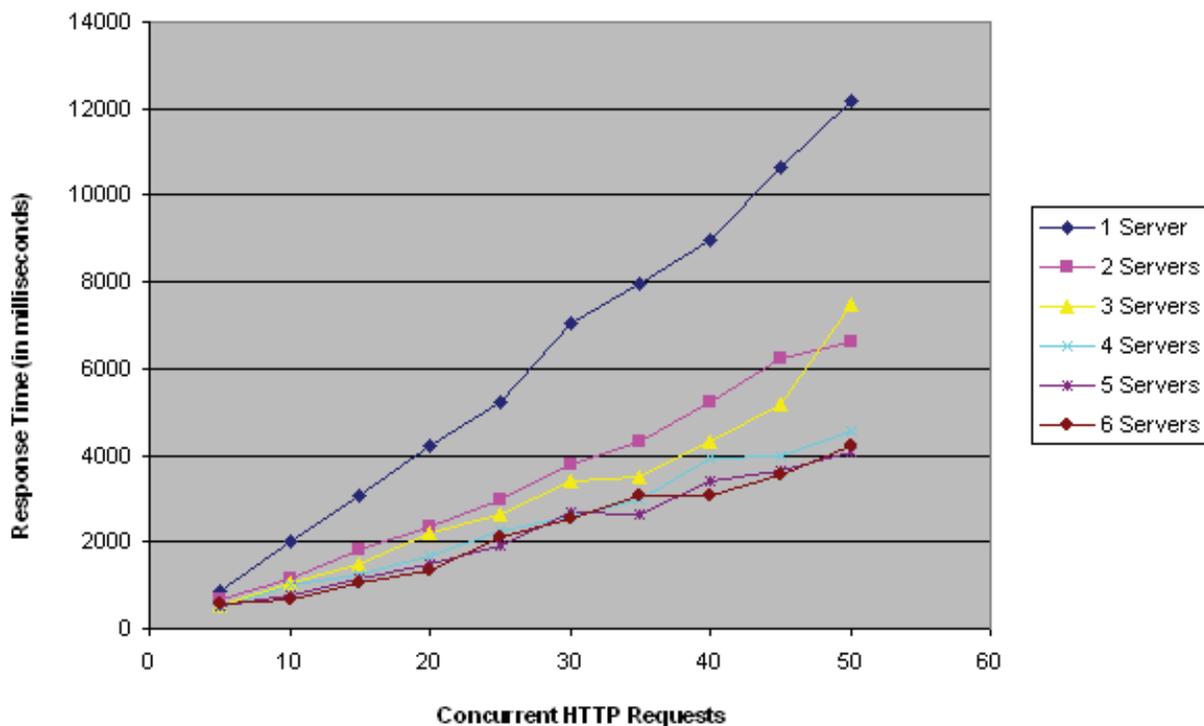
LABVANTAGE's scalability can be enhanced through

clustering of the application servers (see Figure 3). A cluster is a group of application servers that work together as a single logical server to manage client requests. With clustering, an increasing number of users can be supported without any fall off in performance.

Clustering utilizes load balancing, a process that routes client requests to the "best" ("best" is determined by the application server's specific load balancing algorithms) server within the cluster. With load balancing, overall throughput is scaled out by multiplying the number of users typically supported by a single server by the total number of nodes in the cluster. LABVANTAGE achieves HTTP load balancing by running a cluster of servers, whether for small clusters (up to 8 nodes) or larger clusters utilizing hardware alternatives for load balancing.

Clustering also maximizes LABVANTAGE's reliability by eliminating a single point of failure. If one or more servers fail, the cluster automatically routes future client

Figure 4: Benchmark of LABVANTAGE's Clustering Performance



requests to other servers within the cluster, providing continual service.

For more information regarding LABVANTAGE's scalability and performance, please refer to the LABVANTAGE Performance White Paper.

Multilingual Support

LABVANTAGE is the only LIMS with true multilingual support for user interface translation, time zones, regional settings, and date formatting, coupled with Unicode support that enables seamless multi-site and multi-language deployment and collaboration. This capability, coupled with LABVANTAGE's web-based architecture eliminates the need to provide multiple servers or thick-clients for international users. Simply put, LABVANTAGE's multilingual support functionality enables it to be end-user specific, rather than server or client specific. This greatly increases the speed and

reduces the cost of a global LIMS deployment.

For more information regarding LABVANTAGE's multilingual support capability, please refer to the Multilingual Support White Paper.

Summary

LABVANTAGE's architecture provides a powerful, low-cost, low-maintenance framework for today's competitive laboratory environment, particularly when compared to web-enabled or web-based implementations, which carry a higher cost of deploying applications to a large end-user base. By leveraging standard internet technologies, it provides easy access to disparate data using common web browser software. The architecture is scalable, highly reliable, and secure.

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