



Aras Innovator 10 Scalability Benchmark Methodology and Performance Results

**Aras Innovator 10 Running on
SQL Server 2014 Enterprise Edition**

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Executive Summary

This white paper presents benchmark testing and results for the second round of scalability load testing of Aras Innovator 10.

This second round of independent testing conducted by Logic 20/20 used Microsoft SQL Server 2014. Previous tests were run with Microsoft SQL Server 2012.¹

Testing was designed to mimic real-world usage scenarios and data structures. The user load and data set in the second round of testing were increased by 2x or more relative to the prior test scenario to demonstrate a step function improvement in scalability.

Tests verify that Aras Innovator 10 on SQL Server 2014 Enterprise Edition scales to 1,000,000 named users with 250,000 concurrent users while maintaining excellent performance.

The test data set started with approximately 25 million part items with 15,000 bill of materials (BOM) structures each containing between 900 to 3,600 parts across 3 to 6 BOM levels with 300 to 600 parts on each level.

Tests were run on standard, commercially available HP ProLiant seventh-generation data center hardware using Microsoft recommended database settings.²

The tests described in this paper were performed on a standard HP ProLiant DL980G7 server with 40 cores (80 logical processors) with two HP ioDrive2 Duo I/O Accelerators.

Load testing was conducted at 125,000, 150,000, 200,000, and 250,000 concurrent users to monitor for page response times, RAM usage, CPU utilization, disk queue length, and other performance metrics. Test results are summarized below:

- Average response times were excellent across the different user loads from 125,000 to 250,000 concurrent users.
- Performance at the 250,000 user level demonstrated average response times for all operations of 0.069 seconds.
- No hardware bottlenecks were observed during any of the tests.
- Under the heaviest load average CPU utilization was generally below 10 percent and was never higher than 20 percent.

The results of the tests indicate that the performance of Aras Innovator 10 running on SQL Server 2014 Enterprise Edition scales consistently and nearly linearly with hardware as the data set and user count are increased.

Testing validates that Aras Innovator 10 on SQL Server 2014 Enterprise Edition can handle an extremely high number of concurrent users and data when running on standard server configurations.

¹ [Aras Innovator 10 Scalability Benchmark Methodology and Performance Results on SQL Server 2012](#)

² [Database Server Configuration Best Practices for Aras Innovator 10](#)

Introduction

Product Lifecycle Management (PLM) software has become increasingly important for enterprises to conduct global product development with suppliers worldwide and manufacturing at multiple locations, however, industry trends are pushing many corporate PLM environments beyond their scalability limits.

Continued growth in product complexity, such as systems that bring together sophisticated mechanical designs, electronics, software and firmware, is resulting in more complicated processes around the world and across the extended enterprise. Geographically distributed engineering centers, supply chains with design authority, outsourced manufacturing, and design anywhere / build anywhere strategies are all driving PLM user counts to new levels and forcing the need for greater PLM scalability.

To address these new scalability requirements Aras has introduced Aras Innovator 10 enabled on Microsoft SQL Server 2014 Enterprise Edition to provide a new level of PLM platform scalability for enterprises with global supply chains and a significant number of PLM users. Aras Innovator 10 is based on an innovative web architecture which scales up and scales out and which was designed specifically for large, distributed enterprise scenarios.

This paper presents the independent benchmark testing conducted by Logic 20/20, the methodology used and the results achieved which validate the scalability and performance of Aras Innovator 10 on Microsoft SQL Server 2014 Enterprise Edition for the largest, high user count PLM workloads.

About Aras

[Aras](#) is a global company providing the next generation of enterprise Product Lifecycle Management (PLM) software. The Aras team includes executives and technologists from across the PLM industry, and the company focuses on delivering a full-featured PLM suite out-of-the-box that is more easily adapted to companies' specific competitive practices rather than forcing them to compromise to fit the software.

An open architecture with advanced PLM platform technology makes Aras more scalable, flexible and secure for the world's largest organizations, and a full set of applications provide complete functionality for companies of all sizes.

With business solutions for global product development, multi-site manufacturing, supply chain operations and quality compliance, Aras is ideally suited for companies that have complex products and processes.

- "What really drove our selection of Aras was the comprehensive PLM functionality and advanced technology."

- Tony DeGregorio
CIO, Textron Defense Systems

Aras is offered in a SaaS-style subscription (Software as a Service) which eliminates PLM license expenses for a lower total cost of ownership and faster time to value than traditional PLM systems.

Companies running Aras include Boeing's Insitu, Freudenberg, GE, GETRAG, Hitachi, Honda, Mitsubishi, Motorola, TEVA Pharmaceuticals, Textron, XEROX, the US Army, and thousands of others worldwide.

Aras Innovator 10

Aras Innovator 10 is Aras' flagship product and is a modern, lean, and scalable platform with a suite of PLM business solutions that deploy quickly and adapt easily to evolving business needs at a low total cost of ownership.

An HTML5 web browser user interface provides application functionality for:

- Multi-CAD data management and mechatronics
- Bill of Materials (BOM) management
- Requirements management
- Configuration management
- Enterprise change workflows
- Stage-gate program management
- Project portfolio management
- Quality compliance, APQP, FMEA, CAPA and other PLM processes

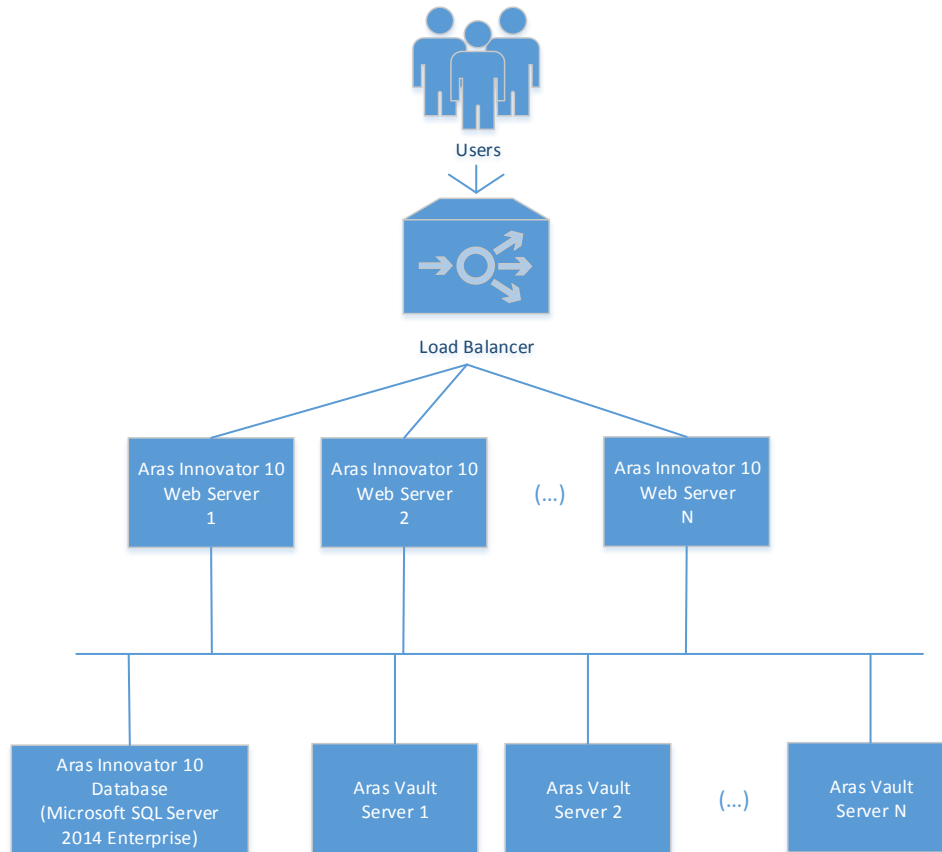
- "In switching to Aras we now have a highly capable, global PLM platform."

- *Bruce Leidal*
CIO, Carestream Health

Aras Innovator 10 is built entirely on proven infrastructure technologies and open web standards. Because of its web architecture, Aras Innovator 10 provides a range of deployment options including conventional data center, private and public cloud, or hybrid scenarios with compliance-grade security and robust integration capabilities.

The underlying enterprise application framework in Aras Innovator 10 is a model-based service oriented architecture (model-based SOA). The model-based SOA technology is a metadata architecture with a dynamic schema that relies on a loosely coupled set of federated web services designed for scalability, flexibility, and extensibility.

The model-based SOA technology in Aras Innovator 10 enables scalable performance whether running business applications out-of-the-box or highly customized. Applications are changed by modeling instead of complex coding and compiling which makes satisfying specialized business requirements faster and easier while performance remains consistent and upgradability is maintained without impacting the customizations.



The Aras Innovator 10 architecture employs a scale-out and scale-up approach. Application services are hosted on scale-out web servers. File containers (CAD models and drawings, documents, and other files) are stored in scale-out vault servers with replication. The Aras Innovator 10 database is used to host metadata which is ideal for storage in a relational database server and leads to excellent scale-up capabilities³.

SQL Server 2014 Enterprise Edition

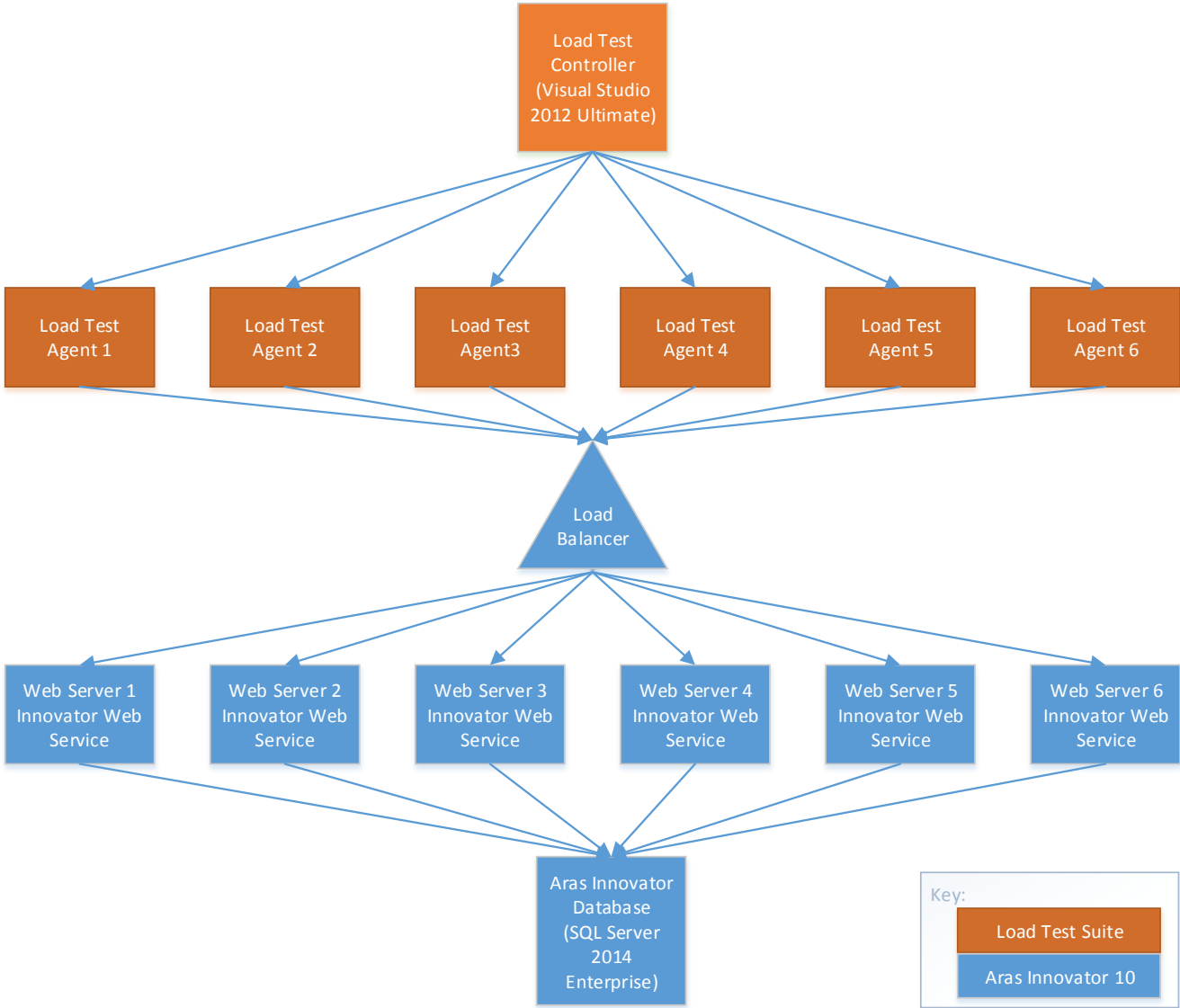
Aras Innovator 10 utilizes Microsoft’s SQL Server 2014 Enterprise Edition database for persistent metadata storage. SQL Server 2014 is designed to deliver comprehensive, high-end data center, cloud, and hybrid capabilities for mission-critical applications.

SQL Server 2014 Enterprise Edition has introduced a wide range of performance and scalability enhancements into the database engine, to enable even greater support for big data and demanding workloads. In-Memory OLTP and Buffer Pool Extension to SSD along with a new design for cardinality estimation logic provide new levels of performance for mission-critical applications. Other improvements include greater processing, memory capacity, and increased partition support. Together, these capabilities help SQL Server 2014 deliver predictable performance at scale for the world’s most demanding applications.

³ Additional information about the Aras Innovator Architecture can be found at [PLM alpha](#).

Benchmark Methodology

The following sections discuss the specific methodology used in conducting the Aras Innovator 10 benchmarking. The diagram below depicts the physical structure of the benchmarking environment.



Microsoft Visual Studio Ultimate 2012 was used in benchmarking to simulate user load. Visual Studio Ultimate’s distributed load test tool allowed for the benchmarking tests to be run remotely and concurrently on multiple computers (load test agents), generated high numbers of user sessions, and captured performance metrics.

Test Hardware

HP ProLiant DL980G7 with Two HP ioDrive 2 Duo I/O Accelerators

Testing was conducted on an enterprise class HP ProLiant DL980G7⁴ system, which featured the Intel® Xeon® CPU E7-4870. The system had the following technical specifications:

- Four 2.4GHz processors with a total of 40 cores (80 logical processors)
- 256 GB of RAM
- Two 2410 GB ioDrive2 Duos⁵
- Eight solid state drives (SSD)
- HP 5900 10 GbE Network Switch
- HP 10Gb 530T Ethernet Adapter

Test Scenarios and Methods

One of the goals of the second round of testing was to accurately simulate a real-world work environment with 1,000,000 named users and between 125,000 and 250,000 concurrent users.

The test environment was set up with the following data:

- 1,000,000 named users
- 25,000,000 parts
- A randomly generated set of approximately 15,000 BOM structures
 - Each BOM structure contained between 900 and 3,600 parts across 3 to 6 levels with 300 to 600 parts on each level

Both the user load and data set in this second round of Aras Innovator 10 testing using SQL Server 2014 were increased by 2x or more relative to the prior test scenario using SQL Server 2012 to demonstrate a step function improvement in scalability:

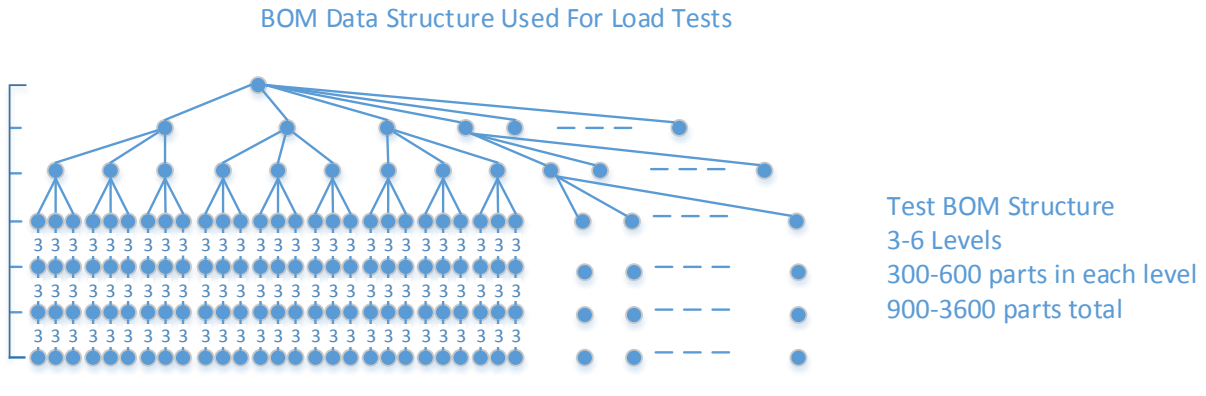
- Double the number of named users (1,000,000 vs 500,000)
- Double the number of concurrent users (250,000 vs 125,000)
- Two and a half times the number of part items (25,000,000 vs 10,000,000)
- Three times the number of BOM structures (15,000 vs 5,000).

⁴ Source: [HP ProLiant 980 Overview/Specs](#)

⁵ Source: [HP Fusion-io Accelerator Website](#)

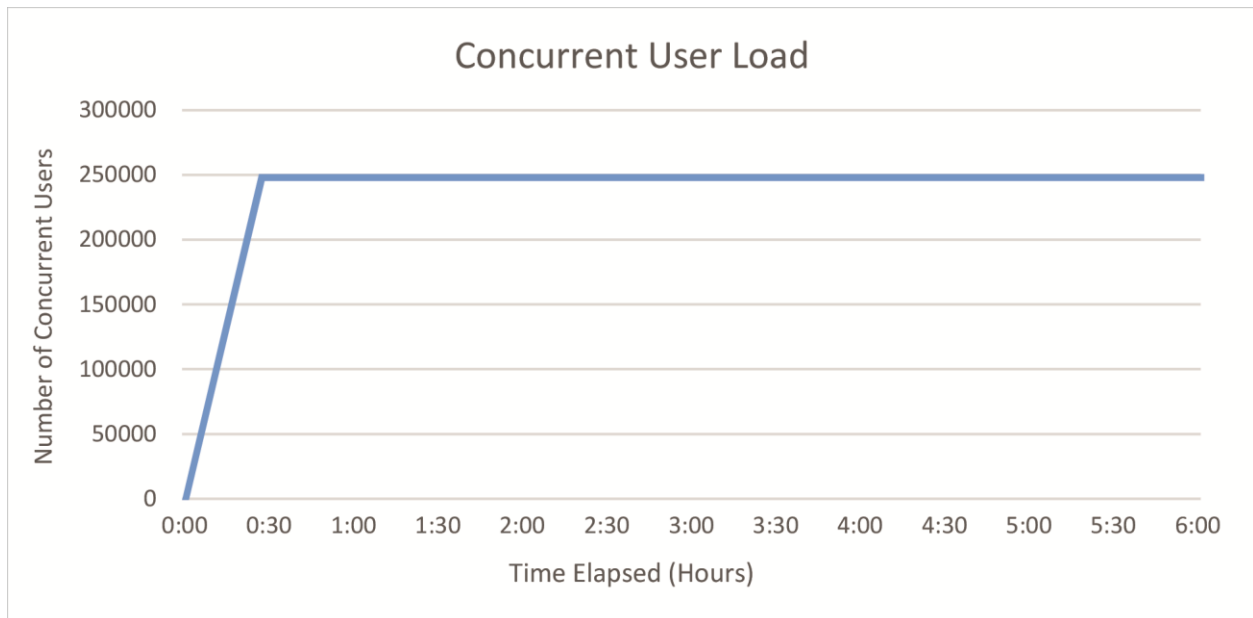
BOM Data Structure

The following diagram depicts the BOM data structure used for the tests. BOM structures consisted of many individual parts grouped into hierarchical structures. The data was housed in the Aras Innovator 10 database and was accessed and manipulated by the simulated users during the testing.



User Load

The following diagram details the concurrent user load over time. Tests with 250,000 concurrent users were conducted for a six hour duration to ensure consistency of performance at the largest loads over time. Other tests were conducted for two hour durations.



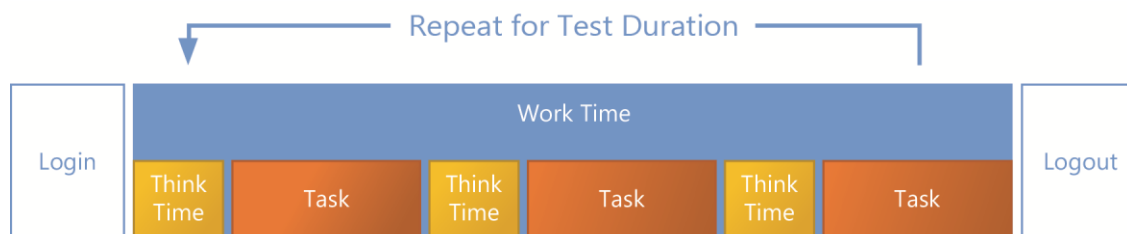
Test Case Structure

Login is the user authentication step, and starts a work session. A random user logs into Aras Innovator 10 at the rate of 100 users per second.

Think Time is the wait time that mimics real world pauses that a user exhibits. In these tests, there were two think times used. The first think time was a random number of seconds at an interval of 25-60 seconds. The second think time is a fixed 90 seconds.

Work Time is occupied with a work scenario. There are three work scenarios picked randomly at a weighted interval of 80 percent for scenario one, 10 percent for scenario two, and 10 percent for scenario three.

Logout logs the user out of a work session.



Scenarios

Scenario 1	Engineers, purchasing personnel, and quality assurance technicians perform repeated criteria-based queries for bill of materials information, and view details of selected parts, including the BOM, to use the information for work tasks and decisions.
Steps	Activities and transactions
1	Log on
2	Go to search screen
3	Enter part search criteria
4	Execute search
5	Display search results
6	Select Part Item
7	View Part Item
8	View BOM
9	Close Part form
10	Repeat steps 2-9 for different Part
11	Log out at the end of testing

Scenario 2	Engineers at suppliers worldwide make updates to component information and costing on parts. Each engineer logs on through roles-based permissions and performs a part number search for the affected items, makes edits, and saves the updates.
Steps	Activities and transactions
1	Log on
2	Go to search screen
3	Enter search criteria
4	Execute search
5	Display search results
6	Select Part Item
7	Lock Part Item to edit
8	Update Item
9	Save Item
10	Close form
11	Repeat steps 2-10 for different Item
12	Log out at the end of testing

Scenario 3	Designers, configuration engineers, and manufacturing personnel update assembly designs to replace parts and components that have reached end-of-life. Each parent assembly is edited to remove the affected item from the bill of material and add a new part or component.
Steps	Activities and transactions
1	Log on
2	Go to search screen
3	Enter part number search criteria
4	Execute search
5	Display search results
6	Select Assembly
7	Open Assembly for edit
8	Remove the affected BOM row
9	Create a new BOM row
10	Save the Assembly
11	Close the form
12	Repeat steps 2-12 for different Assembly
13	Log out at the end of testing

Performance Results

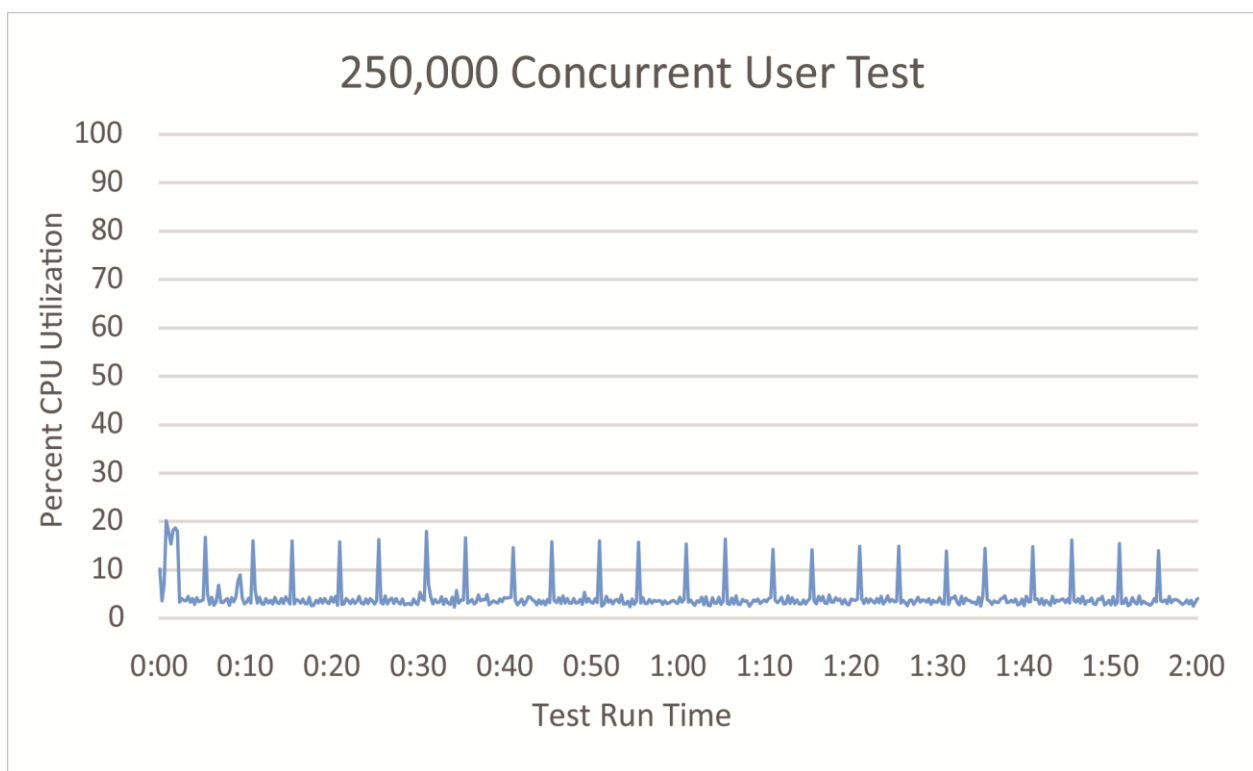
The focus of the benchmarks was to load test Aras Innovator 10 running on SQL Server 2014 Enterprise Edition in a typical data center environment using commercially available HP ProLiant servers.

Key Findings

Testing validates that Aras Innovator 10 on SQL Server 2014 Enterprise Edition can handle an extremely high numbers of concurrent users and data while maintaining very fast performance when running on standard server configurations.

- CPU and RAM resources were not constrained in any of the tests performed.
- Average response times were excellent across the different user loads from 125,000 to 250,000 concurrent users.
- The HP ProLiant DL980G7 server performed well at the 250,000 user level with very low latency, low I/O constraint, and average response times of 0.069 seconds for all operations.
- Under the heaviest load average CPU utilization was generally below 10 percent and was never higher than 20 percent.

CPU Performance



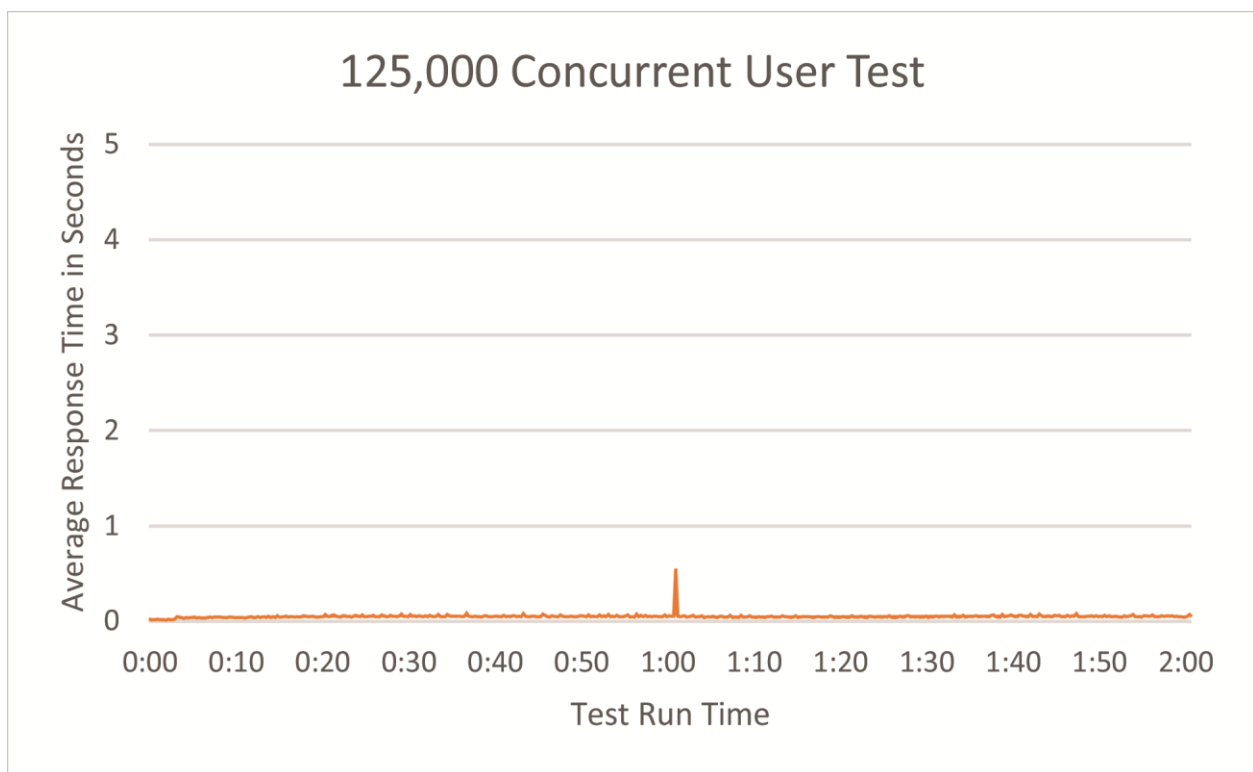
Response Time Performance

The following graphs show the response times in seconds for Aras Innovator 10 with SQL Server 2014 Enterprise Edition on the HP ProLiant DL980 during testing.

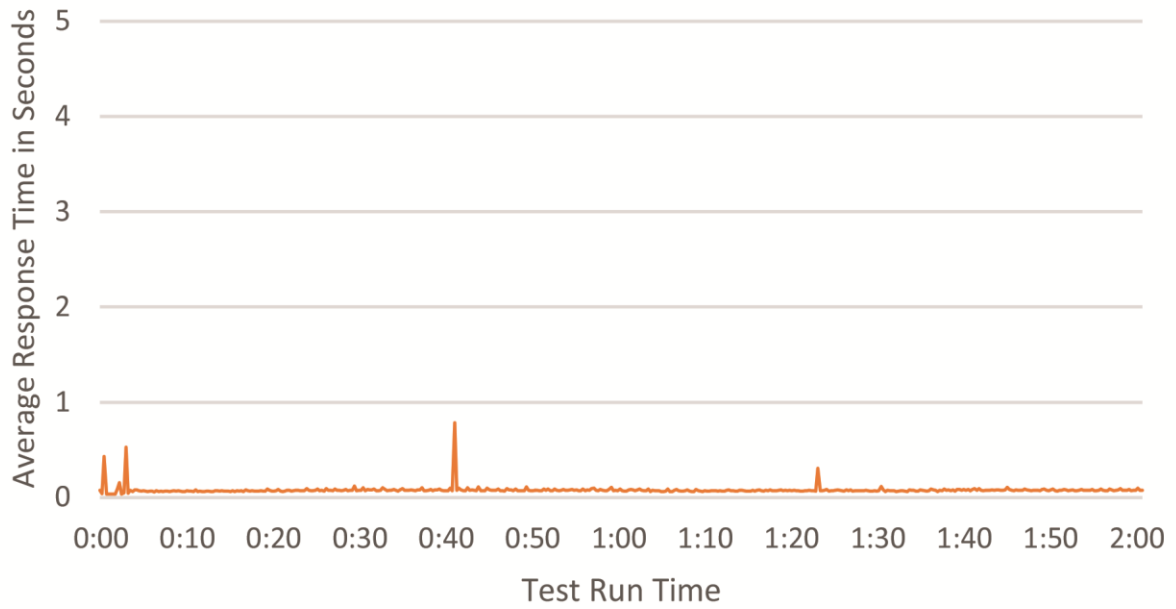
There were no significant constraints to CPU, memory, or system I/O during any of the concurrent user tests from 125,000 through 250,000.

Periodic spikes in the page response time occurred when the database updated the table statistics, a normal operation and common condition for any relational database.

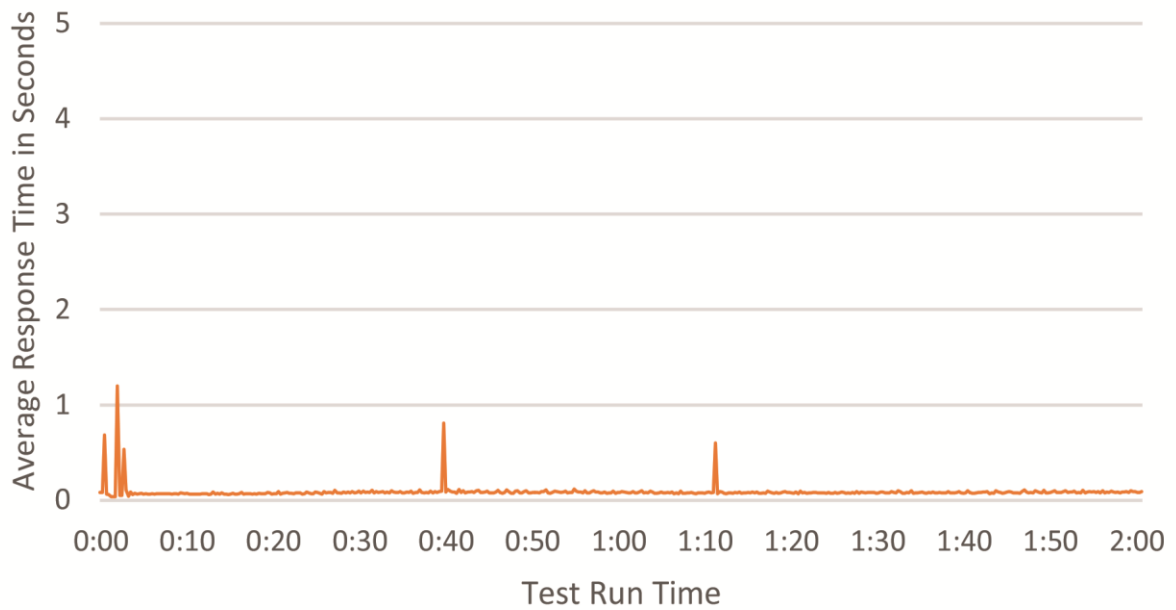
As the load test continues to create and modify data, the database engine periodically updates table statistics to re-optimize execution plans for queries which results in periodic short delays in response time.

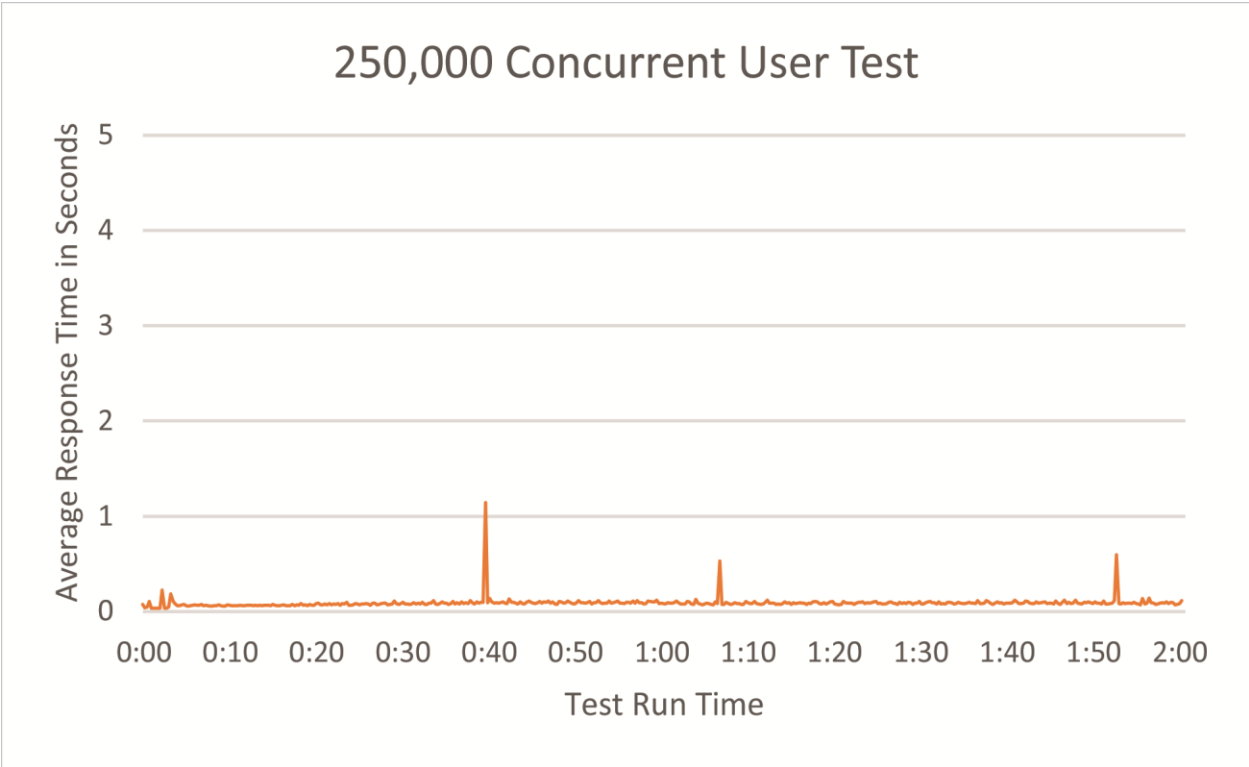


150,000 Concurrent User Test



200,000 Concurrent User Test

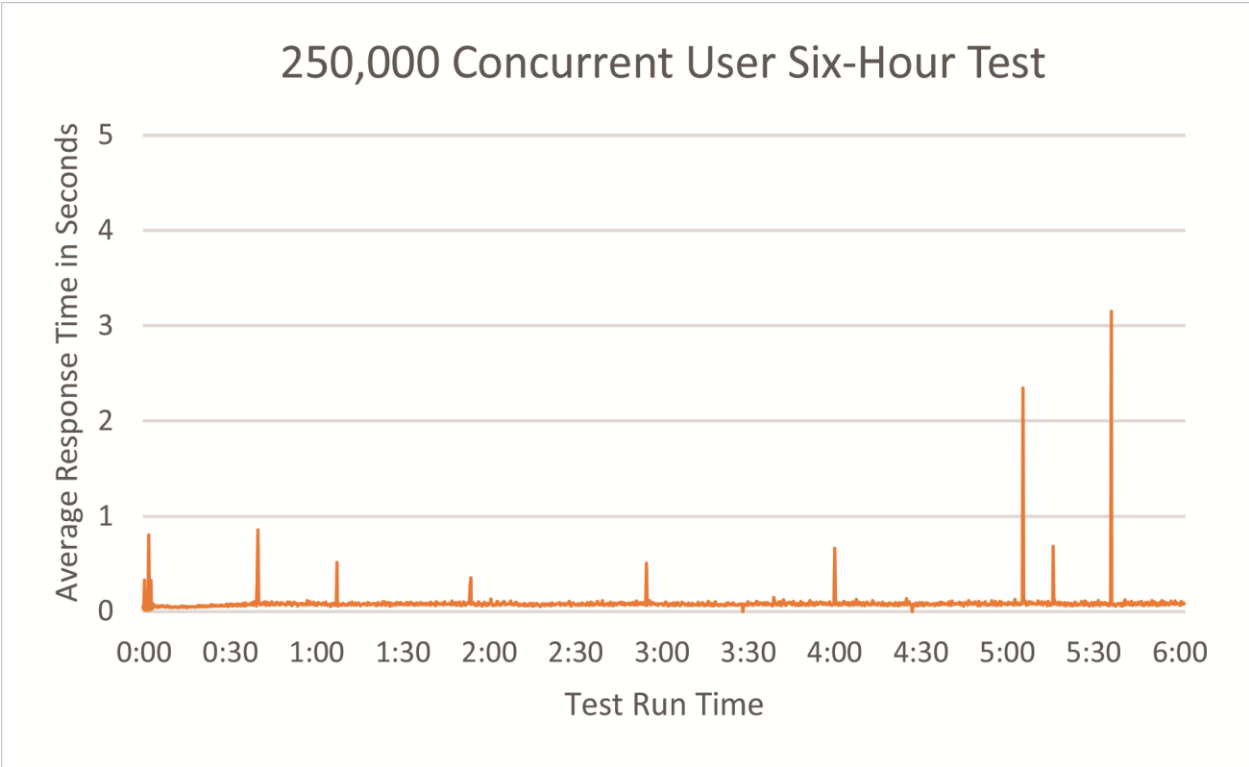




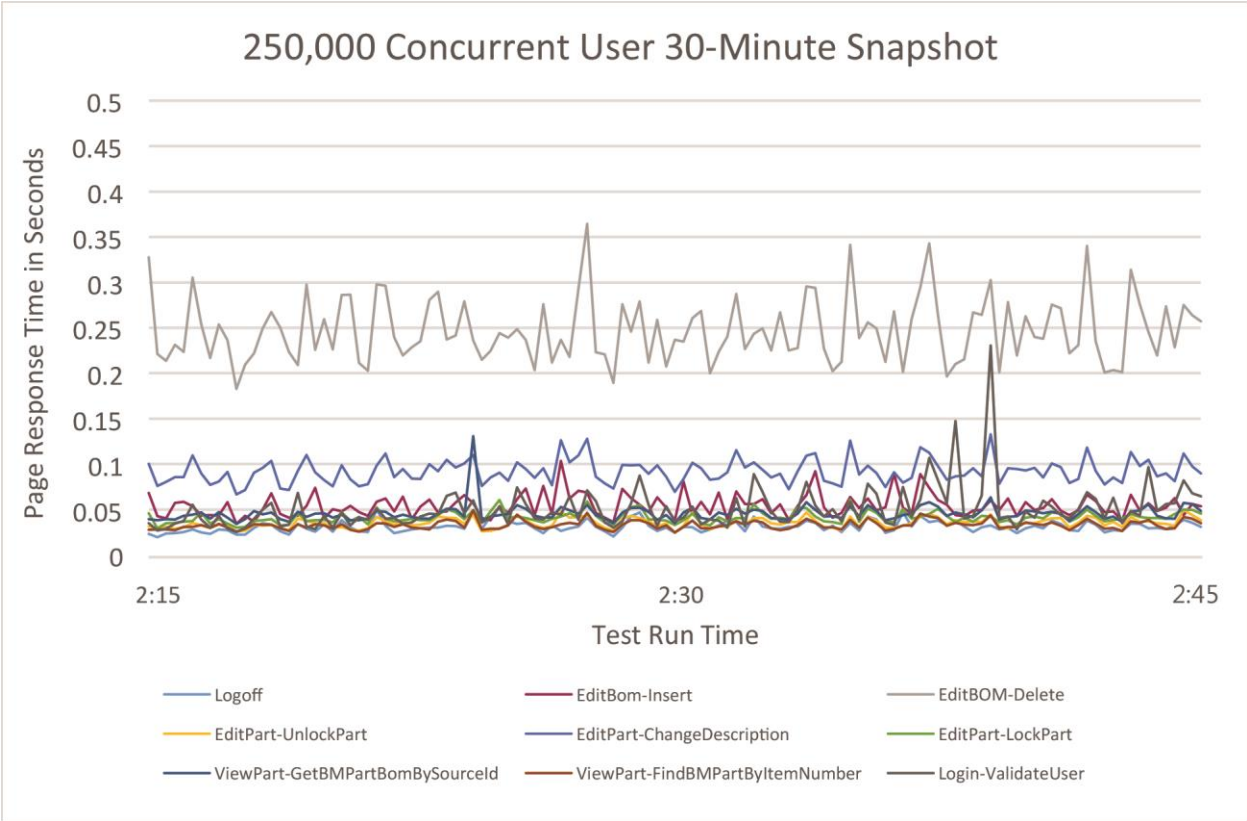
The response times averaged across all tests ranged from 0.046 seconds to 0.069 seconds. The fastest operations (specifically search) took, on average, 0.025 seconds. Update operations, which were expected to be the slowest, took 0.217 seconds on average.

There remained an abundant amount of CPU and RAM available on the server during all tests; total percentage of CPU utilization did not exceed 20 percent.

Previous testing without the ioDrive2 Duos experienced bottlenecks in system I/O at loads over 125,000 concurrent users. This testing with two ioDrive2 Duos along with a 10Gb NIC and LAN switch did not show any appreciable hardware bottlenecks.



In addition to the two-hour tests performed at increasing user loads, a six-hour test was conducted at the 250,000 concurrent user load. This test demonstrated consistent page response times and CPU utilization for the entire duration, and performance results were similar to the two-hour tests conducted.



The above graph is a snapshot of the six-hour test, showing a close-up look at the response time during a 30-minute window of the testing. The scale here is at 0.5 seconds to demonstrate the excellent response time experienced throughout the test period.

Performance Conclusions

Aras Innovator 10 running SQL Server 2014 Enterprise Edition on a standard HP server configuration showed strong performance and excellent resource utilization across all tests.

During testing, the average CPU utilization was consistently below 10 percent and was never higher than 20 percent. The average response times were very fast across the different user loads from 125,000 to 250,000 concurrent users.

Aras Innovator 10's architectural design enables scale-out on the file system and web servers with scale-up on the database by moving non-transactional data to the scale-out servers. This allows for the handling of very large levels of throughput by using frequent, short database transactions.

The scalability enhancements in SQL Server 2014 Enterprise Edition enabled Aras Innovator 10 to scale to 1,000,000 named users and 250,000 concurrent users with exceptionally fast and consistent performance.

As expected in an online transaction processing workload like Aras Innovator 10, the database performance of SQL Server 2014 Enterprise Edition at scale was crucial. A key factor in database performance is I/O subsystem latency and throughput. A further consideration with 250,000 concurrent users is the throughput and latency of the NIC and network switches. The hardware used in this test illustrates the scalability and performance benefits of using high performance NIC and LAN hardware with dedicated I/O accelerator drives.

The benchmark testing results in this paper validate that Aras Innovator 10 running on SQL Server 2014 Enterprise Edition scales nearly linearly with hardware upgrades and is architected for very high numbers of concurrent users.

Additional information about Aras and Aras Innovator 10 is available at www.aras.com.

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