



Aras Innovator 10 Scalability Benchmark Methodology and Performance Results

**Aras Innovator 10 Running on
SQL Server 2012 Enterprise Edition**

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Executive Summary

This white paper presents the benchmark testing and results that illustrate the performance and scalability of Aras Innovator 10 running on Microsoft SQL Server 2012 Enterprise Edition using load tests that mimic real-world usage scenarios and data structures.

Testing confirmed that Aras Innovator 10 on SQL Server 2012 Enterprise Edition scales from 25,000 to over 100,000 concurrent users while maintaining optimal performance.

Independent testing was conducted by Logic 20/20 on HP ProLiant seventh-generation data center hardware using recommended database settings.¹

The database used in testing had 500,000 named users and started with approximately 10 million part items with 5,000 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.

The tests were performed on two different standard server configurations: a 64 logical processor HP server and an 80 logical processor HP server. Tests were run with several disk setups, including the HP ioDrive2 Duo I/O Accelerator.

Each server was tested with an increasing number of users to monitor page response times, RAM usage, CPU utilization, disk queue length, and other performance metrics under different loads. Test results are summarized below:

- HP business class server² was tested at 25,000, 75,000, and 125,000 concurrent users.
 - Under the heaviest load, CPU utilization remained under 30 percent.
- HP enterprise class server³ was tested at 75,000 and 125,000 concurrent users.
 - Under the heaviest load, average CPU utilization was 16 percent.
 - Performance at the 125,000 user level demonstrated an average response time for operations that ranged from 0.157 seconds to 0.511 seconds.
- HP enterprise class server with an I/O accelerator was tested at 75,000 and 125,000 concurrent users.
 - Under the heaviest load average CPU utilization was 13 percent.
 - Performance at the 125,000 user level demonstrated average response times for all operations of 0.05 seconds.

The results of the tests indicate that Aras Innovator 10 performance scales consistently and nearly linearly with hardware. Testing validates that Aras Innovator 10 running on SQL Server 2012 Enterprise Edition can handle very high numbers of concurrent users when running on standard server configurations.

¹ [Database Server Configuration Best Practices for Aras Innovator 10](#)

² HP ProLiant DL585G7

³ HP ProLiant DL980G7

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, which is intended 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 2012 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."

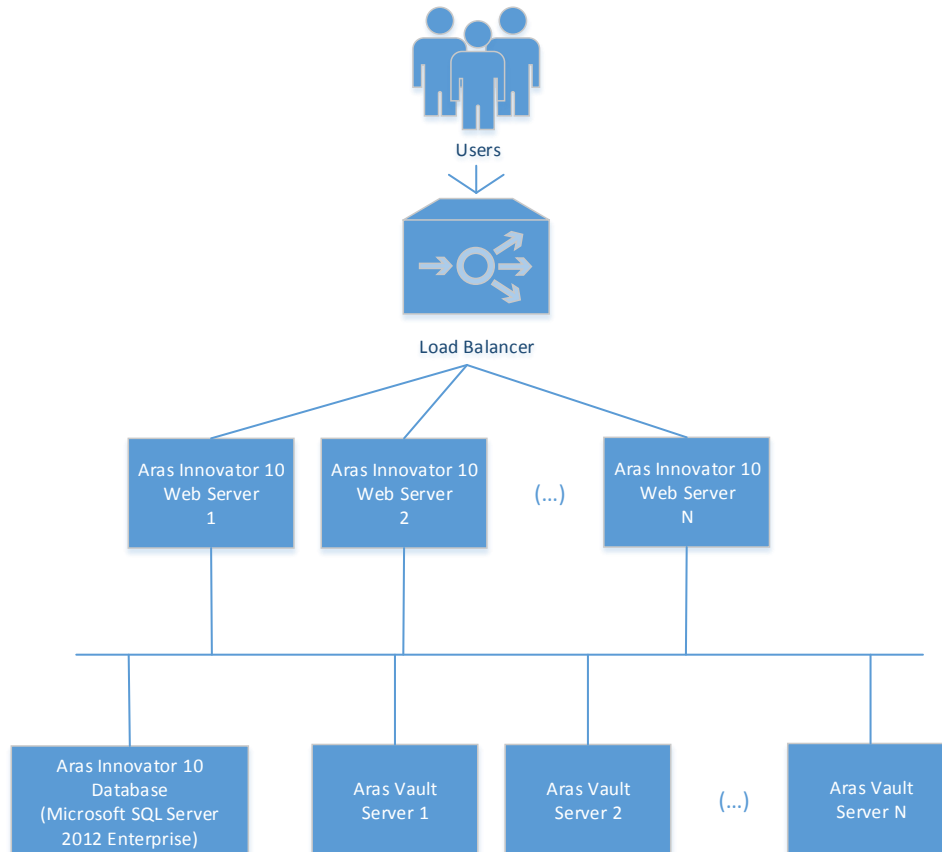
*- Bruce Leidal
CIO, Carestream Health*

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 capabilities⁴.

SQL Server 2012 Enterprise Edition

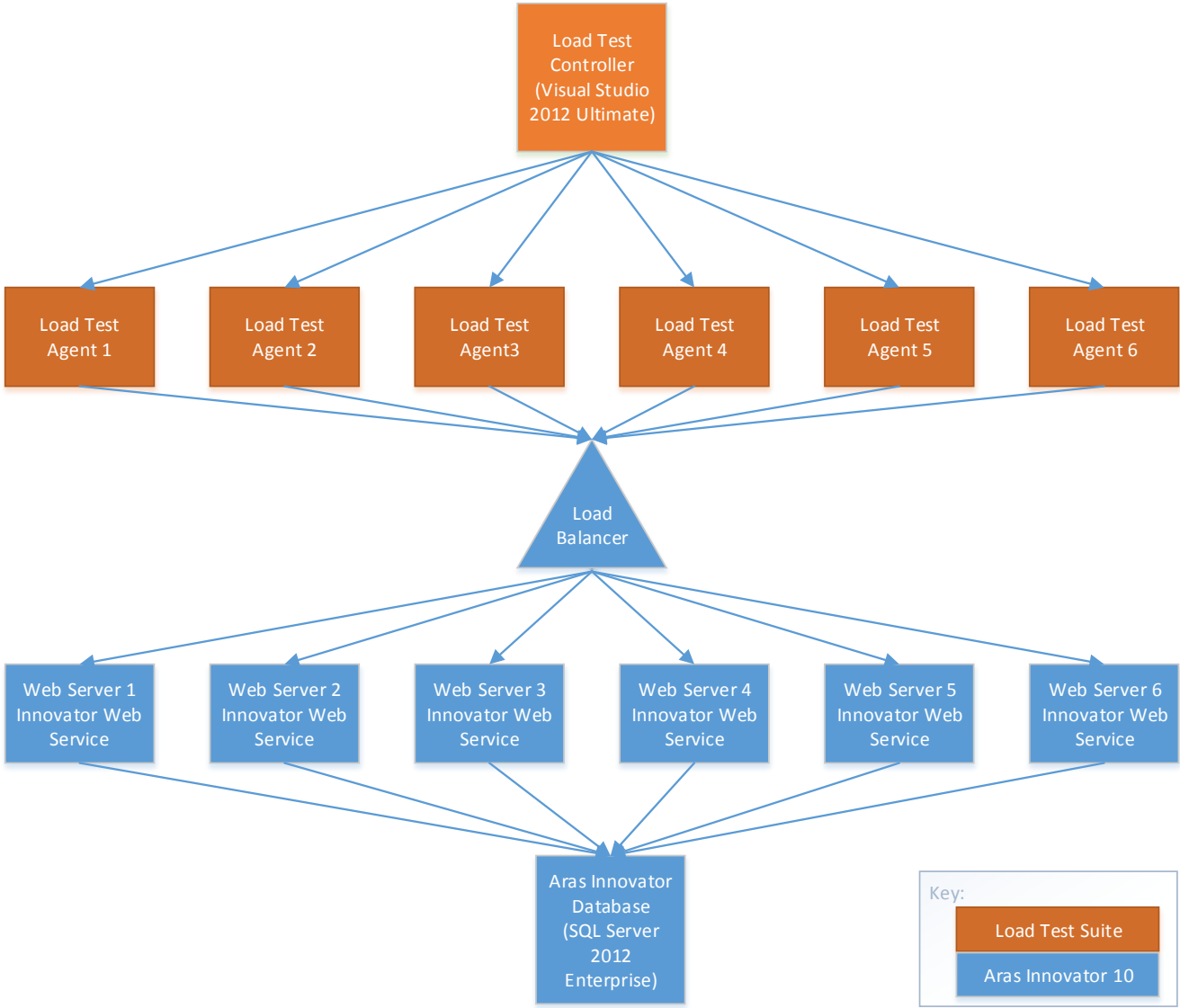
Aras Innovator 10 runs on the Microsoft SQL Server 2012 Enterprise Edition database for persistent metadata storage. SQL Server 2012 Enterprise Edition is designed to deliver comprehensive, high-end data center capabilities for mission-critical applications.

SQL Server 2012 Enterprise Edition has introduced a wide range of performance and scalability enhancements into the database engine to enable a new level of support for the largest workloads including greater processing and memory capacity, increased partition support, and xVelocity in-memory technologies which enable sub-second query responses and rapid column-oriented processing. Together, these capabilities along with other improvements help SQL Server 2012 deliver predictable performance at scale.

⁴ 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 DL585G7⁵

The first system used in the benchmark was the business class HP ProLiant DL585G7 server, which features 32 cores, 64 logical processors, 128 gigabytes (GB) of RAM, and 8 hard disk drives (HDD).

HP ProLiant DL980G7⁶

The second system used in the benchmark was the more robust enterprise class HP ProLiant DL980G7, which features 40 cores, 80 logical processors, 256 GB of RAM and 8 solid state drives (SSD).

HP ProLiant DL980G7 with I/O Accelerator⁷

The final testing took place on the same enterprise class HP ProLiant DL980G7 system used in the previous test, but with an HP ioDrive2 Duo I/O Accelerator card installed.

Note: 64-bit hardware was used in order to access large blocks of memory.

Test Scenarios and Methods

One of the goals of the tests was to accurately simulate a real-world work environment with 500,000 named users and between 25,000 and 125,000 concurrent users.

The test environment was set up with the following data:

- 500,000 named users
- 10,000,000 parts
- A randomly generated set of approximately 5,000 Bill Of Materials (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

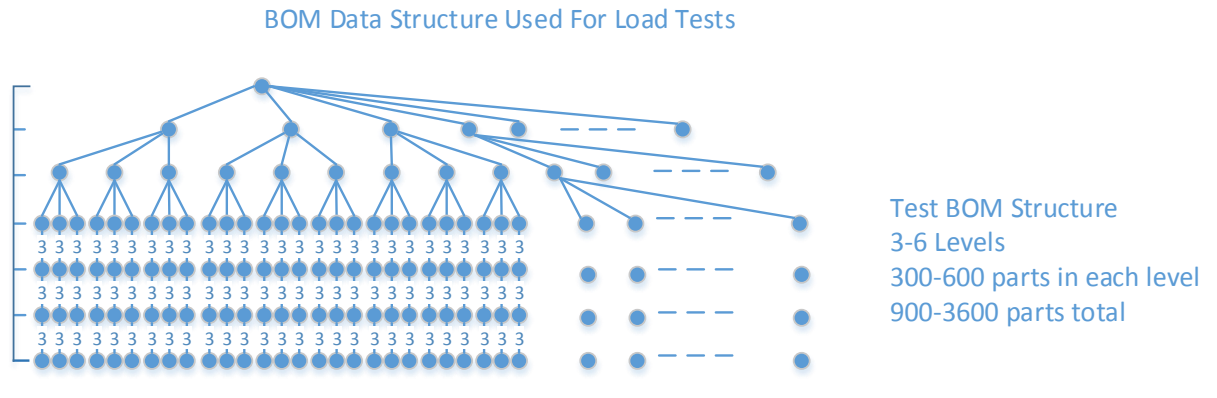
⁵ Source: [HP ProLiant 585 Overview/Specs](#)

⁶ Source: [HP ProLiant 980 Overview/Specs](#)

⁷ Source: [HP Fusion-io Accelerator Website](#)

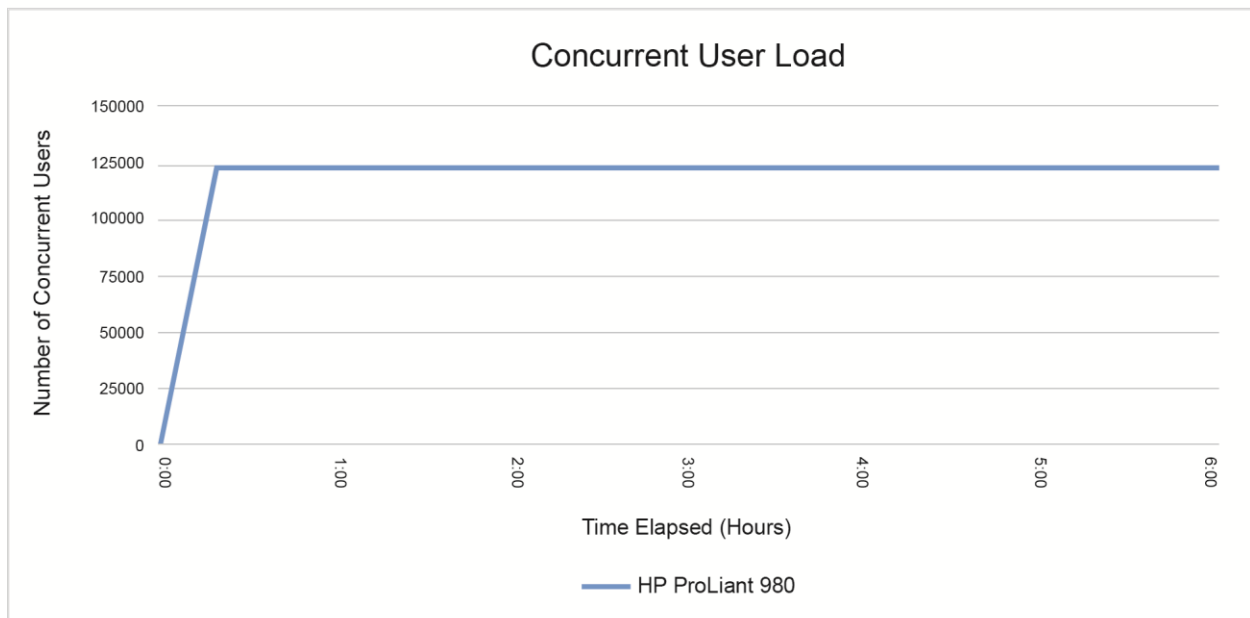
BOM Data Structure

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 125,000 concurrent users were conducted for six hour durations to ensure consistency of performance at the largest loads over time. Other tests were conducted for one hour durations.



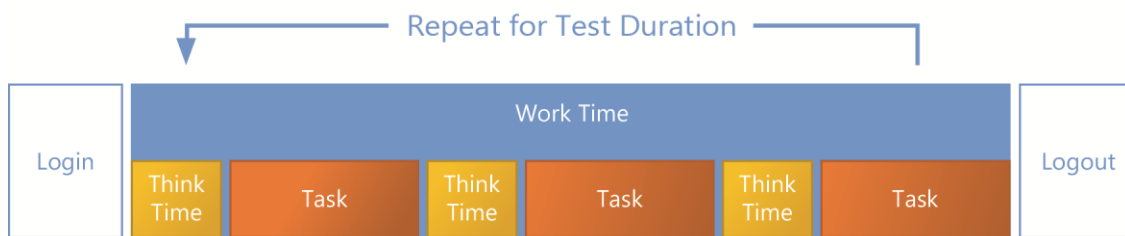
Test Case Structure

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 2012 Enterprise Edition in a typical data center environment. Therefore, three system configurations across two different HP ProLiant servers were used.

Key Findings

CPU and RAM resources were not constrained in any of the tests performed.

HP ProLiant DL585G7:

- Performed well at the 75,000 concurrent user level with average response times ranging from 0.033 seconds to 0.203 seconds.
- With the load at 125,000 concurrent users, the server's I/O subsystem became a bottleneck as disk queue lengths and latency increased.

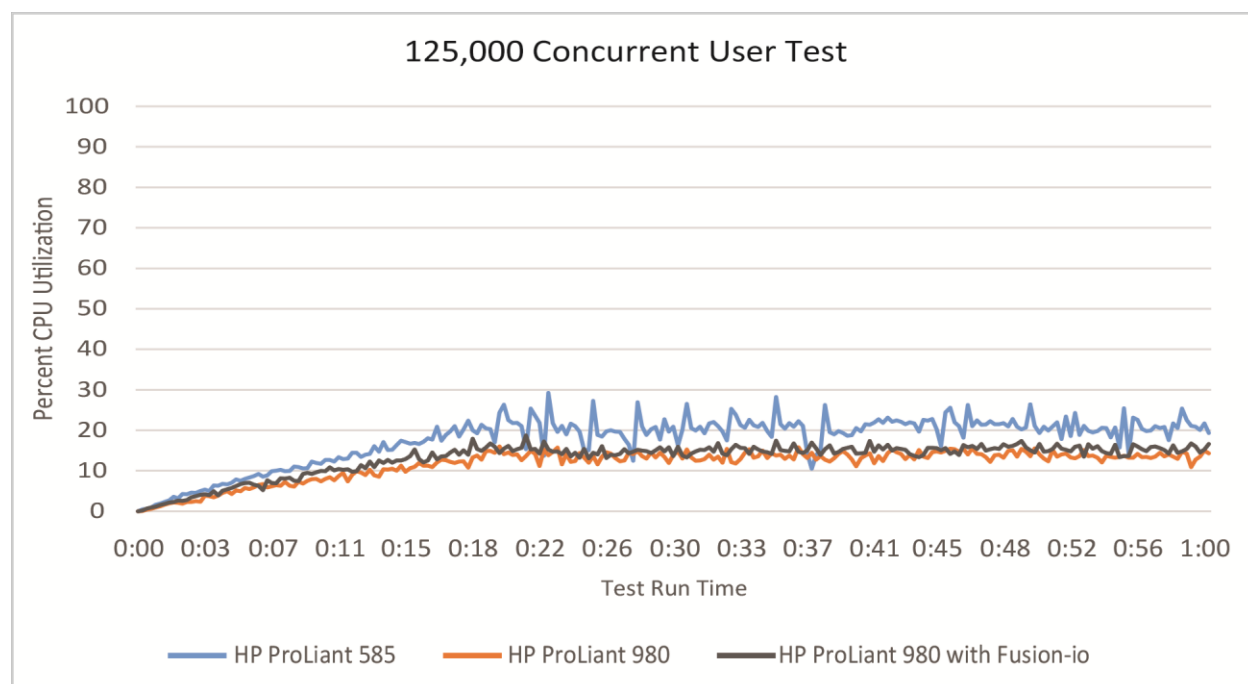
HP ProLiant DL980G7:

- Performed well at the 75,000 concurrent user level with average response times ranging from 0.025 seconds to 0.140 seconds.
- Continued to perform well at the 125,000 concurrent user level with average response times between 0.157 seconds and 0.511 seconds, although the I/O subsystem constraint became evident.

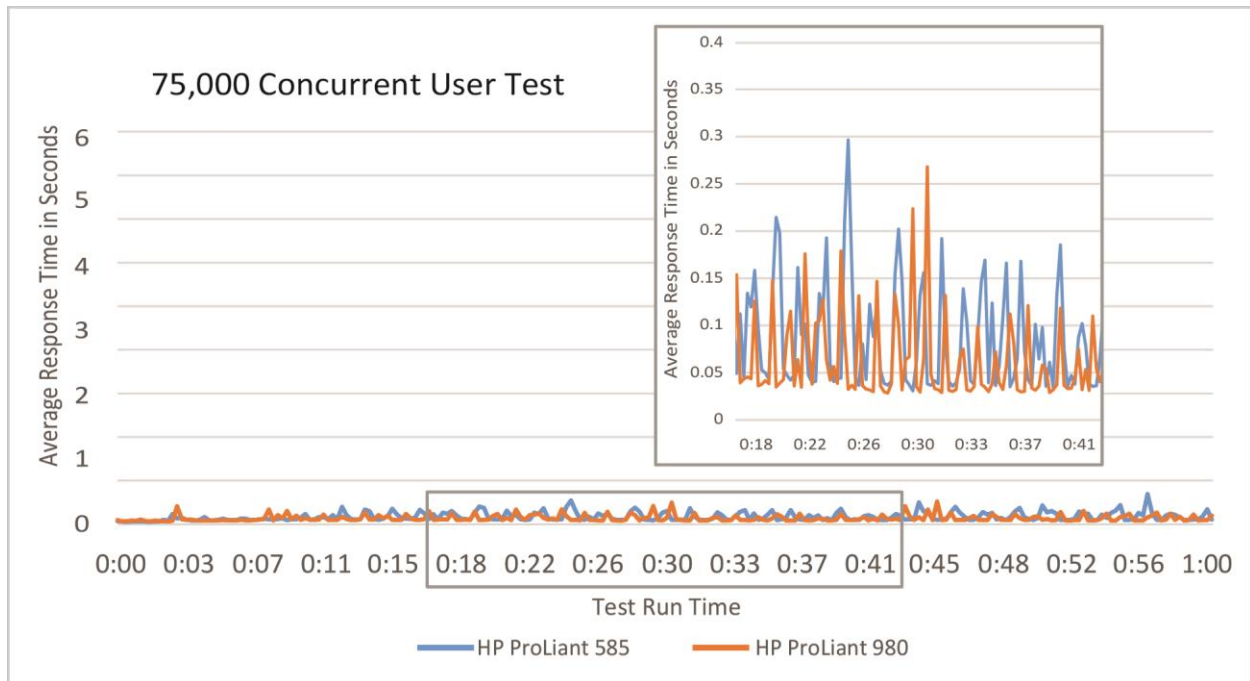
HP ProLiant DL980G7 with HP ioDrive2 Duo I/O Accelerator:

- Performed well at the 125,000 user level with very low latency, no signs of the I/O constraint and average response times of 0.05 seconds for all operations.

CPU Performance



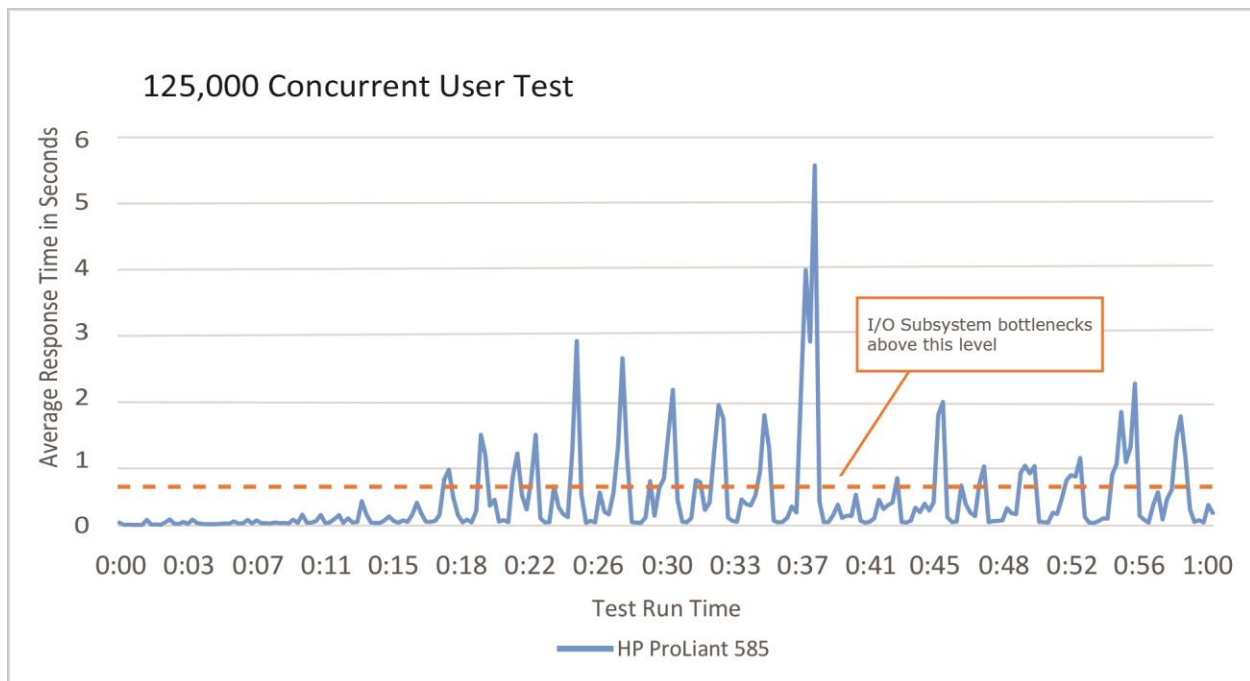
Response Time Performance



The above graph shows the average response times in seconds for Aras Innovator 10 with SQL Server 2012 Enterprise Edition on the HP ProLiant 585 and 980 during the 75,000 concurrent user tests. At this number of users, there were no significant constraints to CPU, memory, or system I/O.

The response times on the ProLiant 585 ranged from an average of 0.033 seconds to 0.203 seconds. This means that the fastest operations (specifically search) took an average only 0.033 seconds. Update operations, which are expected to be the slowest, took only 0.203 seconds on average.

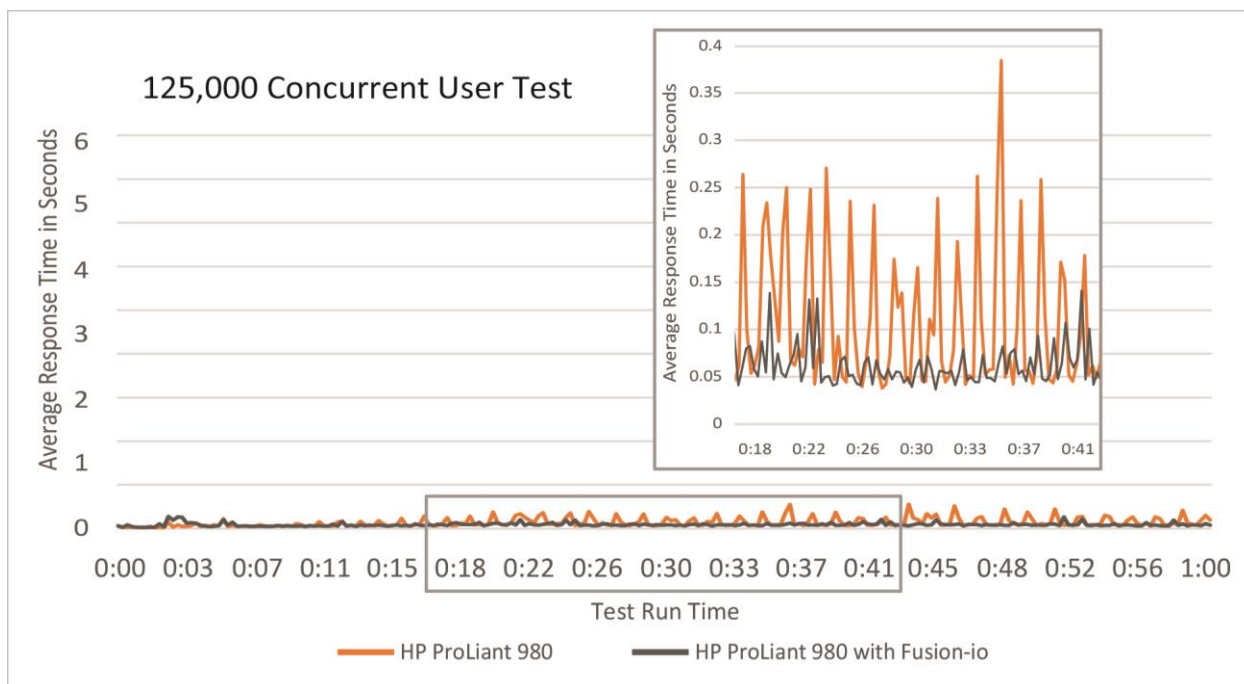
On the ProLiant 980, the response times ranged from 0.025 seconds best case to 0.140 seconds worst case at the 75,000 concurrent user levels. These numbers give the range by sorting the operations and taking the top and bottom averages across all operations.



There remained an abundant amount of CPU and RAM available on all tested servers; total percentage of CPU utilization did not exceed 30 percent.

The ProLiant 585's I/O subsystem began to show limitations during the 125,000 concurrent user tests. Disk queue lengths and other counters such as PAGEIOLATCH_XX indicate that latency was increasing due to bottlenecks at the server's I/O subsystem.

The ProLiant 585 as it was tested had eight HDDs, which is less than typical for this size server attempting to service 125,000 concurrent users. The server did not have enough spindles to spread the write operations across.



The HP ProLiant 980 with eight SSDs handled the 125,000 concurrent user tests more consistently than the HP ProLiant 585. The results of ProLiant 980 tests with the HP ioDrive2 Duo I/O Accelerator card show that when I/O subsystem latency is removed, the spikes disappear and performance is faster and more consistent. With the I/O accelerator, Aras Innovator 10 demonstrated extremely low average response times of 0.05 seconds for all operations.

With significant CPU and memory resources available during all tests on both the ProLiant 585 and 980, it was evident that the I/O subsystems accounted for the performance variations between the different tests.

Note: The I/O accelerator dramatically decreased I/O latency, which in turn improved response times.

Performance Conclusions

Aras Innovator 10 and SQL Server 2012 Enterprise Edition running on standard HP server configurations showed strong performance and excellent resource utilization across all tests. During testing average CPU utilization was consistently below 25 percent and total percentage of CPU utilization never exceeded 30 percent. The average response times were fast across the different concurrent user loads tested from 25,000 to 125,000.

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.

As expected in an online transaction processing workload like Aras Innovator 10, the greatest constraint was in the I/O subsystem's ability to read and write to disk. The hardware used in the tests illustrates the difference between mid-range and high-end systems. Moving from 8 HDDs to 8 SSDs installed with an HP ioDrive2 Duo I/O Accelerator card helped demonstrate the improvements that hardware upgrades such as the I/O subsystem can have on scalability and performance.

The benchmark testing results in this paper validate that Aras Innovator 10 running on SQL Server 2012 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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