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Executive summary

We live and work in a new era of extreme business speed with heightened customer, partner, and employee expectations. To better compete and grow, businesses demand more innovation, speed, and flexibility from their data centers. SAS Visual Analytics allows your organization to explore all relevant data quickly and easily. Using SAS Visual Analytics™ (VA) you can look at more options, uncover hidden opportunities, identify key relationships and make more precise decisions faster than ever before. SAS VA customers require a hardware/software configuration that can deliver data analysis results quickly and accurately. To meet that need, enterprise customers demand reliable and fast servers that can scale to meet their business analytics requirements. This paper provides details for a reference configuration for SAS VA that provides the performance required by SAS VA in a single server, symmetric multiprocessing (SMP) environment.

This paper highlights the key findings from running SAS VA using the Visual Analytics workload suite running on an HP DL580 Gen8 server.

HP ran the tests; and, SAS certified that the test suite was run correctly and that the performance results meet the needs of a typical user.

Target audience: The target audience for this reference architecture is the IT community studying solutions for their environments. Business users and IT professionals who are interested in implementing a SAS VA solution may find this paper useful for a sample SAS configuration and a demonstration of the HP ProLiant server’s scalability.

Document purpose: The purpose of this document is to describe a recommended architecture, highlighting recognizable benefits to technical audiences.

This white paper describes testing performed in March 2015.

Introduction

SAS Visual Analytics allows your organization to explore all relevant data quickly and easily. You can look at more options, uncover hidden opportunities, identify key relationships and make more precise decisions faster than ever before.

One of the keys to being able to successfully deploy SAS Visual Analytics is having a server that can economically provide the robust performance required to enable SAS VA. The DL580 Gen8 is just such a server. It is built on the Gen8 innovative and intuitive hardware and software features, and supports high-density and cost effective Intel® Xeon® E7-4800 v2 and E7-8800 v2 processors. The DL580 Gen8 is ideal for deploying SAS VA in environments where model size is too large for the amount of memory available in 2-socket servers and many 4-socket servers, but not large enough to warrant deploying multiple parallel systems.

This SAS Visual Analytics Explorer reference architecture is intended to provide an understanding of the expected performance and system resources required to support ad hoc data exploration and reporting.

Solution overview

The HP ProLiant DL580 Gen8 Server is an enterprise-grade four socket (4S) x86 server offering breakthrough performance, rock-solid reliability, and compelling consolidation and manageability efficiencies. It is ideal for mission-critical enterprise, business intelligence and database applications.

Featuring Intel® Xeon® E7-4800 v2 and E7-8800 v2 processors, in this case, the E7-4890 v2 15-core processors running at 2.8GHz, the HP DL580 Gen8 offers blazing fast results with enhanced processor performance, more memory slots (96 DIMMs), greater I/O bandwidth (9 PCIe Gen3.0 slots), and increased storage performance (12Gbps SAS attached storage) over the HP DL580 Gen7 systems. HP ProLiant DL580 Gen8 has security and data protection features for system resiliency that your business can depend upon.

Additionally, with intelligent manageability through HP OneView, HP Integrated Lights-Out 4 (iLO 4), and user-inspired features, you get faster, lower cost infrastructure management.

SAS VA is delivered in two types of formats. The first, which is the topic of this paper, is a single server implementation, also referred to as SMP. The second, which is outside the scope of this paper, is multiple parallel systems, also referred to as MPP.

The HP ProLiant DL580 Gen8 server is a SAS VA configuration offering the type of performance required to successfully enable SAS VA at an economical price point. The larger memory footprint of the DL580 Gen8 Server allows deployments of larger SAS VA SMP environments than would be available using 2-socket servers and even too large for the DL560 Gen8 4-socket server, reducing the cost of deployment over MPP environments.

SAS VA (SMP and MPP configurations) have very prescriptive configuration rules.
SAS VA requires hardware that supports current generation Intel Xeon v2 or v3 processors with a minimum clock speed of 2.6GHz. In the DL580, which is a four processor server, using fifteen-core Intel Xeon E7-4890 v2 processors provides a total of sixty cores.

Memory must be at least 16GB per core. As a result, if using 4x fifteen-core E7-4890 v2 processors, the minimum memory must be 1TB. Additionally, memory must function at a minimum of 1600MHz. The memory available on the DL580 Gen8 server is capable of running at 1600MHz. However, only LRDIMMs are able to function at this speed, and they are only able to function at this speed when placed in Lockstep mode. Testing was performed using LRDIMMs with both Lockstep Mode, running at 1600MHz and also Interleaved Mode running at 1333MHz. An interesting fact is that the Interleave result was faster than the Lockstep result. As a result of this finding, it is HP’s belief that any memory that has the ability to run at 1333MHz in Interleaved mode will provide the type of throughput demonstrated during the testing. The memory that’s able to function at this rate and at the same time allows 1TB of memory to be configured using 2 DIMMs per memory channel are 16GB Dual-rank RDIMMs, the 32GB Quad-rank LRDIMMs and the 64GB LRDIMMs. Instructions in the appendix will demonstrate how to place the server’s memory in Interleaved and Lockstep mode. These memory configurations allow for 1TB, 2TB and 4TB of memory to be configured allowing for simultaneous in-memory model sizes of 512GB, 1TB and 2TB respectively.

As with all SAS installations, HP recommends placing the server in High Performance mode. Instructions for doing so are included in the appendix.

As with earlier releases of SAS VA, virtualization is now an option with these DL580 Gen8 servers. The DL580 has a role for customers wishing larger servers and/or virtualization capabilities.

**Figure 1. Reference Configuration**

- DL580 Gen8
- 4 X 15-Core 2.8GHz Intel® Xeon® E7-4890 v2 processors
- 2TB of memory using 64 X 32GB LRDIMMs
- 4 X 900GB 10K RPM internal disk drives
- RHEL 6.5
- SAS 9.4
- SAS Visual Analytics 7.1
- XFS file system
Solution components

The server hardware and operating system software used to drive the test were:

HP ProLiant DL580 Gen8
- 4 X 15-core 2.8GHz Intel Xeon E7-4890 v2 Processors
- 2TB of memory using 64 X 32GB LRDIMMs
- 4 X 900GB 10K RPM Internal SAS (Serial Attached Storage) Disk Drives
- 1 X 2-port 10Gb Ethernet adapter, one port used for network traffic
- 1 X 4-port 1Gb FlexibleLOM adapter for management traffic
- Red Hat® Enterprise Linux® (RHEL) 6.5

The software components used to achieve the performance results were:
- SAS™ 9.4
- SAS Visual Analytics Server™ 7.1
- SAS LASR Analytic Server™
- SAS Metadata Server™
- SAS Visual Analytics Middle Tier™

Capacity and sizing

SAS VA is an in-memory analytics engine. This means that the data to be analyzed must fit in memory during the analysis. Using a 1TB memory size means that the total size of the data to be analyzed must be 750GB or smaller. Using 2TB of memory size means that the total size of the data to be analyzed cannot exceed 1.5TB. Finally, using 4TB of memory means that a model up to 3TB can be analyzed. Multiple concurrent models may make up the in-memory footprint. Models that have been loaded into memory may be unloaded to make room for new models. The restriction is on the total size of all models simultaneously in memory at any given time.

The configuration rules are relatively stringent. If a customer requires concurrently loaded data models in excess of this limitation, they will need to move from the single system (SMP) model to the multiple system (MPP) model.

Important
This test scenario provides a benchmark for comparing hardware and/or software products; it is not intended to be used as a sizing guideline. In the real world, server performance is highly dependent upon the application design and workload profiling.

As with any laboratory testing, the performance metrics quoted in this paper are idealized. In a production environment, these metrics may be impacted by a variety of factors.

As a matter of best practice for all deployments, HP recommends implementing a proof-of-concept using a test environment that matches as closely as possible the planned production environment. In this way, appropriate performance and scalability characterizations can be obtained. For help with a proof-of-concept, contact an HP Solution Design Services (SDS) representative at sastech@hp.com.

Workload description

The scenario is designed to generate a heavy load on the server. The goal is to demonstrate CPU usage characteristics and server response time to users’ ad-hoc analytical requests.

In this scenario, business analysts use SAS Visual Analytics Server to explore their company’s sales and operational data to quickly discover trends. The goal is to rapidly reveal opportunities that can improve revenue or operational efficiency.

The scenario is designed to approximate the types of usage that would occur during a monthly, quarterly or annual reporting cycle with a mixture of users: ones needing summary reports or graphs and analytical users who need quick answers to questions posed by management.
The data for this test is made up of the following:

- The table has 219 million rows, 46 columns, and is 60GB.
- There are more than 6 years of daily detail at the product description level.
- The geography hierarchy includes facility, region, state, and city.
- The product hierarchy includes brand, line, category, and description.
- The time hierarchy includes year, month, and day.
- The measures include revenue, expense (CAPEX, material, operational staffing), employee counts, profit, product quality, and unit capacity.

The concurrent user base is made up of 2 types of users, light and heavy. Light users typically perform less CPU intensive activities such as generating summarized reports or simple univariate statistics and graphs. Heavy users perform more advanced statistical analyses such as correlations.

For the 5 light user, 1 heavy user scenario, 5 concurrent light users perform the following actions:

- Log on to SAS Visual Analytics Explorer.
- Select the data table, report type, and variables to include for their analysis. Report types include: bar charts, line charts, box plots, cross-tabulations, and heat maps.
- There is from 5-15 seconds of think time between drag-and-drop actions.
- After displaying the report, there is 1-3 minutes of think time.
- The user creates a total of three reports following this process.
- After displaying reports, users log off and back on after random delays of 60-90 seconds.

For this scenario, 1 heavy user performs the following actions:

- Log on to SAS Visual Analytics Explorer.
- Select the data table for their analysis.
- Select 10 variables for a correlation analysis.
- There is 5-15 seconds of think time between drag-and-drop actions.
- After displaying the report, there is 1-3 minutes of think time.
- The user creates a total of three reports following this process.
- After displaying reports, user logs off and back on after a random delay of 60-90 seconds.

**Workload data/results**

HP LoadRunner is used to drive the one hour, 6-user scenario. Users enter the processing queue at 10-second intervals or at 1 minute intervals. All users are active within 1 minute for the 6-user, 10-second introduction scenario. For the 6-user, 1-minute introduction scenario, all users are active within 7 minutes. Users are engaged in report design and exploratory data analysis activities. As a user's processing cycle completes, the session logs off and is replaced by a new user session, maintaining a full level of concurrency. The test runs for 60 minutes at full concurrency and ramps down, depending upon which scenario, over 1 minute to 6 minutes.

Each test was run twice to ensure repeatable results.

During the 60-minute scenario, the response times were as follows:

- Box plots, bar charts, line charts, cross-tabulations, and heat maps complete in 12 seconds or less, on average.
- Correlations for 10 variables complete in 15 seconds or less, on average.
Table 1. 6-User, 10-second introduction test results using memory in Interleave mode (average response times)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Run 1 Result</th>
<th>Run 2 Result</th>
</tr>
</thead>
<tbody>
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<td>DatebyMonth_Expense_LineChart</td>
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<tr>
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<tr>
<td>Drag_10_Measures_CORR2</td>
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<tr>
<td>Drag_10_Measures_CORR3</td>
<td>9.171</td>
<td>8.829</td>
</tr>
<tr>
<td>DragAllOtherExp_CrossTab</td>
<td>4.133</td>
<td>4.255</td>
</tr>
<tr>
<td>DragDatebyYear_LineChart</td>
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<td>9.035</td>
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<td>OpenTable</td>
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</table>

Graph 1. 6-User, 10-second introduction CPU Utilization charts using memory in Interleave mode
### Table 2. 6-User, 1-minute introduction scenario using memory in Interleave mode (average response times)

<table>
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<th>Metric</th>
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<th>Run 2 Result</th>
</tr>
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<tbody>
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<td>8.362</td>
<td>8.453</td>
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</table>

### Graph 2. 6-User, 1-minute introduction CPU Utilization charts using memory in Interleave mode
Table 3. 6-User, 10-second introduction test results using memory in Lockstep mode (average response times)

<table>
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<tr>
<th>Metric</th>
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<th>Run 2 Result</th>
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Graph 3. 6-User, 10-second introduction CPU Utilization charts using memory in Lockstep mode
Table 4. 6-User, 1-minute introduction test results using memory in Lockstep mode (average response times)

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<td>OpenTable</td>
<td>9.035</td>
<td>8.346</td>
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</table>

Graph 4. 6-User, 1-minute introduction CPU Utilization charts using memory in Lockstep mode
Analysis and recommendations

HP recommends the HP ProLiant DL580 Gen8 server as configured for SAS Visual Analytics environments where customers would like a single server environment with memory requirements too large for dual processor systems but not yet large enough for MPP environments.

Frequently asked questions:

Q: What if I'm looking to build an environment that is half the size of this RA. Could I use any of the data presented here?

A: Yes. A customer can start with a DL580 Gen8 server using only 2 CPUs and 1TB of memory and then add processors and memory as their needs demand.

HP also sells the DL560 Gen8 server, which when appropriately configured will provide 32-cores and 512GB of memory.

Finally, HP sells 2 socket servers that have CPU and memory speeds that will fill the needs of customers requiring less than 512GB of memory and fewer than 32 cores.

Q: What if I'm looking to build an environment that is twice the size of this RA. Could I use any of the data presented here?

A: Yes. Customers with a memory requirement larger than 2TB would need to move to a SAS VA MPP implementation. In that scenario, most likely a customer would choose dual socket servers having a maximum capacity of two CPUs per server. This choice would be made based on price, because dual socket servers are less expensive on a per-socket basis than four socket servers. However, a customer can build a SAS MPP using the DL580 Gen8 as a building block.

Q: What if my workload is slightly different? How would I leverage this document for my purposes?

A: This test scenario can provide a benchmark for comparing hardware and/or software products; it is not intended to be used as a sizing guideline. In the real world, server performance is highly dependent upon the application design and workload profiling.

As with any laboratory testing, the performance metrics quoted in this paper are idealized. In a production environment, these metrics may be impacted by a variety of factors.

As a matter of best practice for all deployments, HP recommends implementing a proof-of-concept using a test environment that matches as closely as possible the planned production environment. In this way, appropriate performance and scalability characterizations can be obtained. For help with a proof-of-concept, contact an HP Solution Design Services (SDS) representative at sastech@hp.com.

Best practices for the solution

The server and operating system configuration is straightforward. Nothing needs to be added, other than the packages that SAS requires in order for Visual Analytics to function properly.

It is recommended that customers deploy Visual Analytics using a 10GbE connection to download new tables and to interact with the users. However, customers may wish to deploy 1GbE. If 1GbE is deployed, HP recommends bonding the 4 ports to create a single target. This will increase the speed at which data can be transferred and will provide a more pleasing experience for the user base.

Guidance deployment steps

1. Acquire your DL580 Gen8 server configured for your unique needs with the correct amount number of processors and cores, the correct amount of memory and the correct number and size of disk drives. The SAS EEC and SASTECH@hp.com will assist you with defining the requirements specific to your expected utilization.
2. Install the DL580 Gen8 in your environment. This could include, but is not limited to:
   A. Installing the DL580 Gen8 in a rack.
   B. Adding the DL580 Gen8 server to the corporate network so that users can access the server, once it’s configured.
3. Install Red Hat Enterprise Linux. SAS recommends RHEL 6.1 and later versions. We used RHEL 6.5.
4. Install all of the required components to support SAS Visual Analytics. The latest copy of this can be found at http://support.sas.com/documentation/installcenter/en/ikvisanlytofrndmsr/68018/HTML/default/index.html
5. Install SAS Visual Analytics. This is typically performed by a SAS consultant.
6. Configure SAS Visual Analytics for your unique requirements. This is typically performed by a SAS consultant using information provided to him by you, our mutual customer.
7. Load and import your data model.
8. If needed, create your data query procedures.

**Bill of materials**

**Note**
Part numbers are at time of publication and are subject to change. The bill of materials does not include complete support options or other rack and power requirements. If you have questions regarding ordering, please consult with your HP Reseller or HP Sales Representative for more details. [hp.com/large/contact/enterprise/index.html](http://hp.com/large/contact/enterprise/index.html)

Table 5. Bill of materials

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<td>8</td>
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<td>HP DL580 Gen8 12 DIMM Memory Cartridge</td>
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<td>HP 32GB 4Rx4 PC3-14900L-13 Kit</td>
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<td>HP Air Flow Optimization Kit</td>
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<td>E5Y43AAE</td>
<td>HP OV for DL 3yr 24x7 FIO 1 Svr E-LTU</td>
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**Summary**

The world is moving more and more quickly with each passing day.

Businesses have been collecting more and more data. The ability to analyze this big data is key to being able to more effectively guide and run a business.

The more quickly and thoroughly the data is analyzed, the more timely the information, the better companies are able to react to changes in business.

SAS Visual Analytics is just the product to accelerate that analysis, but it requires a fast, reliable and economical computer to enable that analysis. The DL580 Gen8 server is just such a computer. Properly configured, this server allows analysis of
larger data sets than would be possible on our DL360 Gen9, DL380 Gen9 or DL560 Gen8 SMP solutions, and allows for larger numbers of users to access those data sets concurrently. And while not often mentioned, SAS VA may be used in a virtualized environment on this equipment.

**Implementing a proof-of-concept**

As a matter of best practice for all deployments, HP recommends implementing a proof-of-concept using a test environment that matches as closely as possible the planned production environment. In this way, appropriate performance and scalability characterizations can be obtained. For help with a proof-of-concept, contact an HP Solution Design Services (SDS) representative at sastech@hp.com.

**Appendix A – Setting a server in Lockstep memory mode**

**Note**
The better results were obtained using Interleave memory mode, which is how HP’s servers are delivered from the factory.

Step 1 – Boot the server and interrupt the boot process by pressing F9.
Step 2 – Select System Configuration.

Step 3 – Select BIOS/Platform Configuration.
Step 4 – Select System Options.

Step 5 – Select Advanced Memory Protection.
Step 6 – Select Lockstep Mode.

Step 7 – Select F10 to save your configuration.
Step 8 – Press the escape key 3 times.

Step 9 – Reboot the server again and when it completes its reboot, it is in Lockstep mode.
Appendix B – Setting a server in Interleave memory mode

Note
The better results were obtained using Interleave memory mode, which is how HP’s servers are delivered from the factory.

Step 1 – Boot the server and interrupt the boot process by pressing F9.

Step 2 – Select System Configuration.
Step 3 – Select BIOS/Platform Configuration.

Step 4 – Select System Options.
Step 5 – Select Advanced Memory Protection.

Step 6 – Select Interleave Mode (represented by Advanced ECC Support).
Step 7 – Select F10 to save your configuration.

Step 8 – Press the escape key 3 times.
Step 9 – Reboot the server again and when it completes its reboot, it is in Interleave mode.

Appendix C – Setting a server to High Performance power mode

Step 1 – Reboot the server and interrupt the boot process by pressing F9.
Step 2 – Select System Configuration.

Step 3 – Select BIOS/Platform Configuration (RBSU).
Step 4 – Select Power Management options.

Step 5 – Select HP Power Profile.
Step 6 – Select Maximum Performance.

Step 7 – Select F10 to save the configuration.
Step 8 – Press the escape key 4 times followed by enter to reboot your server.
For more information

HP ProLiant DL580 Gen8  hp.com/servers/dl580
Infrastructure Insights for the New Style of IT  hp.com/go/convergedinfrastructure
HP ProLiant Servers  hp.com/go/proliant
SAS Institute  sas.com
HP and SAS Institute  hp.com/go/sas
SAS Visual Analytics  sas.com/visual-analytics
HP OneView  hp.com/go/oneview

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