

## Paper 272-27

**Tuning WebHound™ 4.0 and SAS® 8.2 for Enterprise Windows Systems**

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**ABSTRACT**

Windows is SAS' largest and fastest growing platform. Windows 2000 Advanced Server and Windows 2000 Datacenter, coupled with advances in microprocessor and system design, now provide mainframe-class performance and scalability and many SAS users will consider using large Windows systems to deploy their SAS applications.

The new "Windows mainframes" also offer new features and benefits such as clustering, fail-over, hard-partitioning, processor affinity and more features that were previously unavailable on Windows platforms.

But, how do you optimize SAS applications to take full advantage of these new high-end Windows systems?

This paper details the specific system tuning activities performed for WebHound 4.0 and SAS 8.2 on the Unisys ES7000 running Windows 2000 Datacenter. Testing recently performed in Cary, NC resulted in recommended system and application configuration changes to achieve maximum performance and scalability for WebHound 4.0. Topics covered include:

- Definition of the WebHound 4.0 workload tested
- How performance testing was performed and key metrics that were measured
- Results of CPU scalability when comparing enterprise system to commodity systems
- Recommended system and application configurations
- General sizing guidelines

**INTRODUCTION**

Performance testing was performed to document the results achieved from testing on the ES7000 for the WebHound 4.0 with SAS 8.2 product release. The testing was performed to:

1. Determine scalability of the application on the ES7000 in a 16 processor configuration
2. Determine if there is improved performance when comparing to 8 processor commodity servers
3. Provide performance characterization information for the application behavior on the ES7000
4. Provide application sizing guidelines for various sets of workloads (defined as small, medium and large)

Performance testing was performed on the following 2 hardware configurations:

- Unisys 8 CPU Commodity ES5085 Server for baseline comparison purposes
- Unisys ES7000 16 CPU Enterprise Server

The final release of WebHound 4.0 was utilized for the

performance testing. No code changes were made to the product to improve performance, only changes to system and product configurations.

For the purpose of this document, the term *scalability* is defined as achieving improved performance benefits when increasing CPUs, Memory and I/O capabilities

**BENCHMARK AND TEST DESCRIPTION****WEBHOUND ARCHITECTURE**

WebHound delivers accurate and up-to-date information regarding your Web site traffic: Who is visiting? How long do they stay? What are they looking at? Answers to these and many other questions are standard in WebHound. There are two uses of WebHound - the first is the build phase and the second is the exploitation phase. For the purpose of this paper, we will be addressing the build phase only."

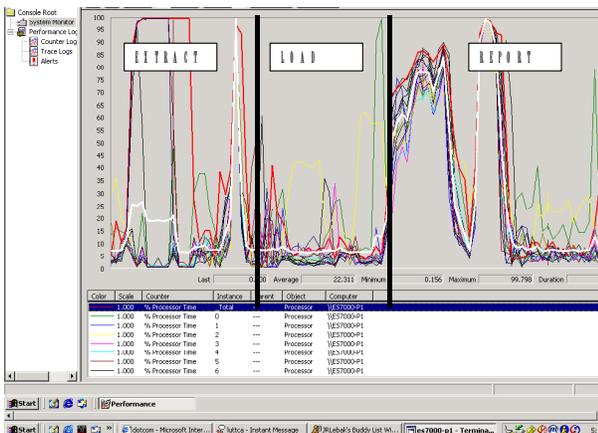
The build process of WebHound is a batch-oriented processing program that is driven by commands that instruct WebHound which Web log files to process, what type of processing to perform, etc. It can be initiated in a client/server SAS session to run all processing on the server. The bulk of the processing is performed on the server with only status and reporting messages being reported to the client system. All testing performed was run with the SAS client executing on the same ES7000 partition as the SAS server.

**PARALLEL PROCESSING CAPABILITY**

This version of WebHound takes advantage of the parallel processing capabilities of the MP Connect feature in the SAS/CONNECT product. The parallel processing provides the ability to configure multiple numbers of jobs (or SAS sessions) that will be spawned across the CPUs to improve performance (which in the case of WebHound is reduced processing time). This is accomplished by the parent SAS session spawning multiple processes (or child SAS sessions). As indicated in the results section of this document, this software feature was critical to the improved performance gains on the ES7000 when additional CPUs were configured.

It should be noted that the WebHound application does NOT perform parallel processing 100% of the time. Rather parallel processing can only be established during the Extract and Report sections of the build phase (about 30-40% of the total time). The performance gains that can be achieved from parallel processing and multiple CPUs are obviously limited to those times.

The diagram below shows a snapshot of CPU utilization for an entire processing run. The white line represents the processor utilization for all 16 CPUs, while the other colors represent utilization for each individual processor. As you can see from the variable spikes, this is where parallel processing is being performed.



**WebHound Total Parallel Processing**

Since the WebHound processing is performed in sequence with Extract, Load and finally Report, you can see that the most of the parallel processing occurs more than 1/2 way thru the entire run. This is where the report section begins, making this processing the most beneficial to a multiple CPU configuration.

**TEST DESCRIPTION**

**SYSTEM CONFIGURATIONS:**

**Unisys ES5085 System (8 CPU Commodity Server):**

- 8 700 MHZ Xeon Processors (Profusion chipset)
- 4 GB of RAM
- 2 Fibre channel paths to ESM7900 Disk Subsystem (thru a SAN)
- Windows 2000 Advanced Server SP2

**Unisys ES7000 System (16 CPU Enterprise Server)**

- 16 700 MHZ Xeon Processors
- 32 GB of RAM
- 2 Fibre channel paths to ESM7900 Disk Subsystem (thru a SAN)
- Windows 2000 Datacenter Server SP2

**Unisys ESM7900 Disk Subsystem (for both systems)**

- 1 DPE (Base Unit) with 10 18 GB drives
- 1 DAE (Expansion Unit) with 10 18GB drives
- 2 Brocade SAN switches
- 2 Fibre channel controllers from the SAN switches providing access to storage subsystem
- RAID /I/O arrays (Striped then Mirrored)

**WORKLOAD CHARACTERIZATION**

The workloads used during the performance testing were defined using two important factors regarding the Web log files that are input into WebHound for processing:

- ▶ Number of Days
- ▶ Size of Files

It was determined that testing would include 3 different values for each of the above factors. For the "Number of Days" factor, 1, 7 and 30 days were determined to be meaningful and provide important sizing guideline information for potential customers. For the "Size of Files" factor, Small, Medium and Large file sizes were defined that represent typical customer data sizes for Web log files to be processed.

When both factors are combined, the testing was performed for a total of **9 (3 x 3) workloads** in the different system configurations.

The TOTAL size of data to be processed by WebHound for each workload is defined as follows:

	<u>1 DAY</u>	<u>7 DAY</u>	<u>30 DAY</u>
▶ <b>SMALL</b>	141MB	798MB	3.13GB
▶ <b>MEDIUM</b>	219 MB	2.61GB	11.0GB
▶ <b>LARGE</b>	2.9 GB	17.3 GB	40.1 GB

**TESTING METHODOLOGY**

The performance testing executed all three phases of WebHound processing including: Extract, Load and Report. During the testing various monitoring tools were used to evaluate the behavior of the system and application. Where it was determined that bottlenecks were occurring or performance gains could be achieved, reconfiguration of WebHound parameters and/or system configuration were performed to determine if the changes resulted in improved performance. Those changes that did not improve performance or cause degradation were removed. Significant reconfiguration of the number of jobs parameter in WebHound was done to determine the scalability of the application and find out what number(s) produced the BEST results.

Details of the changes that were implemented to achieve optimal performance can be obtained if needed. The final changes that contributed to the best performance results on the ES7000 are collected and documented as sizing guidelines and recommendations in later sections of this document.

The following tools were utilized throughout the testing processes:

- W2K Datacenter Performance Monitor – This tool was used significantly during the testing processes. All of the system performance counters are displayed (or logged) using this tool. Analysis of CPU, Memory and I/O bottlenecks were determined by examining various counters looking for queuing of resources.
- W2K Task Manager – This tool was used to examine the individual SAS processes running during parallel processing. It provided statistics of CPU utilization, I/O and Memory usage for each individual process.
- Navisphere Analyzer – ESM7900 Disk Subsystem Performance Statistics
- Unisys Enterprise Software Suite (ESS) – define thresholds and perform appropriate actions when they are exceeded

**TESTING RESULTS**

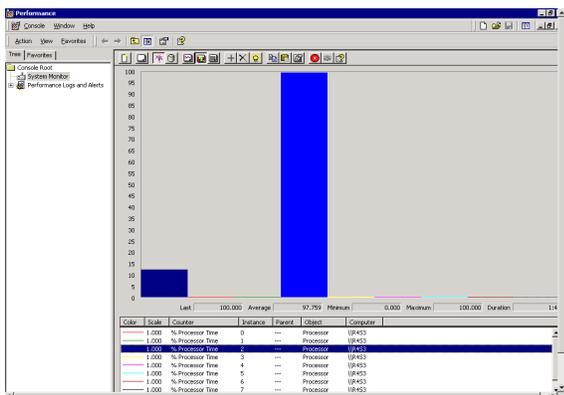
During testing it was found that results could vary significantly depending on the on the type of data in the Web log files. As a result, no generalizations can be made regarding how much data can be processed in a specific period of time. For example, processing of 10 Web log files that total 2.0 GB in size for one website could produce different timings than that of a similar website with different data. No analysis of the type of data in the 9 different workloads was performed and therefore no recommendations or conclusions made.

**CPU SCALABILITY**

Processor scalability was determined by evaluating the CPU utilization of the system (when there were NO other bottlenecks in the system) and CPU queuing.

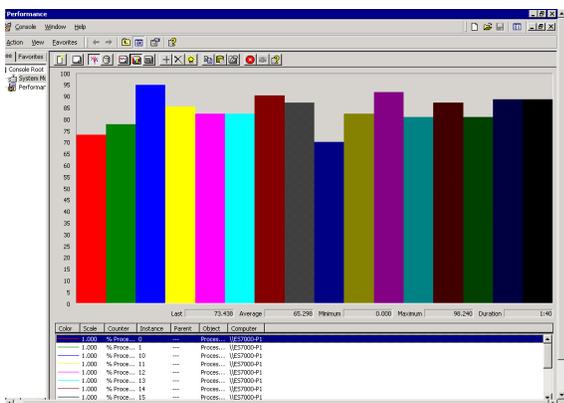
Also, by increasing the number of concurrent jobs that are run, it was expected that the BEST results would be achieved when number of jobs is configured as 2 less than the number of total processors. This expectation was based on the following:

- ▶ Previous SAS testing performed on the ES7000 to determine scalability resulted in this linear-linear scalability
- ▶ WebHound uses almost 95% CPU utilization for a single processor-single job configuration at various stages of processing. This is demonstrated in the picture below, which is a snapshot of the CPU utilization from Performance Monitor while running with NO parallel processing (single job):



CPU Utilization w/ NO Parallel Processes

In contrast however, when taking a snapshot of CPU utilization when 16 jobs are configured in an ES7000 16 processor system, you can see that ALL 16 CPUs are being utilized at above 90%:



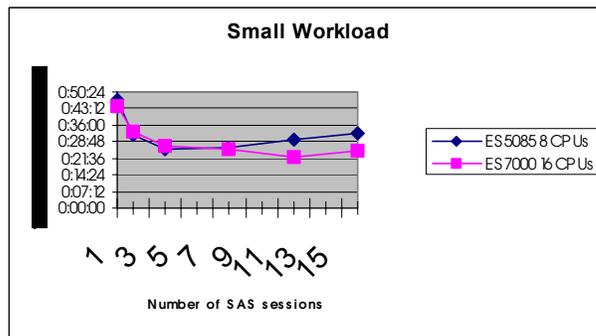
CPU Utilization w/14 Parallel Jobs

While usage of all CPU available in the system is important to measure performance, it by itself does not indicate scalability. Scalability can be determined only by obtaining IMPROVED performance results when additional CPUs (or other resources) are configured.

With that in mind, the following charts show the number of concurrent jobs configured for WebHound on one axis and the total processing time (metric measured to determine scalability) on the other axis. Results are presented for one workload (Small) for a SINGLE day of Web log data.

As you can see from this chart, the decrease in total time to process is continual and levels off at approximately 2 CPUs less than the total number of processors. This proved to be true for all systems tested (8x Commodity and 16x ES7000). The more

CPUs that can be configured and used for parallel processing, the greater the reduction in the total amount of time to complete WebHound processing:



**BEST RESULTS COMPARISON (BETWEEN COMMODITY AND ENTERPRISE SERVERS)**

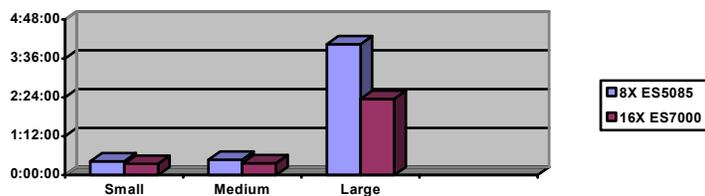
The Unisys ES5085 8 processor system provided a baseline for comparison to results achieved on the 16 CPU Unisys ES7000 system.

As indicated in the charts below, the ES7000 system testing results in LESS time to perform processing of all 3 WebHound phases (Extract, Load and Report) for ALL workloads. This indicates that **more CPUs do provide improved performance results** for the key metric, total processing time (which is represented by the colored bars in the chart).

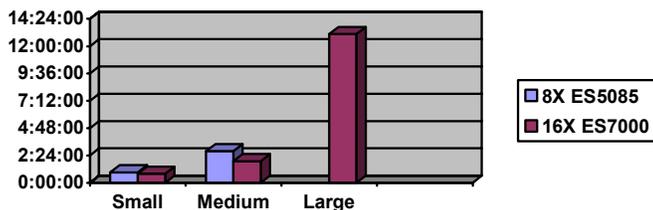
The charts also show that more significant timesavings are obtained for those larger workloads that require significant amount of data (Web log files and sizes) to process. The times reported in these charts represent the BEST results achieved for each workload on a particular system.

The **BLUE** Columns represent the total processing time for the 8-way commodity server while the **PURPLE** column represents the total processing time for the ES7000 Enterprise Server.

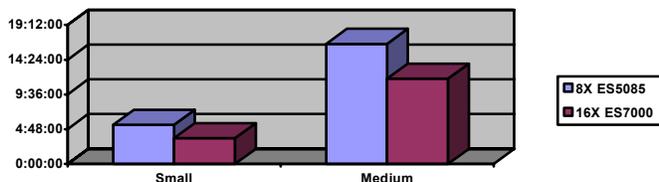
**One Day Processing:**



**Seven Day Processing:**



**Thirty Day Processing:**



**Note:** The LARGE workload could not be processed to completion on the 8-processor commodity server.

**ES7000 SIZING RECOMMENDATIONS**

The following chart represents the actual sizes (MAXIMUM) of disk space required for each workload tested. As you can see, there are limited conclusions and generalizations one can make about the space required. Perhaps a “rule of thumb” is to have at LEAST the amount of space for the STAY area as that of the Web log files and at least 2 times the amount of space for the Scratch area.

	Web logfiles:	Stay Area:	ScratchArea:
<b>SMALL:</b>			
1 Day	1 File 140 MB	295 MB	640 MB
7 Days	7 Files 798 MB	953 MB	1.76 GB
30 Days	28 Files 3.15 GB	3.13 GB	5.91 GB
<b>MEDIUM</b>			
1 Day	4 Files 219 MB	299 MB	620 MB
7 Days	28 Files 2.61 GB	2.47 GB	4.30 GB
30 Days	116 Files 11.0 GB	8.75 GB	15.6 GB
<b>LARGE</b>			
1 Day	14 Files 2.94 GB	3.02 GB	3.87 GB
7 Days	111 Files 17.3 GB	16.8 GB	23.2 GB

**SAS FILE LOCATIONS**

The following files are required for WebHound processing. It is recommended that EACH one be placed on SEPARATE disks (or Logical Units for the ESM7900) that are distributed across the storage processors in the ESM7900 and multiple I/O channels (at least 2) from the ES7000.

**For SASMART (STAY Area):**

The data warehouse space required (commonly referred to as the SASMART area) will depend on the number and size of Web log files as well as the type of processing to be performed. This area is a permanent area where information is typically kept and maintained by WebHound for a certain period of time (that is configurable in WebHound).

General guidelines for the amount of space required for each workload tested can be obtained from the information in the sections preceding this. These are just general guidelines to help estimate disk space requirements, but do not accurately represent the storage requirements for your specific Web log

files.

It is recommended that a reliable hardware RAID level be used for this area (RAID 1+0) since data integrity and reliability is important.

**For Scratch Area:**

This is a temporary area that is used by WebHound during processing. It is cleaned up every time that a specific WebHound job is run. Hardware RAID 1+0 is recommended for this disk (LUN). Use multiple channels paths and software disk striping with W2K Operating System to avoid possible I/O bottlenecks.

**For SAS WORK:**

This is a temporary area that is used by SAS during processing. Each concurrent SAS job that is executed during parallel processing requires additional disk space allocated to the SAS WORK area.

Immediately when performance testing began there were indications of disk queuing on the logical drives configured for the SAS work area. This bottleneck and queuing got worse as the number of SAS sessions increased on the server. This is due to the fact that each SAS Session spawned by the primary WebHound session, was accessing the same file system for its SAS WORK activities. As a result, there are two configuration methods that can be used to eliminate this potential bottleneck:

1. Distribute the SAS WORK areas for each SAS MP Connect session across many disks by programming methods within the SAS WebHound processing work
2. Distribute the SAS WORK area across multiple disks (LUNS) using the W2K Datacenter software striping feature (and dynamic disks). With the Disk Manager program, multiple disks can be combined to form a single drive (i.e. drive W) and the operating system will distribute the I/O and data across all of those disks (called LUNs)

RAID 0 should be used for all of those disks (LUNs) that provide SAS WORK access.

**CPUS**

As shown in previous sections, the general recommendation is to configure more CPUs to accomplish reduced processing time (up to 16). CPUs can be dynamically assigned to the SAS applications on the ES7000 as demand requires using tools provided by both Microsoft and Unisys.

In addition, using W2K Datacenter tools, CPUs can be moved to the WebHound application as required and, when its processing is done, be returned to other applications that will require these resources.

The general recommendation is to start no more than 2 less than the total number of CPUs for total number of SAS sessions (for example start 14 SAS sessions and leave 2 for the W2K OS in a 16 CPU system).

**DISK SUBSYSTEM**

A fibre-based disk subsystem is recommended for WebHound. The application has proven to be I/O intensive at various stages throughout the processing. SAS files should be spread across multiple spindles using the hardware RAID capabilities of the subsystem. A RAID I/O configuration provides the striping for performance advantage and the redundancy for availability (striping is done first, then mirroring. RAID I/O may be beneficial for those disks that will contain the SAS warehouse for WebHound. The Scratch and Work area should also be

configured as RAID I/O for performance and reliability benefits.

A minimum of 6 logical units (or LUNs) is recommended to be presented to the Windows Datacenter Operating System. (These LUNs are presented as disk devices under disk management). Two of these LUNs should provide the disk for the SAS warehouse and scratch area respectively. Since the SASWORK area I/O activity seems to be very intensive at times, it is recommended to use the 4 LUNs all mapped together as one logical unit for the Windows Operating System. This configuration is performed using the Disk Management tool in W2K. This allows the operating system to essentially stripe the I/O across those 4 LUNs, eliminating a potential bottleneck. This configuration increased performance results by 80% during performance testing.

Storage Area Network (SAN) configuration using switches is recommended (but not required) to provide all of the technical and economic benefits of SANs including the flexibility to reassign disks (LUNs) to other operating systems when required.

### I/O CHANNELS

Multiple I/O channels (MINIMUM of 2) are recommended to distribute the I/O activity across all channels and to also provide redundancy in the event of a failure, which improves availability. A fully populated ES7000 has 96 PCI slots making the number of I/O channels that might be required NOT a concern for slot availability.

The distribution of the disk configurations above should utilize all I/O channels available to the disk subsystem.

A minimum of 4 fibre channel connections from the SAN switches to the disk arrays is recommended for performance and redundancy benefits.

### MEMORY

Memory recommendations depend on the amount of data to process (size and number of Web log files) and the type of processing to be done. Some general guidelines:

1. A MINIMUM of 16 GB is recommended regardless of the size and number of Web log files for a 16 processor configuration (i.e. 1 RAM for each CPU)
2. The larger the size of the Web log files and the more files that are to be processed requires additional.
3. The number of SAS sessions initiated by SAS/CONNECT affects the memory usage (number of job WebHound parameter). More SAS sessions require additional memory. If using more than 14 SAS sessions (number of jobs) in a 16 CPU configuration, the recommendation is to add 1GB of RAM per additional SAS session.
4. Concurrent WebHound processing (i.e. multiple WebHound programs running at the same time). Obviously, double the memory if running 2 different WebHound processing at the same time.
5. For significantly large workloads (like those that have the characteristics defined in this LARGE test), it is likely that more than 16GB of RAM will be required.

### CONCLUSION AND RECOMMENDATIONS

As a result of this testing, it has been proven that an enterprise Windows 2000 system, like the ES7000, that is capable of supporting more than 8 CPUs (a typical commodity server) is beneficial to WebHound customers who desire reduced processing time.

As demonstrated in this document, scalability can be achieved with WebHound processing. It has been proven that the **more CPUs** that are configured and available on a server with a robust I/O subsystem, **the more saving in total processing time** (the key metric measured) occur.

In addition, a 16 to 32 CPU ES7000 system configuration could be beneficial to those that require reduced processing time AND have the need to process MULTIPLE Web sites at the same time. One WebHound process could be taking advantage of the performance gains of a 16 CPU environment while a separate WebHound program could be taking advantage of the additional CPUs in the system.

Larger workloads (many files and large files) are most beneficial to the timesavings and scalability results that can be provided with the ES7000 hardware.

### ACKNOWLEDGMENTS

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