WebSTONE: The First Generation in HTTP Server Benchmarking

Gene Trent
MTS
Silicon Graphics

Mark Sake
MTS
Silicon Graphics

February 1995

ABSTRACT

With the advent of the Hyper Text Transfer Protocol (HTTP) it was just a matter of time before the commercial use would be evident. Performance testing of different hardware platforms as well as different implementations of HTTP has made it necessary to create a new benchmark that will allow a customer easily to understand the performance characterizes of different vendors. The WebSTONE, a web serving benchmark has been developed in an attempt to better understand the performance characterics of both hardware and software. The following paper describes the benchmark in technical detail and issues involved in developing this benchmark. This benchmark was developed because there is currently no other way of testing the application. This benchmark is intended for free distribution both this white paper and code. It is the intent for this benchmark to grow and better help test system performance for future systems and HTTP implementations.

Gene Trent
Copyright © Silicon Graphics, 1995

Contents

1 Web Overview page 5

2 WebSTONE overview page 5
- 2.1 The WebSTONE as a performance tester **page 6**
- 2.2 WebSTONE's measure of server Performance **page 6**
- 2.3 What the WebSTONE doesn't test **page 7**

3 WebSTONE Architecture page 7
- 3.1 WebSTONE Software **page 8**

4 Configuration Parameters page 9
- 4.1 Duration test **page 9**
- 4.2 Repetition test **page 9**
- 4.3 Number of files **page 9**
- 4.4 Number of pages **page 10**
- 4.5 Server software and hardware configuration **page 10**
- 4.6 Number of Webchildren **page 10**
- 4.7 Number of networks **page 10**
- 4.8 Number of clients **page 11**
- 4.9 Workload of pages **page 11**
- 4.10 Logging **page 11**
- 4.11 Debugging **page 11**

5 Workload Parameters page 11
- 5.1 General modem mix **page 11**
- 5.2 General mix **page 12**
- 5.3 Media rich mix **page 12**
- 5.4 General and media rich mix **page 12**

6 Load Generation page 12
- 6.1 Page selection **page 12**
- 6.2 Page access **page 13**
- 6.3 Duration of the test **page 13**

Gene Trent
Copyright © Silicon Graphics, 1995

7 Benchmark Results page 13
7.1 Summary of results page 20

8 Future Work page 21

9 Acknowledgments page 22

10 Author Information page 22

11 References page 22

12 Trademarks page 22

Figures

Figure 3 A WebSTONE test environment page 7
Figure 3.1 Webchildren client page 8

Gene Trent
Copyright © Silicon Graphics, 1995

1. Web Overview

Since the advent of the internet over 20 years ago, there has not been an easy way to access information on the network unless you were proficient with a number of UNIX commands and understood how the network functioned. But now, thanks to HTTP, the ability to reference information and to travel the net (known as surfing) has been made incredibly simple. A user with a GUI (graphical user interface) can navigate through the internet as easily as they do through their windows based personal computers with the click of mouse button.

HTTP is an application-level protocol with low overhead and the speed necessary for distributed, collaborative, hypermedia information systems. It is a generic, stateless, object-oriented protocol which can be used for many tasks, such as name servers and distributed object management systems, through extensions of its request methods (commands). A feature of HTTP is the typing and negotiation of data representation, allowing systems to be built independently of the data being transferred. The protocol is typically layered on top of TCP/IP in order to guarantee data transfer. Other methods of data transfer maybe used, but, the vast majority of existing systems use TCP/IP for HTTP transfers. The protocol consists of a request and response paradigm. See reference for further information on HTTP.

Once a content or commercial provider has their HTTP server on the Internet a user with the use of an internet browser is able to access the provider with a common interface defined through the Hyper Text Markup Language (HTML), which is a subset of SGML (Standard Generalized Markup Language).

HTML is a simple markup language used to create documents that may be shared between different platforms. The language allows text, data, graphics, news, mail and a number of other utilities to interact with the HTTP server and browser. This gives the user the freedom to enjoy the benefits of the provider without having to know how it is accomplished.

2. WebSTONE overview

The WebSTONE is a new benchmark that tests the performance of HTTP in contrast to server platform's and different implementations of HTTP. Because there are many different types of server software that is currently available, as well as different hardware platforms, there needs to be a mechanism for testing benchmarking server software and hardware platform performance. The WebSTONE is a benchmark that attempts to do this. As with any new benchmark the WebSTONE is a starting point. Once the benchmark is introduced into the general World Wide Web (WWW) community, improvements and enhancements will be made to further the use of this benchmark in support of better end user performance.

Gene Trent
Copyright © Silicon Graphics, 1995

Since the functionality of the Web is similar to the functionality of NFS™, the LADDIS benchmark was reviewed for possible as the web benchmark. Unfortunately, there was no easy way to adapt this benchmark. However, LADDIS did offer a perspective on how to benchmark client/server environment. The WebSTONE is used to measure maximum and average response times for connecting to the server. In addition throughput data is also generated. The WebSTONE is executed simultaneously on one or more clients resident on the server's network. Each client is able to launch a number of children (called Webchildren) depending on how the system load is configured. Each Webchildren is able to request information from the server based on a given file load. The WebSTONE is written to be independent of the server platform or software running on it. In essence it treats the server as a blackbox.

2.1 The WebSTONE as a measure of performance

In addition to a benchmark that generates standardized data for comparison of different platforms, the WebSTONE is also a performance tester and maybe used as a tool to help identify performance characterizations of server platforms. It is our goal that the benchmark will evolve and will help define a standard the WWW community may use when comparing data.

Used as a performance tool the WebSTONE, uses workload parameters and clients to generate HTTP traffic that allows an HTTP server to be stressed in a number of different ways. This can gives insight into the server's behavior and performance in a variety of environments.

There four different workloads that represent a sample of the existing servers currently in use on the web.

- The first one is a workload for general use actives that is sensitive to modem users.
- The second workload is a general mix that is not as concerned with the modem user, but, is still sensitive to download times.
- The third mix is a media rich mix that has very large content.
- the fourth mix is a combination of both the first and third mix.

It should be noted that since the web is still in its infancy it will take time to have well defined mixes that will be considered standard. It also should be noted that there is also the chance that there will be no such thing as a standard mix and each customer will have to define their own mix based on individual sites and run the test against the selected systems.

2.2 WebSTONE's measure of server performance

The WebSTONE is a configurable benchmark that allows performance measurement of the server in the following ways:

- Average and maximum connect time
- Average and maximum response time
- Data throughput rate

Copyright © Silicon Graphics, 1995

- Number of pages retrieved
- Number of files retrieved

The benchmark's goal is to control as much of the clients running environment as possible. The WebSTONE has no interest in the server configuration.

Since the object is to control as much of the client environment as possible we decided to is write the benchmark in C and not to use existing code libraries as they are not written with performance in mind. The benchmark sends HTTP requests to the server and then processes the performance data when done. This insures that only the code necessary to execute the given request is performed in the most direct path.

Though there will always be added overhead in the benchmark this ensures the most control over the accuracy of the benchmark. With this method the layer of existing libraries is removed and only what is needed to measure the pure performance of the server is used.

2.3 Metrics the WebSTONE doesn't test

Since this benchmark is concerned only with the server software and hardware, the WebSTONE does not test the browser or client side applications or libraries. Though in the future it might be of interest to add this to the benchmark. Please see future additions to the benchmark in chapter 8, later on in this paper for other metrics that this benchmark currently does not test but will need to in the near future.

3. WebSTONE Architecture

The WebSTONE architecture is shown in figure 2-1. The Webchildren are controlled by the WebMASTER. The WebMASTER controls the operation of the benchmark run. As shown in figure 2-1 there are 4 Webchildren connected to the HTTP server over a dedicated LAN (LAN 1). The WebMASTER is executed on a separate system outside of the Webchildren. The WebMASTER can be run on one of the clients or on a separate machine. The benchmark currently is configured to run the WebMASTER on a machine that is not on the same network as the clients and the server.

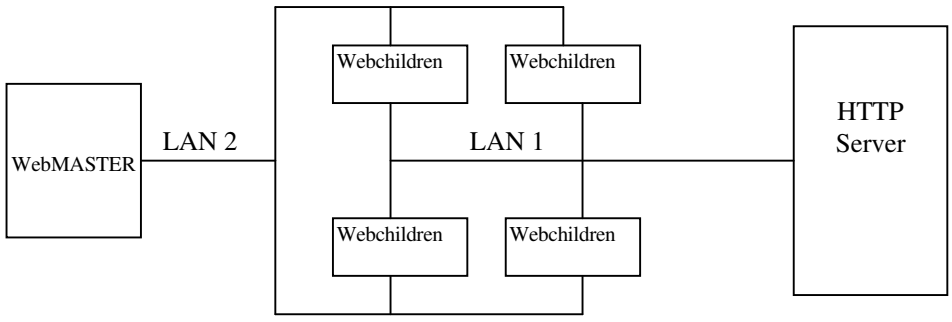

Figure 3 A WebSTONE test environment

Gene Tren.
Copyright © Silicon Graphics, 1995

With the ability to have the WebMASTER on a different system gives the flexibility to have different networks talking to the same server and to have different client configurations.

3.1 WebSTONE Software

The WebSTONE is a distributed, multi-process benchmark. The master process (WebMASTER) reads the client configuration files as well as the command line. The WebMASTER then constructs a command line for each Webchildren. The WebMASTER then remotely spawns the Webchildren. Each of the Webchildren then reads the command line and startup communication with the WebMASTER. After all the Webchildren have been initialized the WebMASTER instructs the Webchildren to commence the benchmark.

As each Webchildren finishes its run the WebMASTER collects the data from each client and coalesces the data into a report. During the run the Webchildren are autonomous of each other and the WebMASTER.

Figure 3.1 shows an example of a typical client running 3 Webchildren. The Webchildren are spawned by the WebMASTER. Each Webchild then reads its configuration files and opens log files if part of the test.

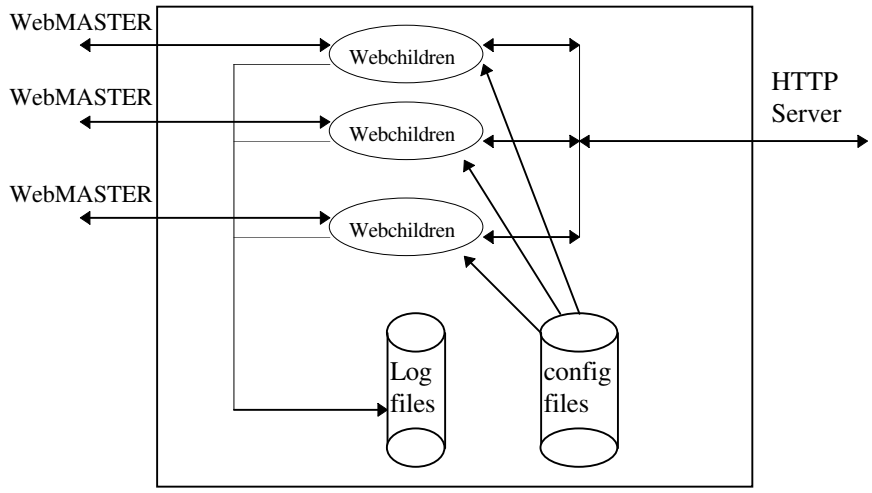

Figure 3.1 Webchildren

Gene Trent
Copyright © Silicon Graphics, 1995

4. Configuration Parameters

Since the WebSTONE can has many variables this gives the flexibility to configure and run many different suites. The standard mix of files will give a general performance indicator. The parameters that are configurable are listed below:

- **Duration of test**
- **Repetition of test**
- **Number of files**
- **Number of pages**
- **Server software and hardware configuration**
- **Number of Webchildren**
- **Number of networks**
- **Number of clients**
- **Workload of pages**
- **Logging**
- **Debugging**

4.1 Duration of test

The WebSTONE is designed to run for a specified duration. A given test is run in units of minutes. The maximum running time is dependent on your client memory and the number of Webchildren to be spawn.

4.2 Repetition test

The WebSTONE has the ability to run for a number of iterations. This is basically a loop counter. For example: If the test consists of a set of 4 files and the test to be run was to request each file 1 time and then report back the status of that run the benchmark would then attempt to retrieve each file one time and then generate a report based on this data.

4.3 Number of files

There are two different ways to read files or UIL's into the benchmark. The configuration file "filelist" contains a list of pages and files that are already preconfigured. There is a limit of 50 files per page in the current implementation of this benchmark.

The other way to read files into the run is at the command line. The user may list the files to be tested on the command line. This is limited by the number of arguments allowed on the command line.

Gene Trent
Copyright © Silicon Graphics, 1995

4.4 Number of pages

At this point the concept of a page needs to be introduced. Since the concept of a HTML document is one that has text with inline images like GIF and JPEG in it, there is a conceptual view that a page is the HTML text plus all the GIF and JPEG files that are associated with it that make to whole document. This approach was taken to mimic as closely to a real life environment usage patters where GIF and JPEG inlined images are automatically down load upon retrieval of the HTML text page. Therefore from this point on a page will be considered the set of files it takes to create an HTML viewable document. Note: Though in real life an applications program would lite off all the request for the files at one time, it was decided that this was not an issue since multiple children run on each client and that the acquired affect of simultaneously connections is stilled achieved.

The WebSTONE is designed to use the concept of pages during testing. The WebSTONE is able to handle up to 100 pages with 50 files per page.

4.5 All of the server software and hardware configuration

Though the WebSTONE is design to test different server software and hardware configurations the benchmark in itself does not discriminate as to configuration. This allows the tester to try different configurations in order to achieve optimal performance for the server software and hardware. NOTE: In fairness the tests should be run with the same hardware and software as reported in the test results. All hardware and sever software configurations should be disclosed when a test is released.

4.6 The number of Webchildren

On each client host the number of Webchildren requesting pages or files from the server is configurable. Note that as the number of Webchildren increase less memory is available on the client hosts for running tests and there could be a performance penalty depending on the speed of the clients running on the client host.

4.7 Number of networks

It is possible to have more then one network connected to the server and to have clients on different networks running the benchmark. Though this was not done in this version of the benchmark there should be no reason that it would not work provided that the server host name is the same on all the clients.

Copyright © Silicon Graphics, 1995

4.8 Number of clients

The WebSTONE supports the ability to have as many children on each client as long as there is enough memory on both the WebMASTER and client systems. Note there maybe an issue of performance bottlenecks on the client side if there are too many Webchildren or the client is slow.

4.9 Workload of pages

Each page in the WebSTONE has a weight associated with it. A page may be from 1 to 100% of the test. See the filelist for further information on configuration. Weighting is used to simulate that activity of a given page. The higher the percentage the more often the page is hit. The lower the percentage the less often the page will be hit.

4.10 Logging

Logging is added to the benchmark, but caution should be exercised when using this option as each Webchildren logs every connection and relevant data in a separate file. The logging information contains additional information that is not returned to the WebMASTER.

4.11 Debugging

Debugging is added to help debugged if there is a problem with the server or client. In debugging mode the HTTP header is display for each request that is sent.

5. Workload configuration

One of the goals for the WebSTONE is to model a real world workload via a synthetic workloads based on data gathered from different sites (Hotwired, IUMA, Netscape, and of course SGI). Unfortunately this is small data set to pull from but, it has been found that it does currently represents the general use of HTTP. In this benchmark there are 4 different mixes from the data gather from those sites.

5.1 General modem mix

The General modem mix is a synthetic page mix that would be used if modem users where to be considered. Two concerns to a potential server site should be the size of the pages that are on their system and type of access to the server. If a end user is accessing the server with a 14.4kbs modem then it would be in the best interest of the site to have small pages as to not take

Copyright © Silicon Graphics, 1995

a long time to download the data. This mix takes the end user that has to use a modem as their connection into account. This mix will consist of small pages that are less then 20k bytes and mainly text with sparse graphics files.

5.2 General mix

The General mix is one that is not concerned with modem users however, it is still concerned with the network responsiveness and throughput. File sizes in this mix will be between 1 and 100k bytes.

5.3 Media rich mix

Media rich is defined by the type and size of data stored. Media referees to multi-media content such as: MPEG and Quicktime movie files, MPEG and aiff ..etc. sound clips, and large graphics files. Media rich content sites are not worried about the size of their files. These files usually consist of movie clips and sound files. This mix is used to cover this need. These files range in size from 20k to megabytes.

5.4 General and media rich mix

To cover the combination of a site that wishes to server both small content and Media rich content this mix was created. This mix will most suite this need.

6. Load Generation

The current load generation of the WebSTONE is to request pages and files from the server as fast as the server can send them. Reflecting the current environment in the WWW community. To generate a load there are four things that are needed.

- A number of Webchildern. The more Webchildern that are requesting pages from the server the more load that this will cause.
- The type of page. This is mainly determined by the page size and the weight of the page.
- Number of clients. The more clients that are in the test the more Webchildern that are able to be brought to bear on the server.
- The number of pages. The more pages that are requested test other aspects of server.

6.1 Page selection

Each page in the mix has a percentage associated with it. This percentage is the weighting factor. The higher the number the more frequent the page will be hit. A random number is

Copyright © Silicon Graphics, 1995

generated and then compared to the page weight. If the random number matches the page weight then that pages' files are retrieved one at a time. Each Webchildren has its own random number sequence.

6.2 Page Access

After a page is selected by random weight then each Webchild contacts the HTTP server and requests the first file of the page. After the Webchild receives the first page it requests the next one until all the files for that page have been requested. On each page the time it takes to connect and down load the file is recorded and log if logging is turned on.

6.3 Duration of the test

The WebSTONE is designed to run until the clients run out of memory or the loop counter hits 20000. The loop counter is the ability to run a test in repetition as to time. This test is limited because of client memory. If client memory is not an issue this number can be changed and the benchmark recompiled. Most tests do not last longer than 1 hour..

7. Benchmark Results

The following is a typical run of the benchmark. The first run is of the benchmark against the Netsite server followed by the NCSA server.

The following parameters were modified to run the test:
nm_clusters
somaxconn = 50
nm_clusters = 4000
tcp_keepidle = (1200)
tcp_keep_timer_in_close = 1

Hardware platform:

1 150 MHZ IP22 Processor
FPU: MIPS R4010 Floating Point Chip Revision: 0.0
CPU: MIPS R4400 Processor Chip Revision: 5.0
On-board serial ports: 2
On-board bi-directional parallel port
Data cache size: 16 Kbytes
Instruction cache size: 16 Kbytes
Secondary unified instruction/data cache size: 1 Mbyte
Main memory size: 256 Mbytes
Integral ISDN: Basic Rate Interface unit 0, revision 1.0
XPI FDDI controller: xpi0, firmware version 9411032038, SAS
Integral Ethernet: ec3, version 1

Gene Trent
Copyright © Silicon Graphics, 1995

Integral Ethernet: ec0, version 1
Integral SCSI controller 5: Version WD33C95A, differential, revision 0
Disk drive: unit 4 on SCSI controller 5
Disk drive: unit 3 on SCSI controller 5
Disk drive: unit 2 on SCSI controller 5
Disk drive: unit 1 on SCSI controller 5
Integral SCSI controller 4: Version WD33C95A, differential, revision 0
Integral SCSI controller 0: Version WD33C93B, revision D
Disk drive: unit 5 on SCSI controller 0
CDROM: unit 4 on SCSI controller 0
Disk drive: unit 2 on SCSI controller 0

The file set used for this test is listed below. In this case a general and media rich mix was used.

```
#This file is used to configure the pages and files to be tested for.
6
40 3
/file3k.html
/file4k.html
/file5k.html
5 3
/file10k.html
/file17k.html
/file20k.html
5 2
/file5m.html
/file1m.html
20 3
/file6k.html
/file7k.html
/file200k.html
20 2
/file3m.html
/file21k.html
10 2
/file500k.html
/file13k.html
```

What follows is the results of a test ran for 10 minutes with the above page sets. The first set of data is from the Netsite server.

```
Netsite 1.0
*****************************************************************
/usr/local/bin/webstone -w xpi0-alfalfa -c sulu:2959 -u filelist -t 35 -n %d
Client: gateweb-indy8    Number of Clients: 6
Client: gateweb-indy9    Number of Clients: 6
Client: gateweb-indy10   Number of Clients: 6
Client: gateweb-indy11   Number of Clients: 6

Waiting for READY from 24 clients
All READYs received
Sending GO to all clients
All clients started at Fri Mar 17 11:23:10 1995
Waiting for clients completion
```


Gene Trent
Copyright © Silicon Graphics, 1995

All clients ended at Fri Mar 17 11:58:34 1995
Page # 0
==========
Total number of times page was hit 6649
Total time 4238.492450 seconds
Maximum Response time 2.071999
Total connect time for page 77.660191
Maximum time to connect 0.052151
Total amount of data moved 81702912
Page size 12288
Total number of connects 19947
==========

Page # 1
==========
Total number of times page was hit 607
Total time 526.552497 seconds
Maximum Response time 1.805497
Total connect time for page 8.111734
Maximum time to connect 0.036912
Total amount of data moved 29213696
Page size 48128
Total number of connects 1821
==========

Page # 2
==========
Total number of times page was hit 980
Total time 15710.908864 seconds
Maximum Response time 22.764984
Total connect time for page 19.605667
Maximum time to connect 5.785718
Total amount of data moved 6165626880
Page size 6291456
Total number of connects 1960
==========

Page # 3
==========
Total number of times page was hit 2866
Total time 2581.663009 seconds
Maximum Response time 3.341992
Total connect time for page 33.253920
Maximum time to connect 0.046310
Total amount of data moved 625108992
Page size 218112
Total number of connects 8598
==========

Page # 4
==========
Total number of times page was hit 3040
Total time 25083.667145 seconds
Maximum Response time 11.803875

Gene Trent
Copyright © Silicon Graphics, 1995

Total connect time for page 26.375753
Maximum time to connect 0.036555
Total amount of data moved 9628385280
Page size 3167232
Total number of connects 6080
==========

Page # 5
==========
Total number of times page was hit 1628
Total time 2148.113647 seconds
Maximum Response time 2.793287
Total connect time for page 14.345538
Maximum time to connect 0.036117
Total amount of data moved 855207936
Page size 525312
Total number of connects 3256
==========

==========
WEBSTONE number: 450
Total number of clients: 24
Total cumulative time of test for all hosts (sec): 50333.931099
Total number of pages retrieved from server: 15770
Total number of errors to server: 0
Total number of connects to server: 41672
Average time per connect: 0.004304 seconds
Maximum time to connect: 5.782854 seconds
Total mount of data moved: 17409474560
Total bytes of body moved: 17401507840 bytes.Total bytes of header moved 7966720
Average body size: 417583 bytes. Average retrieval size 417774
Thruput = 345879 bytes/sec
Average Response time: 1.207859 seconds
Maximum Response time: 19.524160 seconds

****
NCSA 1.3
****

/usr/local/bin/webstone -w xpi0-alfalfa -c sulu:2920 -p 1081 -u filelist -t 35 -n %d
Client: gateweb-indy8   Number of Clients: 6
Client: gateweb-indy9   Number of Clients: 6
Client: gateweb-indy10   Number of Clients: 6
Client: gateweb-indy11   Number of Clients: 6

Waiting for READY from 24 clients
All READYs received
Sending GO to all clients
All clients started at Fri Mar 17 10:46:38 1995
Waiting for clients completion
All clients ended at Fri Mar 17 11:22:02 1995
Page # 0
==========

Gene Trent
Copyright © Silicon Graphics, 1995

Total number of times page was hit 1414
Total time 16772.472590 seconds
Maximum Response time 23.797445
Total connect time for page 93.585630
Maximum time to connect 5.997783
Total amount of data moved 17375232
Page size 12288
Total number of connects 4242
==========

Page # 1
==========
Total number of times page was hit 144
Total time 1797.158479 seconds
Maximum Response time 23.050203
Total connect time for page 0.673942
Maximum time to connect 0.013216
Total amount of data moved 6930432
Page size 48128
Total number of connects 432
==========

Page # 2
==========
Total number of times page was hit 102
Total time 4813.787541 seconds
Maximum Response time 56.573603
Total connect time for page 6.192456
Maximum time to connect 5.905150
Total amount of data moved 641728512
Page size 6291456
Total number of connects 204
==========

Page # 3
==========
Total number of times page was hit 580
Total time 7588.192121 seconds
Maximum Response time 25.115934
Total connect time for page 2.897182
Maximum time to connect 0.019975
Total amount of data moved 126504960
Page size 218112
Total number of connects 1740
==========

Page # 4
==========
Total number of times page was hit 600
Total time 16247.815216 seconds
Maximum Response time 39.003870
Total connect time for page 1.790447
Maximum time to connect 0.015736
Total amount of data moved 1900339200

Gene Trent
Copyright © Silicon Graphics, 1995

Page size 3167232
Total number of connects 1200
==========

Page # 5
==========
Total number of times page was hit 294
Total time 2922.036210 seconds
Maximum Response time 20.210504
Total connect time for page 18.487052
Maximum time to connect 5.843007
Total amount of data moved 154441728
Page size 525312
Total number of connects 588
==========

==========
WEBSTONE number: 89
Total number of clients: 24
Total cumulative time of test for all hosts (sec): 50244.193163
Total number of pages retrieved from server: 3134
Total number of errors to server: 0
Total number of connects to server: 8420
Average time per connect: 0.014684 seconds
Maximum time to connect: 5.995063 seconds
Total mount of data moved: 2848899584
Total bytes of body moved: 2847382528 bytes.Total bytes of header moved 1517056
Average body size: 338169 bytes. Average retrieval size 338349
Thruput = 56701 bytes/sec
Average Response time: 5.967243 seconds
Maximum Response time: 42.658441 seconds

cern 3.0 **********
/usr/local/bin/webstone -w xpi0-alfalfa -c sulu:2996 -p 1080 -u filelist -t 45 -n %d
Client: gateweb-indy8   Number of Clients: 6
Client: gateweb-indy9   Number of Clients: 6
Client: gateweb-indy10   Number of Clients: 6
Client: gateweb-indy11   Number of Clients: 6

Waiting for READY from 24 clients
All READYs received
Sending GO to all clients
All clients started at Fri Mar 17 15:10:43 1995
Waiting for clients completion
All clients ended at Fri Mar 17 15:56:07 1995
Page # 0
==========
Total number of times page was hit 3724
Total time 16302.320093 seconds
Maximum Response time 62.488345
Total connect time for page 7149.901812
Maximum time to connect 59.671519
Total amount of data moved 45530112
Page size 12288

Gene Trent
Copyright © Silicon Graphics, 1995

Total number of connects 11105
==========

Page # 1
==========
Total number of times page was hit 501
Total time 2637.893006 seconds
Maximum Response time 38.798005
Total connect time for page 1229.359340
Maximum time to connect 35.484663
Total amount of data moved 24018944
Page size 48128
Total number of connects 1496
==========

Page # 2
==========
Total number of times page was hit 432
Total time 3164.881323 seconds
Maximum Response time 41.850207
Total connect time for page 1267.914110
Maximum time to connect 35.819251
Total amount of data moved 2707423232
Page size 6291456
Total number of connects 862
==========

Page # 3
==========
Total number of times page was hit 2080
Total time 8849.459607 seconds
Maximum Response time 63.461733
Total connect time for page 3450.850531
Maximum time to connect 59.909275
Total amount of data moved 453441536
Page size 218112
Total number of connects 6205
==========

Page # 4
==========
Total number of times page was hit 1732
Total time 10588.881744 seconds
Maximum Response time 63.663196
Total connect time for page 5386.565167
Maximum time to connect 59.516712
Total amount of data moved 5447897088
Page size 3167232
Total number of connects 3452
==========

Page # 5
==========
Total number of times page was hit 943

Gene Trent
Copyright © Silicon Graphics, 1995

Total time 3968.363226 seconds
Maximum Response time 62.245675
Total connect time for page 2099.311825
Maximum time to connect 59.244292
Total amount of data moved 491273216
Page size 525312
Total number of connects 1878
==========

==========
WEBSTONE number: 209
Total number of clients: 24
Total cumulative time of test for all hosts (sec): 45943.710179
Total number of pages retrieved from server: 9412
Total number of errors to server: 247
Total number of connects to server: 25167
Average time per connect: 0.823767 seconds
Maximum time to connect: 30.002288 seconds
Total mount of data moved: 9394691072
Total bytes of body moved: 9389627392 bytes.Total bytes of header moved 5063680
Average body size: 373093 bytes. Average retrieval size 373294
Thruput = 204483 bytes/sec
Average Response time: 1.825553 seconds
Maximum Response time: 34.973206 seconds

7.1 Summary of results

Netsite 1.0
WEBSTONE number: 450
Total number of clients: 24
Total cumulative time of test for all hosts (sec): 50333.931099
Total number of pages retrieved from server: 15770
Total number of errors to server: 0
Total number of connects to server: 41672
Average time per connect: 0.004304 seconds
Maximum time to connect: 5.782854 seconds
Total mount of data moved: 17409474560
Total bytes of body moved: 17401507840 bytes.Total bytes of header moved 7966720
Average body size: 417583 bytes. Average retrieval size 417774
Thruput = 345879 bytes/sec
Average Response time: 1.207859 seconds
Maximum Response time: 19.524160 seconds

Cern 3.0
WEBSTONE number: 209
Total number of clients: 24
Total cumulative time of test for all hosts (sec): 45943.710179
Total number of pages retrieved from server: 9412
Total number of errors to server: 247
Total number of connects to server: 25167
Average time per connect: 0.823767 seconds
Maximum time to connect: 30.002288 seconds
Total mount of data moved: 9394691072

Gene Trent
Copyright © Silicon Graphics, 1995

Total bytes of body moved: 9389627392 bytes.Total bytes of header moved 5063680
Average body size: 373093 bytes. Average retrieval size 373294
Thruput = 204483 bytes/sec
Average Response time: 1.825553 seconds
Maximum Response time: 34.973206 seconds

NCSA 1.3
WEBSTONE number: 89
Total number of clients: 24
Total cumulative time of test for all hosts (sec): 50244.193163
Total number of pages retrieved from server: 3134
Total number of errors to server: 0
Total number of connects to server: 8420
Average time per connect: 0.014684 seconds
Maximum time to connect: 5.995063 seconds
Total mount of data moved: 2848899584
Total bytes of body moved: 2847382528 bytes.Total bytes of header moved 1517056
Average body size: 338169 bytes. Average retrieval size 338349
Thruput = 56701 bytes/sec
Average Response time: 5.967243 seconds
Maximum Response time: 42.658441 seconds

The three examples above show a typical output from a run of the WebSTONE benchmark.
The WebSTONE number is the number of pages retrieved per minute.
Average time to connect: This is calculated by dividing the total time to connect by the total number of connects.
Maximum time to connect: This is defined as the longest time it took to connect during the run.
Total amount of data moved: This is the amount of data transferred during the run. (NOTE: this also includes data moved of pages that where incomplete. Incomplete pages means that the page was interrupted during retrieval and was unable to complete.)
Average Response time: This is calculated by dividing the total response time by the number of response.
Maximum response time: This is the maximum time to connect and transfer a page.

8. Future of the WebSTONE and future work

As this is the first version of the benchmark it is to be considered a living benchmark that will continue to grow and improve.

In the future there are a number of things that need to be added to the benchmark that this author at this time did not have time to add. The following is but a small list.

- Effects of the CGI (Common Gate Interface)
- Security (encryption and authentication)
- HTML parsing
- RDBMS performance

Gene Trent
Copyright © Silicon Graphics, 1995

These and others are of importance in the near future.

9. Acknowledgments

There are a number of people that have helped with this benchmark over the past 2 months. First and foremost Mark Sake who helped code and developed/architected the first version of the benchmark. Steffen Low for support and belief that this should happen. To Helena Winkler-Parenty for all her help. I would also like to special thank David Ceimwize for contributions to this paper.

Additional thanks to Neal Nucklus and Bill Nowicki for critical input to this paper and the benchmark.

10. Author information

Gene Trent is a Member of Technical staff in the Advance Data Division of Silicon Graphics. Mr. Trent is the principal Software Engineer that developed the WebSTONE benchmark and author of this white paper. Gene holds a bachelors degree in Electronic Engineer technology from Devry Institute of Technology. He can be reached at et@sgi.com or at Silicon Graphics 2011 N. Mountain View, Ca

Mark Sake is a Member of Technical staff in the Advance Data Division of Silicon Graphics. Mr. Sake co-authored the WebSTONE benchmark.

11. References:

[1] Berners-Lee, Fielding, and Frystyk Nielsen.
"Hypertext Transfer Protocol - HTTP/1.0"
Network Working Group INTERRNET_DRAFT
<draft-fielding-http-spec-01.ps>
<URL:http://www.ics.uci.edu/pub/ietf/http/> December 19, 1994

[2] Mark Wittle, Bruce E. Keith
"LADDIS: The Next Generation In NFS File Server Benchmarking"
USENIX Association Conference Proceeding, 1993

12. Trademarks

Copyright © Silicon Graphics, 1995

NFS[tm] is a trademark of Sun Microsystems, Inc.
UNIX is a registered trademark of UNIX Systems Laboratories.

Gene Trent
Copyright © Silicon Graphics, 1995