



SAVE ENERGY

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## DELIVERABLE

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### SAVE ENERGY Serious Game Server

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### Statement of originality:

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## EXECUTIVE SUMMARY

This deliverable describes the server for the SAVE ENERGY serious game, officially known as 'Green My Place' (GMP). The document briefly describes the server and lists its parts and where they can be accessed (online). The major concepts of the server, and brief guidelines for examination, are included.

The content of this deliverable is mainly schematic, explanations are kept to a minimum, given that the server itself is readily available to examine.

# 1 INTRODUCTION

## 1.1 Abstract

With the alterations in the design of the GMP game, the purpose of the server task was also altered. Not only would the server now be storing player scores, but it would also host the entire game, in the sense that it would meet requests from the player's web browser for the content of the web portal and mini-games. It would also need to communicate in duplex with the ISA iCenter pilot data server.

## 1.2 Overview

The server is a Linux node (Linode) Virtual Private Server (VPS) based in London, UK. Full server administrator capabilities are provided, including freedom to define own Linux distro, use fdisk or the tools provided to create disk image partitions, and to run any automation of tasks desired (e.g. *cron jobs*).

On the Green My Place Linode is hosted a Postgres SQL database, the website defined by a Ruby on Rails framework, an SVN code repository with development and commit versions plus the Trac project management system.

The software corresponding to deliverable 5.3 is available for review.

## 2 HISTORY

Initially the server was conceived as an internally hosted machine, scaling to meet demand by iterative hardware upgrades during periods of negligible use. While attempting to streamline this model, the solution was shifted to a Virtual Private Server (VPS), which is upgradable on the fly without downtime and is more cost effective and reliable. The VPS used is described in D5.1.

Development began on the internally located machine, running through iterations of simple PHP before beginning to test the possibilities of different frameworks. Although there are many PHP frameworks, the framework chosen was Ruby on Rails (as described in D5.1).

Thus since February the entire backend was essentially re-coded from scratch based on the principles underlying Rails and with the imperative to maintain good support for the modular multi-component game framework (including, but not limited to:

- Site controllers – pieces of Ruby code
- Site pages – html generated by Ruby
- Site localisation files
- Flex pages
- Flex page data support in xml, for scoring, account data, localisation and more
- Knowledge repository
- Database support for all components

Key technology and design decisions were made in the period from December 2009 until January 2010, and once those issues had been put aside, smooth development was maintained. Recent notable updates to the backend include all sorts of functionality developments and upgrades to allow seamless management of both the code-base and the community. Not to mention the connection with the ISA server feeding us energy data from the pilots. The backend is now truly a robust and reliable model.

### 3 FUNCTIONALITY

The Linode solution includes functionality to allow complete monitoring and control of network traffic (Figure 1), CPU (Figure 2), and storage (Figure 3). Additionally one can run the Linode by console, configure network settings such as IP address & reverse DNS, maintain automated backups, monitor for unintended shutdowns (and auto-restart), or configure the key features by adding or removing RAM, storage or bandwidth.

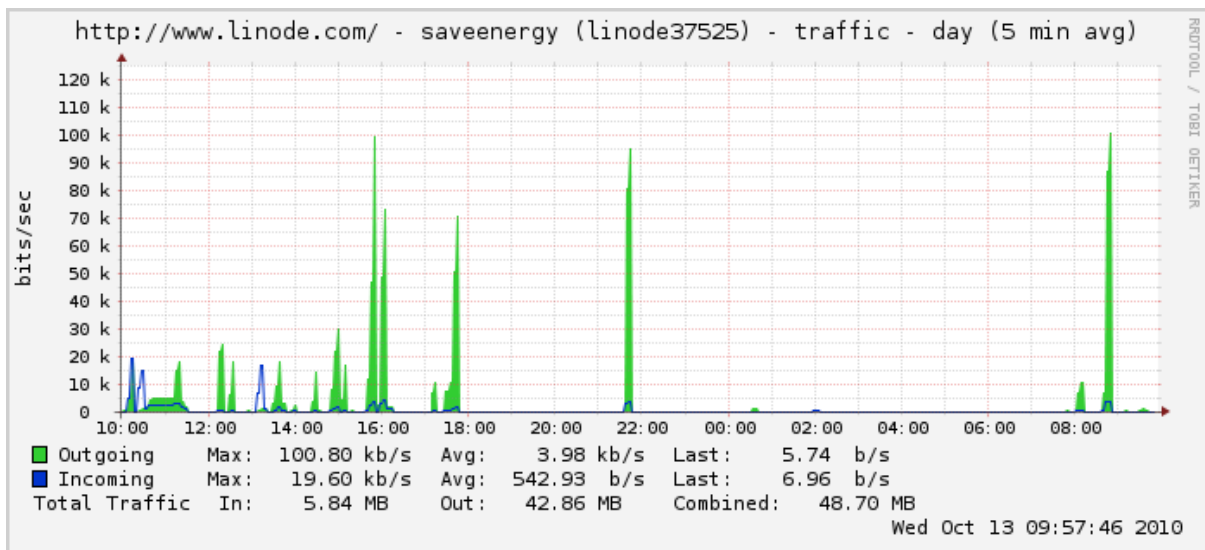


Figure 1 Traffic analysis for 1 day (complete history also available)

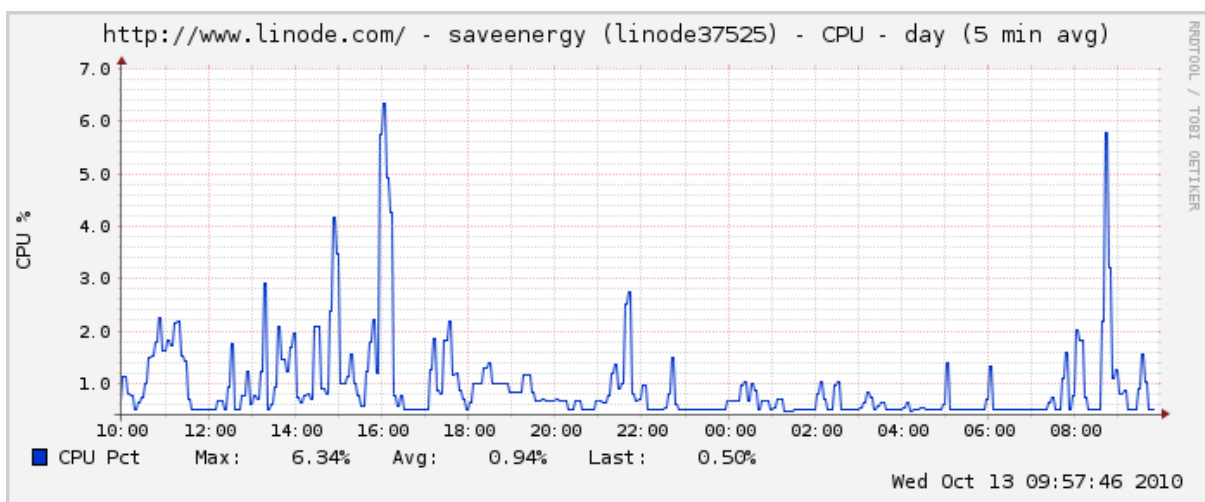
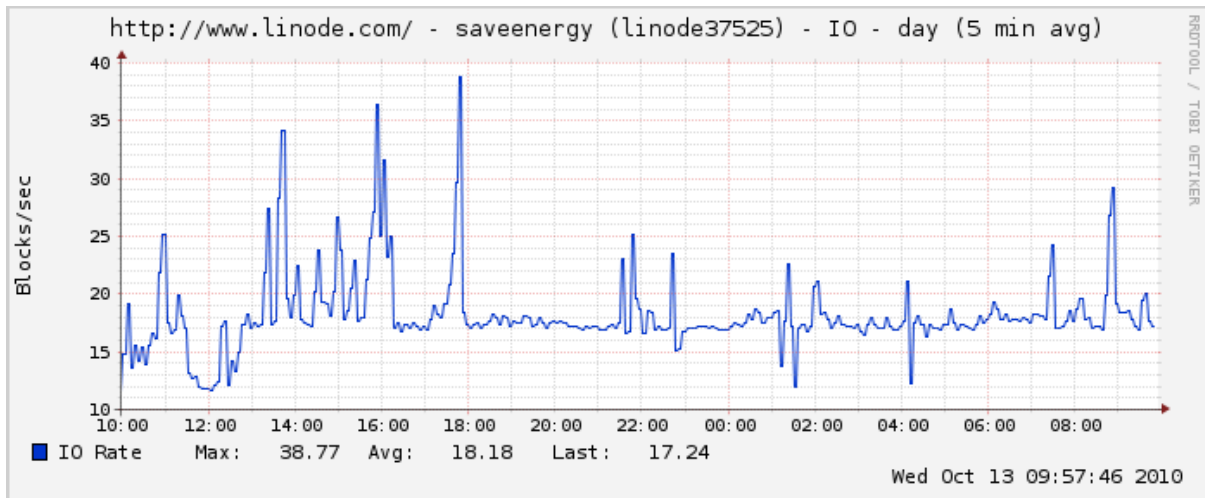


Figure 2 CPU analysis for 1 day (complete history also available)



**Figure 3 Disk IO analysis for 1 day (complete history also available)**

The Rails framework is covered in more detail in D5.1, but it also forms a key part of the server solution by allowing admin control of site entities directly on the site.

Finally of note is the Trac project management solution, which is also web based and allows a management-view access to all code, linking it with a roadmap of tasks.

## 4 TESTING

Automated testing of the server has been performed regularly. Several thousand virtual users were created in order to define a test-bed for the database and user-related functionality of the website, while the linkage the iCenter database for providing pilot energy-use data has been regression tested on the game development side. The server setup has been stress tested to obtain statistics for function under a range of request conditions: details of this have been included in Annex 1.

To summarise the tests, the dynamic requests are performing at approximately 120 requests per second. The heaviest pages have five or so dynamic requests from the flash. So that would bring it to 24 requests per second. Of course there are also images and style-sheets and SWFs, but those should be mostly cached on client's browser, so wouldn't be that much of a problem.

Profiling prototypical site use (such as trying to estimate how many page loads people do) in order to estimate traffic weight leads us to believe that our test results are within safe bounds. In "Green My Place", people spend most of their time on mini-games, which doesn't put stress on the server.

Finally, server performance can still be optimized in several ways beyond what had been achieved so far. The simplest thing would be to start caching everything, especially starting from the dynamically created XMLs, which should make those requests orders of magnitude faster (this simply hasn't been needed yet).

Additionally, as described above, complete monitoring of the Linode descriptive statistics is possible at all times, and automated watchdogs are in place for such events as Linode downtime.

## 5 CONCLUSION

In summary, the Green My Place server is a robust and reliable solution, as has been proven by the testing carried out.

The next steps include:

- Finalising the ISA iCenter connection
- Testing the entire platform – frontend and server – under beta conditions, i.e. with a dedicated test group closely modelling the target audience (with smaller numbers).
- 11<sup>th</sup> hour review of the database structure to ensure all required data points will be collected
- Building a query structure to enable data mining and analysis of player behaviour as the game evolves.

Finally, please see D5.1 for more details of the server and game architecture Figure 4.

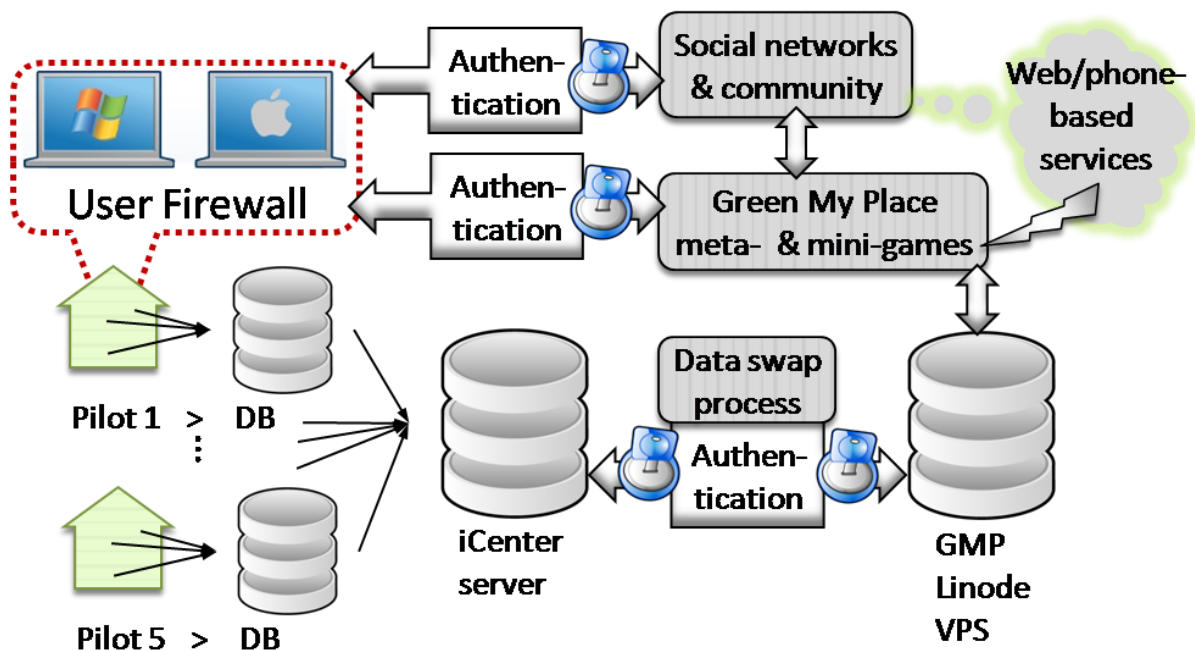


Figure 4 The architecture diagram for Green My Place, taken from D5.1. The GMP Linode server is on the bottom left.

## 6 ANNEX 1

### 6.1 Login Page Stress Testing log

This is ApacheBench, Version 2.3 <\$Revision: 655654 \$>  
Copyright 1996 Adam Twiss, Zeus Technology Ltd, <http://www.zeustech.net/>  
Licensed to The Apache Software Foundation, <http://www.apache.org/>

Benchmarking greenmyplace.net (be patient)

```
Server Software:      Apache/2.2.12
Server Hostname:     greenmyplace.net
Server Port:         80

Document Path:       /
Document Length:     10437 bytes

Concurrency Level:   10
Time taken for tests: 6.948 seconds
Complete requests:   1000
Failed requests:     0
Write errors:        0
Total transferred:   10892015 bytes
HTML transferred:    10437000 bytes
Requests per second: 143.92 [#/sec] (mean)
Time per request:    69.483 [ms] (mean)
Time per request:    6.948 [ms] (mean, across all concurrent requests)
Transfer rate:       1530.84 [Kbytes/sec] received
```

Connection Times (ms)

	min	mean[+/-sd]	median	max
Connect:	0	0 0.6	0	14
Processing:	18	69 37.0	62	255
Waiting:	18	68 36.9	61	254
Total:	18	69 37.0	62	255

Percentage of the requests served within a certain time (ms)

50%	62
66%	76
75%	88
80%	97
90%	119
95%	140
98%	166
99%	185
100%	255 (longest request)



## 6.2 Home Page (Europe Map) Stress Testing log

This is ApacheBench, Version 2.3 <\$Revision: 655654 \$>  
Copyright 1996 Adam Twiss, Zeus Technology Ltd, <http://www.zeustech.net/>  
Licensed to The Apache Software Foundation, <http://www.apache.org/>

Benchmarking greenmyplace.net (be patient)

```
Server Software:      Apache/2.2.12
Server Hostname:     greenmyplace.net
Server Port:         80

Document Path:       /home
Document Length:     9304 bytes

Concurrency Level:   10
Time taken for tests: 6.594 seconds
Complete requests:   1000
Failed requests:     0
Write errors:        0
Total transferred:   9758020 bytes
HTML transferred:   9304000 bytes
Requests per second: 151.64 [#/sec] (mean)
Time per request:    65.945 [ms] (mean)
Time per request:    6.594 [ms] (mean, across all concurrent requests)
Transfer rate:       1445.04 [Kbytes/sec] received
```

### Connection Times (ms)

	min	mean[+/-sd]	median	max
Connect:	0	0 1.6	0	23
Processing:	16	65 40.4	55	269
Waiting:	16	65 40.4	55	269
Total:	16	66 40.6	55	269

### Percentage of the requests served within a certain time (ms)

50%	55
66%	71
75%	81
80%	91
90%	114
95%	147
98%	185
99%	235
100%	269 (longest request)

## 6.3 Pilots Page Stress Testing log

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Licensed to The Apache Software Foundation, <http://www.apache.org/>

Benchmarking [www.greenmyplace.net](http://www.greenmyplace.net) (be patient)

```
Server Software:      Apache/2.2.12
Server Hostname:     www.greenmyplace.net
Server Port:         80

Document Path:       /pilots/4
Document Length:     9288 bytes

Concurrency Level:   10
Time taken for tests: 8.422 seconds
Complete requests:   1000
Failed requests:     0
Write errors:        0
Total transferred:   9742048 bytes
HTML transferred:    9288000 bytes
Requests per second: 118.73 [#/sec] (mean)
Time per request:    84.224 [ms] (mean)
Time per request:    8.422 [ms] (mean, across all concurrent requests)
Transfer rate:       1129.57 [Kbytes/sec] received
```

### Connection Times (ms)

	min	mean[+/-sd]	median	max
Connect:	0	0 0.8	0	13
Processing:	17	84 75.0	63	650
Waiting:	16	83 74.9	63	650
Total:	17	84 75.0	63	650

### Percentage of the requests served within a certain time (ms)

50%	63
66%	81
75%	96
80%	109
90%	150
95%	195
98%	330
99%	449
100%	650 (longest request)

### 6.3.1 The following test is for the xml requests of the pilot pages

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Benchmarking [greenmyplace.net](http://greenmyplace.net) (be patient)

```
Server Software:      Apache/2.2.12
```



```
Server Hostname:      greenmyplace.net
Server Port:         80

Document Path:       /pilots.xml
Document Length:     3562 bytes

Concurrency Level:   10
Time taken for tests: 7.941 seconds
Complete requests:   1000
Failed requests:     0
Write errors:        0
Total transferred:   3920044 bytes
HTML transferred:    3562000 bytes
Requests per second: 125.94 [#/sec] (mean)
Time per request:    79.406 [ms] (mean)
Time per request:    7.941 [ms] (mean, across all concurrent requests)
Transfer rate:       482.10 [Kbytes/sec] received
```

```
Connection Times (ms)
                min  mean[+/-sd] median  max
Connect:        0    0   1.5      0     27
Processing:     21   78  54.8     64    369
Waiting:        0    78  54.7     63    368
Total:          22   79  54.7     65    369
```

```
Percentage of the requests served within a certain time (ms)
 50%    65
 66%    82
 75%    98
 80%   112
 90%   148
 95%   192
 98%   242
 99%   294
100%   369 (longest request)
```

### 6.3.2 Energy data to be shown on pilots page xml request testing

This is ApacheBench, Version 2.3 <\$Revision: 655654 \$>  
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Licensed to The Apache Software Foundation, <http://www.apache.org/>

Benchmarking www.greenmyplace.net (be patient)

```
Server Software:      Apache/2.2.12
Server Hostname:     www.greenmyplace.net
Server Port:         80

Document Path:       /pilots/4/saving_days.xml
Document Length:     4093 bytes

Concurrency Level:   10
Time taken for tests: 14.521 seconds
Complete requests:   1000
Failed requests:     0
Write errors:        0
Total transferred:   4451203 bytes
```



HTML transferred: 4093000 bytes  
Requests per second: 68.87 [# /sec] (mean)  
Time per request: 145.208 [ms] (mean)  
Time per request: 14.521 [ms] (mean, across all concurrent requests)  
Transfer rate: 299.35 [Kbytes/sec] received

Connection Times (ms)

	min	mean[+/-sd]	median	max
Connect:	0	0 0.2	0	4
Processing:	39	144 85.9	123	678
Waiting:	38	144 85.4	122	677
Total:	39	144 85.9	123	678

Percentage of the requests served within a certain time (ms)

50%	123
66%	162
75%	183
80%	206
90%	270
95%	318
98%	369
99%	399
100%	678 (longest request)

## 6.4 'Green Box' Stress Testing log

### 6.4.1 Awards categories xml request testing

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Licensed to The Apache Software Foundation, <http://www.apache.org/>

Benchmarking www.greenmyplace.net (be patient)

```
Server Software:      Apache/2.2.12
Server Hostname:     www.greenmyplace.net
Server Port:         80

Document Path:       /award_categories.xml
Document Length:     2871 bytes

Concurrency Level:   10
Time taken for tests: 7.612 seconds
Complete requests:   1000
Failed requests:     0
Write errors:        0
Total transferred:   3229045 bytes
HTML transferred:   2871000 bytes
Requests per second: 131.37 [#/sec] (mean)
Time per request:    76.121 [ms] (mean)
Time per request:    7.612 [ms] (mean, across all concurrent requests)
Transfer rate:       414.26 [Kbytes/sec] received
```

```
Connection Times (ms)
              min  mean[+/-sd] median  max
Connect:      0    0  1.4      0    44
Processing:   21   76  50.6     61   359
Waiting:      20   75  50.6     61   359
Total:        22   76  50.7     61   359
```

Percentage of the requests served within a certain time (ms)

```
50%    61
66%    79
75%    96
80%   110
90%   145
95%   181
98%   222
99%   255
100%   359 (longest request)
```

### 6.4.2 Awards results xml request testing

This is ApacheBench, Version 2.3 <\$Revision: 655654 \$>  
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Licensed to The Apache Software Foundation, <http://www.apache.org/>

Benchmarking www.greenmyplace.net (be patient)



```
Server Software:      Apache/2.2.12
Server Hostname:     www.greenmyplace.net
Server Port:         80

Document Path:       /awards/find?pilot_id=4&award_category_id=6
Document Length:     491 bytes

Concurrency Level:   10
Time taken for tests: 7.502 seconds
Complete requests:   1000
Failed requests:     0
Write errors:        0
Total transferred:   927043 bytes
HTML transferred:    491000 bytes
Requests per second: 133.30 [#/sec] (mean)
Time per request:    75.017 [ms] (mean)
Time per request:    7.502 [ms] (mean, across all concurrent requests)
Transfer rate:       120.68 [Kbytes/sec] received
```

```
Connection Times (ms)
                min  mean[+/-sd] median  max
Connect:        0    0   0.6      0     7
Processing:     16   74  73.6     56   628
Waiting:        13   73  73.5     55   627
Total:          16   74  73.7     56   628
```

```
Percentage of the requests served within a certain time (ms)
 50%    56
 66%    70
 75%    82
 80%    93
 90%   132
 95%   168
 98%   354
 99%   463
100%   628 (longest request)
```

### 6.4.3 Game descriptions xml request testing

This is ApacheBench, Version 2.3 <\${Revision: 655654} >  
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Licensed to The Apache Software Foundation, <http://www.apache.org/>

Benchmarking www.greenmyplace.net (be patient)

```
Server Software:      Apache/2.2.12
Server Hostname:     www.greenmyplace.net
Server Port:         80

Document Path:       /game_descriptions/find/5.xml?lang=en
Document Length:     533 bytes

Concurrency Level:   10
Time taken for tests: 3.136 seconds
```



```
Complete requests:      1000
Failed requests:        0
Write errors:           0
Total transferred:      889243 bytes
HTML transferred:      533000 bytes
Requests per second:    318.92 [#/sec] (mean)
Time per request:       31.356 [ms] (mean)
Time per request:       3.136 [ms] (mean, across all concurrent requests)
Transfer rate:          276.95 [Kbytes/sec] received
```

#### Connection Times (ms)

	min	mean[+/-sd]	median	max
Connect:	0	0 1.1	0	15
Processing:	8	31 25.2	24	235
Waiting:	1	30 25.2	23	235
Total:	8	31 25.2	24	235

#### Percentage of the requests served within a certain time (ms)

50%	24
66%	31
75%	38
80%	43
90%	57
95%	77
98%	107
99%	140
100%	235 (longest request)

### 6.4.4 Highscores per game xml request testing

```
This is ApacheBench, Version 2.3 <$Revision: 655654 $>
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```

```
Benchmarking www.greenmyplace.net (be patient)
```

```
Server Software:      Apache/2.2.12
Server Hostname:      www.greenmyplace.net
Server Port:          80

Document Path:        /tutorials_week4/highscores_current.xml
Document Length:      947 bytes

Concurrency Level:    10
Time taken for tests:  5.864 seconds
Complete requests:    1000
Failed requests:      0
Write errors:         0
Non-2xx responses:    1000
Total transferred:    1244000 bytes
HTML transferred:     947000 bytes
Requests per second:  170.52 [#/sec] (mean)
Time per request:     58.643 [ms] (mean)
Time per request:     5.864 [ms] (mean, across all concurrent requests)
Transfer rate:        207.16 [Kbytes/sec] received
```



```
Connection Times (ms)
              min  mean[+/-sd] median  max
Connect:      0    0  2.1    0    21
Processing:   15   58 40.8   44   267
Waiting:     12   57 40.5   44   266
Total:       15   58 40.8   45   267
```

```
Percentage of the requests served within a certain time (ms)
 50%    45
 66%    60
 75%    73
 80%    84
 90%   117
 95%   145
 98%   171
 99%   203
100%   267 (longest request)
```

#### 6.4.5 Minigames highscores xml request testing

This is ApacheBench, Version 2.3 <\$Revision: 655654 \$>  
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Benchmarking www.greenmyplace.net (be patient)

```
Server Software:      Apache/2.2.12
Server Hostname:     www.greenmyplace.net
Server Port:         80

Document Path:       /minigames/5/highscores.xml
Document Length:     1670 bytes

Concurrency Level:   10
Time taken for tests: 5.285 seconds
Complete requests:   1000
Failed requests:     0
Write errors:        0
Total transferred:   2028015 bytes
HTML transferred:   1670000 bytes
Requests per second: 189.23 [#/sec] (mean)
Time per request:    52.846 [ms] (mean)
Time per request:    5.285 [ms] (mean, across all concurrent requests)
Transfer rate:       374.77 [Kbytes/sec] received
```

```
Connection Times (ms)
              min  mean[+/-sd] median  max
Connect:      0    0  1.3    0    17
Processing:   14   52 36.7   42   234
Waiting:      0   52 36.5   42   233
Total:       14   53 36.7   42   234
```

```
Percentage of the requests served within a certain time (ms)
 50%    42
 66%    54
 75%    68
```



```
80%      76
90%      99
95%     129
98%     169
99%     192
100%    234 (longest request)
```

#### 6.4.6 Minigames list xml request testing

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Benchmarking www.greenmyplace.net (be patient)

```
Server Software:      Apache/2.2.12
Server Hostname:     www.greenmyplace.net
Server Port:         80

Document Path:       /gamesList.xml
Document Length:     111 bytes

Concurrency Level:   10
Time taken for tests: 3.803 seconds
Complete requests:   1000
Failed requests:     0
Write errors:        0
Non-2xx responses:   1000
Total transferred:   537119 bytes
HTML transferred:    111000 bytes
Requests per second: 262.94 [#/sec] (mean)
Time per request:    38.031 [ms] (mean)
Time per request:    3.803 [ms] (mean, across all concurrent requests)
Transfer rate:       137.92 [Kbytes/sec] received
```

##### Connection Times (ms)

	min	mean[+/-sd]	median	max
Connect:	0	0 0.8	0	11
Processing:	9	37 29.9	28	236
Waiting:	6	36 29.8	27	236
Total:	9	37 30.1	28	241

##### Percentage of the requests served within a certain time (ms)

```
50%      28
66%      37
75%      44
80%      48
90%      69
95%     107
98%     141
99%     163
100%    241 (longest request)
```



## 6.5 Static Pages Stress Testing log

### 6.5.1 Standalone SWF (Flash movie) request testing

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Benchmarking www.greenmyplace.net (be patient)

```
Server Software:      Apache/2.2.12
Server Hostname:     www.greenmyplace.net
Server Port:         80

Document Path:       /swf/ac_button.swf
Document Length:     6009 bytes

Concurrency Level:   10
Time taken for tests: 0.385 seconds
Complete requests:   1000
Failed requests:     0
Write errors:        0
Total transferred:   6310140 bytes
HTML transferred:    6033036 bytes
Requests per second: 2594.65 [#/sec] (mean)
Time per request:    3.854 [ms] (mean)
Time per request:    0.385 [ms] (mean, across all concurrent requests)
Transfer rate:       15988.85 [Kbytes/sec] received
```

Connection Times (ms)

	min	mean[+/-sd]	median	max
Connect:	0	2 0.5	2	3
Processing:	0	2 0.5	2	4
Waiting:	0	1 0.5	2	3
Total:	1	4 0.9	4	7

WARNING: The median and mean for the waiting time are not within a normal deviation

These results are probably not that reliable.

Percentage of the requests served within a certain time (ms)

50%	4
66%	4
75%	4
80%	5
90%	5
95%	5
98%	6
99%	6
100%	7 (longest request)

## 6.5.2 Tutorial content request testing

This is ApacheBench, Version 2.3 <\$Revision: 655654 \$>  
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Benchmarking www.greenmyplace.net (be patient)

```
Server Software:      Apache/2.2.12
Server Hostname:     www.greenmyplace.net
Server Port:         80

Document Path:       /tutorials_week4
Document Length:     948 bytes

Concurrency Level:   10
Time taken for tests: 9.109 seconds
Complete requests:   1000
Failed requests:     0
Write errors:        0
Non-2xx responses:  1000
Total transferred:  1336000 bytes
HTML transferred:   948000 bytes
Requests per second: 109.79 [#/sec] (mean)
Time per request:   91.087 [ms] (mean)
Time per request:   9.109 [ms] (mean, across all concurrent requests)
Transfer rate:      143.24 [Kbytes/sec] received
```

### Connection Times (ms)

	min	mean[+/-sd]	median	max
Connect:	0	0 0.7	0	8
Processing:	39	90 38.9	77	320
Waiting:	39	90 38.8	76	308
Total:	39	91 38.9	77	320

### Percentage of the requests served within a certain time (ms)

50%	77
66%	94
75%	108
80%	119
90%	147
95%	167
98%	201
99%	218
100%	320 (longest request)