



**HoGent**

Faculteit Bedrijf en Organisatie

Studie naar de performantie-impact van Spectre/Meltdown patches op Linux voor een typische workload van een webserver

Karel Willems

Scriptie voorgedragen tot het bekomen van de graad van  
professionele bachelor in de toegepaste informatica

Promotor:  
Karine Van Driessche  
Co-promotor:  
Bert Van Vreckem

Instelling: —

Academiejaar: 2017-2018

Tweede examenperiode



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## .1 Bijlage Ansible

### .1.1 Grub file voor het uitschakelen van Spectre/Meltdown patch

```
GRUB_DEFAULT=0
GRUB_HIDDEN_TIMEOUT=0
GRUB_HIDDEN_TIMEOUT_QUIET=true
GRUB_TIMEOUT=0
GRUB_DISTRIBUTOR='lsb_release -i -s 2> /dev/null || echo Debian'
GRUB_CMDLINE_LINUX_DEFAULT="console=tty1 _console=tty0 _spectre_v2=off _nopti"
GRUB_CMDLINE_LINUX="spectre_v2=off _nopti"
```

### .1.2 Configureren van grub

```
#copy /etc/default/grub
- name: copy grub config
  become: yes
  copy:
    src: files/grub
    dest: /etc/default/grub
    owner: root
    group: root
    mode: 0644
```

```
- name: update grub
  become: yes
  command: update-grub
```

```
- name: Restart server
  become: yes
  command: reboot
  ignore_errors: true
```

### .1.3 Setup Apache en Drupal

```
---
# tasks file for drupal.role
- include_tasks: "setup_apache.yml"
- include_tasks: "setup_php.yml"

- name: enable libapache2-mod-php5
  become: yes
  command: >
  a2enmod php5
  notify: restart apache

- name: Install drush
```

**become:** yes

**apt:** "name=drush┐state=installed"

– **name:** Install php gd

**become:** yes

**apt:** "name=php5-gd┐state=installed"

– **name:** downloading the last version of drupal into a  
folder

**command:** >

**drush dl drupal-7.57**

– **name:** Install Drupal with drush

**ignore\_errors:** yes

**command:** >

**sudo drush -y site-install --db-url=mysql://root**  
**:root@localhost:3306/drupaldb --root="/home/vagrant/**  
**drupal-7.57"**

– **name:** Copy vhost

**copy:** src=files/000-default.conf dest=/etc/apache2/sites-  
available/000-default.conf

**#owner=root group=root mode=0644**

– **name:** Copy ssl vhost

**copy:** src=files/default-ssl.conf dest=/etc/apache2/sites-  
available/default-ssl.conf

**#owner=root group=root mode=0644**

– **name:** reload apache.

**command:** >

**service apache2 reload**

**become:** yes

**# enable clean urls**

– **name:** enable apache rewrite mod

**become:** yes

**command:** >

**a2enmod rewrite**

**notify:** restart apache



## .1.4 Setup MySQL

```
# tasks file for mysql.role
- include_tasks: "setup_mysql.yml"

- name: Copy my.cnf global MySQL configuration.
  template:
  src: my.cnf.j2
  dest: "/etc/mysql/my.cnf"
  owner: root
  group: root
  mode: 0644
  notify: restart mysql

- name: root password is present
  mysql_user: name=root host={{item}} password={{
    mysql_root_password }} state=present
  with_items:
  - '::1'
  - '127.0.0.1'
  - 'localhost'

- name: install .my.cnf with credentials
  template: src=my.cnf.j2 dest=/root/.my.cnf
  mode=0400

- name: Create the directory /etc/mysql/conf.d
  file: path=/etc/mysql/conf.d state=directory
  notify:
  - restart mysql

- name: Start the mysql services
  service: name=mysql state=started enabled=yes

- name: Create the database
  become: yes
  mysql_db: name=drupaldb state=present

- name: grant
  mysql_user:
  name: drupal
```

```
host: 192.168.33.1
password: 'drupal'
priv: ' *.*:ALL,GRANT'
state: present
```

## .1.5 Config redis

```
daemonize yes
pidfile /var/run/redis.pid
port {{ redis_port }}
bind {{ redis_bind }}
timeout 0
tcp-keepalive 0
loglevel notice
logfile ""
syslog-enabled {{ syslog_bool }}
databases {{ databases }}
save 900 1
save 300 10
save 60 10000
stop-writes-on-bgsave-error yes
rdbcompression yes
rdbchecksum yes
dbfilename {{ dbfilename }}
dir ./
slave-serve-stale-data yes
slave-read-only yes
repl-disable-tcp-nodelay no
slave-priority 100
{% if requirepass %}
requirepass {{ redis_pass }}
{% endif %}

appendonly no
appendfilename "appendonly.aof"
appendfsync everysec
no-appendfsync-on-rewrite no
auto-aof-rewrite-percentage 100
auto-aof-rewrite-min-size 64mb
lua-time-limit 5000
slowlog-log-slower-than 10000
slowlog-max-len 128
notify-keyspace-events ""
hash-max-ziplist-entries 512
hash-max-ziplist-value 64
list-max-ziplist-entries 512
list-max-ziplist-value 64
set-max-intset-entries 512
zset-max-ziplist-entries 128
```

```

zset-max-ziplist-value 64
activerehashing yes
client-output-buffer-limit normal 0 0 0
client-output-buffer-limit slave 256mb 64mb 60
client-output-buffer-limit pubsub 32mb 8mb 60
hz 10
aof-rewrite-incremental-fsync yes

```

## .2 Bijlage Vagrant

### .2.1 Vagrantfile

```

# -*- mode: ruby -*-
# vi: set ft=ruby :

serverpatched =
{ :hostname => 'webpatched', :ip => '192.168.33.100', :box
  => 'ubuntu/trusty64' }

servervulnerable =
{ :hostname => 'webvulnerable', :ip => '192.168.33.101', :
  box => 'ubuntu/trusty64' }

loadgenerator =
{ :hostname => 'loadgenerator', :ip => '192.168.33.102', :
  box => 'ubuntu/trusty64' }

Vagrant.configure("2") do |config|
# The most common configuration options are documented and
# commented below.
# For a complete reference, please see the online
# documentation at
# https://docs.vagrantup.com.

# Every Vagrant development environment requires a box. You
# can search for
# boxes at https://vagrantcloud.com/search.
#config.vm.box = "ubuntu/artful64"

config.vm.define serverpatched[:hostname] do |configpatched|
  configpatched.vm.box = serverpatched[:box]

```

```
        configpatched.vm.hostname = serverpatched[:hostname]
    ]
    configpatched.vm.network :private_network, ip:
        serverpatched[:ip]
end
```

```
config.vm.define servervulnerable[:hostname] do |
    configvulnerable|
        configvulnerable.vm.box = servervulnerable[:box]
        configvulnerable.vm.hostname = servervulnerable[:
            hostname]
        configvulnerable.vm.network :private_network, ip:
            servervulnerable[:ip]
end
```

```
config.vm.define loadgenerator[:hostname] do |
    configloadgenerator|
        configloadgenerator.vm.box = loadgenerator[:box]
        configloadgenerator.vm.hostname = loadgenerator[:
            hostname]
        configloadgenerator.vm.network :private_network, ip
            : loadgenerator[:ip]
end
```

```
# config.vm.network "forwarded_port", guest: 80, host:
8080, host_ip: "127.0.0.1"
```

```
config.vm.provider "virtualbox" do |vb|
# Display the VirtualBox GUI when booting the machine
#vb.gui = true
```

```
# Customize the amount of memory on the VM:
vb.memory = "1024"
end
```

```
config.vm.provision "ansible" do |ansible|
```

```

ansible.compatibility_mode = 'auto'
  #ansible.verbose = "vvvv"
    ansible.playbook = "provisioning/playbook.yml"
    ansible.inventory_path = "provisioning/inventory"

  end
end

```

### .3 Ruwe resultaten

#### .3.1 Apache benchmark van systeem met patches

Listing 1: Eerste 50 resultaten

starttime	seconds	ctime	dtime	ttime	wait			
Thu May 03 13:44:42 2018			1525355082	0	14	14	14	14
Thu May 03 13:44:35 2018			1525355075	0	14	14	14	14
Thu May 03 13:44:35 2018			1525355075	0	14	14	14	14
Thu May 03 13:44:40 2018			1525355080	0	14	14	14	14
Thu May 03 13:44:45 2018			1525355085	0	14	14	14	14
Thu May 03 13:44:46 2018			1525355086	0	14	14	14	14
Thu May 03 13:44:39 2018			1525355079	0	14	14	14	14
Thu May 03 13:44:45 2018			1525355085	0	14	14	14	14
Thu May 03 13:44:39 2018			1525355079	0	14	14	14	14
Thu May 03 13:44:46 2018			1525355086	0	14	14	14	14
Thu May 03 13:44:45 2018			1525355085	0	14	14	14	14
Thu May 03 13:44:37 2018			1525355077	0	14	14	14	14
Thu May 03 13:44:42 2018			1525355082	0	14	14	14	14
Thu May 03 13:44:37 2018			1525355077	0	14	14	14	14
Thu May 03 13:44:45 2018			1525355085	0	14	14	14	14
Thu May 03 13:44:38 2018			1525355078	0	14	14	14	14
Thu May 03 13:44:36 2018			1525355076	0	14	14	14	14
Thu May 03 13:44:33 2018			1525355073	0	14	14	14	14
Thu May 03 13:44:40 2018			1525355080	0	14	14	14	14
Thu May 03 13:44:46 2018			1525355086	0	14	14	14	14
Thu May 03 13:44:40 2018			1525355080	0	14	14	14	14
Thu May 03 13:44:45 2018			1525355085	0	14	14	14	14
Thu May 03 13:44:45 2018			1525355085	0	14	14	14	14
Thu May 03 13:44:36 2018			1525355076	0	14	14	14	14
Thu May 03 13:44:33 2018			1525355073	0	14	14	14	14
Thu May 03 13:44:40 2018			1525355080	0	14	14	14	14
Thu May 03 13:44:40 2018			1525355080	0	14	14	14	14
Thu May 03 13:44:46 2018			1525355086	0	14	15	14	14
Thu May 03 13:44:35 2018			1525355075	0	14	15	14	14
Thu May 03 13:44:45 2018			1525355085	0	14	15	14	14
Thu May 03 13:44:47 2018			1525355087	0	14	15	14	14
Thu May 03 13:44:45 2018			1525355085	0	14	15	14	14
Thu May 03 13:44:36 2018			1525355076	0	14	15	14	14
Thu May 03 13:44:35 2018			1525355075	0	14	15	14	14
Thu May 03 13:44:43 2018			1525355083	0	14	15	14	14
Thu May 03 13:44:45 2018			1525355085	0	14	15	14	14
Thu May 03 13:44:37 2018			1525355077	0	14	15	14	14
Thu May 03 13:44:35 2018			1525355075	0	14	15	14	14
Thu May 03 13:44:41 2018			1525355081	0	14	15	14	14

---

Thu	May	03	13:44:43	2018	1525355083	0	14	15	14
Thu	May	03	13:44:47	2018	1525355087	0	14	15	14
Thu	May	03	13:44:43	2018	1525355083	0	14	15	14
Thu	May	03	13:44:38	2018	1525355078	1	14	15	14
Thu	May	03	13:44:45	2018	1525355085	0	14	15	14
Thu	May	03	13:44:37	2018	1525355077	0	14	15	14
Thu	May	03	13:44:47	2018	1525355087	0	14	15	14
Thu	May	03	13:44:34	2018	1525355074	0	14	15	14
Thu	May	03	13:44:47	2018	1525355087	0	14	15	14
Thu	May	03	13:44:37	2018	1525355077	0	14	15	14
Thu	May	03	13:44:45	2018	1525355085	0	14	15	14

### .3.2 Apache benchmark van systeem zonder patches

Listing 2: Eerste 50 resultaten

starttime			seconds	ctime	dtime	ttime	wait		
Thu	May	03	13:44:52	2018	1525355092	0	10	11	10
Thu	May	03	13:44:49	2018	1525355089	0	12	12	12
Thu	May	03	13:44:55	2018	1525355095	0	13	13	13
Thu	May	03	13:44:51	2018	1525355091	0	13	13	13
Thu	May	03	13:44:48	2018	1525355088	0	13	13	13
Thu	May	03	13:44:53	2018	1525355093	0	13	13	13
Thu	May	03	13:44:52	2018	1525355092	0	13	13	13
Thu	May	03	13:44:59	2018	1525355099	0	13	13	13
Thu	May	03	13:44:53	2018	1525355093	0	13	13	13
Thu	May	03	13:44:51	2018	1525355091	0	13	13	13
Thu	May	03	13:45:02	2018	1525355102	0	13	13	13
Thu	May	03	13:44:52	2018	1525355092	0	13	13	13
Thu	May	03	13:44:58	2018	1525355098	0	13	13	13
Thu	May	03	13:44:52	2018	1525355092	0	13	13	13
Thu	May	03	13:44:49	2018	1525355089	0	13	13	13
Thu	May	03	13:44:59	2018	1525355099	0	13	13	13
Thu	May	03	13:44:52	2018	1525355092	0	13	13	13
Thu	May	03	13:45:01	2018	1525355101	0	13	13	13
Thu	May	03	13:44:53	2018	1525355093	0	13	13	13
Thu	May	03	13:44:55	2018	1525355095	0	13	13	13
Thu	May	03	13:44:59	2018	1525355099	0	13	13	13
Thu	May	03	13:44:48	2018	1525355088	0	13	13	13
Thu	May	03	13:44:54	2018	1525355094	0	13	13	13
Thu	May	03	13:44:52	2018	1525355092	0	13	13	13
Thu	May	03	13:44:55	2018	1525355095	0	13	13	13
Thu	May	03	13:44:52	2018	1525355092	0	13	13	13
Thu	May	03	13:44:59	2018	1525355099	0	13	13	13
Thu	May	03	13:44:51	2018	1525355091	0	13	13	13
Thu	May	03	13:44:59	2018	1525355099	0	13	13	13
Thu	May	03	13:44:54	2018	1525355094	0	13	13	13
Thu	May	03	13:45:02	2018	1525355102	0	13	13	13
Thu	May	03	13:44:49	2018	1525355089	0	13	13	13
Thu	May	03	13:44:52	2018	1525355092	0	13	13	13
Thu	May	03	13:44:59	2018	1525355099	0	13	13	13
Thu	May	03	13:44:53	2018	1525355093	0	13	13	13
Thu	May	03	13:44:52	2018	1525355092	0	13	13	13
Thu	May	03	13:44:48	2018	1525355088	0	13	13	13
Thu	May	03	13:44:56	2018	1525355096	0	13	13	13
Thu	May	03	13:44:53	2018	1525355093	0	13	13	13

Thu May 03 13:44:48 2018	1525355088	0	13	13	13
Thu May 03 13:44:52 2018	1525355092	0	13	13	13
Thu May 03 13:44:54 2018	1525355094	0	13	13	13
Thu May 03 13:44:57 2018	1525355097	0	13	13	13
Thu May 03 13:44:51 2018	1525355091	0	13	13	13
Thu May 03 13:44:54 2018	1525355094	0	13	13	13
Thu May 03 13:44:58 2018	1525355098	0	13	13	13
Thu May 03 13:44:59 2018	1525355099	0	13	13	13
Thu May 03 13:44:52 2018	1525355092	0	13	13	13
Thu May 03 13:44:54 2018	1525355094	0	13	13	13
Thu May 03 13:44:52 2018	1525355092	0	13	13	13

### .3.3 Autobench benchmark van systeem met patches

Listing 3: Eerste 50 resultaten

dem_req_rate	req_rate_192.168.33.100	con_rate_192.168.33.100	min_rep_rate_192.168.33.100
20	20.3	0.0	0.0
22	22.3	0.0	0.0
24	24.3	0.0	0.0
26	26.3	0.0	0.0
28	28.3	0.0	0.0
30	30.3	0.0	0.0
32	32.3	0.0	0.0
34	34.3	0.0	0.0
36	36.3	0.0	0.0
38	38.3	0.0	0.0
40	40.1	0.0	0.0
42	42.3	0.0	0.0
44	44.3	0.0	0.0
46	46.3	0.0	0.0
48	48.3	0.0	0.0
50	50.2	0.0	0.0
52	52.2	0.0	0.0
54	54.2	0.0	0.0
56	56.1	0.0	0.0
58	58.2	0.0	0.0
60	60.1	0.0	0.0
62	60.2	0.0	0.0
64	59.8	0.0	0.0
66	60.8	0.0	0.0
68	59.7	0.0	0.0
70	57.4	0.0	0.0
72	54.6	0.0	0.0
74	54.9	0.0	0.0
76	52.6	0.0	0.0
78	41.8	0.0	0.0
80	56.2	0.0	0.0
82	57.7	0.0	0.0
84	56.8	0.0	0.0
86	56.1	0.0	0.0
88	57.0	0.0	0.0
90	57.6	0.0	0.0
92	56.6	0.0	0.0
94	55.0	0.0	0.0
96	52.9	0.0	0.0

---

98	53.7	53.7	0.0	0.0	0.0	0.0	504.9	418.3	0
100	49.7	49.7	0.0	0.0	0.0	0.0	597.0	387.4	0
102	57.0	57.0	0.0	0.0	0.0	0.0	476.2	444.1	0
104	57.9	57.9	0.0	0.0	0.0	0.0	469.7	451.5	0
106	58.0	58.0	0.0	0.0	0.0	0.0	489.1	452.2	0
108	57.3	57.3	0.0	0.0	0.0	0.0	503.6	446.6	0
110	57.2	57.2	0.0	0.0	0.0	0.0	503.1	445.9	0
112	56.4	56.4	0.0	0.0	0.0	0.0	506.0	439.6	0
114	57.7	57.7	0.0	0.0	0.0	0.0	511.0	450.1	0
116	55.9	55.9	0.0	0.0	0.0	0.0	556.6	435.4	0
118	56.9	56.9	0.0	0.0	0.0	0.0	537.6	443.4	0

### .3.4 Autobench benchmark van systeem zonder patches

Listing 4: Eerste 50 resultaten

dem_req_rate	req_rate_192.168.33.101				con_rate_192.168.33.101				min_rep_rate_192.168.33.101
20	20.3	20.3	0.0	0.0	0.0	0.0	435.2	158.0	0
22	22.3	22.3	0.0	0.0	0.0	0.0	13.9	173.9	0
24	24.3	24.3	0.0	0.0	0.0	0.0	14.0	189.5	0
26	26.3	26.3	0.0	0.0	0.0	0.0	13.7	204.9	0
28	28.3	28.3	0.0	0.0	0.0	0.0	14.4	220.9	0
30	30.3	30.3	0.0	0.0	0.0	0.0	14.2	236.3	0
32	32.4	32.4	0.0	0.0	0.0	0.0	14.4	252.3	0
34	34.3	34.3	0.0	0.0	0.0	0.0	13.7	267.6	0
36	36.2	36.2	0.0	0.0	0.0	0.0	14.0	282.0	0
38	38.4	38.4	0.0	0.0	0.0	0.0	13.6	298.9	0
40	40.4	40.4	0.0	0.0	0.0	0.0	13.7	314.5	0
42	42.3	42.3	0.0	0.0	0.0	0.0	13.6	330.0	0
44	44.3	44.3	0.0	0.0	0.0	0.0	13.9	345.3	0
46	46.3	46.3	0.0	0.0	0.0	0.0	14.0	360.9	0
48	48.2	48.2	0.0	0.0	0.0	0.0	13.9	376.0	0
50	50.2	50.2	0.0	0.0	0.0	0.0	14.0	391.2	0
52	52.3	52.3	0.0	0.0	0.0	0.0	14.1	407.5	0
54	54.1	54.1	0.0	0.0	0.0	0.0	14.1	421.5	0
56	56.2	56.2	0.0	0.0	0.0	0.0	14.1	437.9	0
58	58.1	58.1	0.0	0.0	0.0	0.0	13.9	452.8	0
60	60.1	60.1	0.0	0.0	0.0	0.0	14.5	468.5	0
62	62.1	62.1	0.0	0.0	0.0	0.0	15.2	484.1	0
64	64.1	64.1	0.0	0.0	0.0	0.0	13.8	499.7	0
66	66.1	66.1	0.0	0.0	0.0	0.0	13.9	515.0	0
68	68.0	68.0	0.0	0.0	0.0	0.0	14.2	530.2	0
70	64.9	64.9	0.0	0.0	0.0	0.0	61.1	505.6	0
72	64.7	64.7	0.0	0.0	0.0	0.0	83.3	504.5	0
74	63.0	63.0	0.0	0.0	0.0	0.0	148.9	490.9	0
76	64.8	64.8	0.0	0.0	0.0	0.0	126.7	504.7	0
78	62.1	62.1	0.0	0.0	0.0	0.0	158.6	483.9	0
80	62.2	62.2	0.0	0.0	0.0	0.0	166.7	484.7	0
82	63.3	63.3	0.0	0.0	0.0	0.0	179.2	493.2	0
84	60.6	60.6	0.0	0.0	0.0	0.0	252.4	471.9	0
86	62.5	62.5	0.0	0.0	0.0	0.0	221.0	487.1	0
88	61.6	61.6	0.0	0.0	0.0	0.0	237.4	480.4	0
90	61.2	61.2	0.0	0.0	0.0	0.0	249.3	476.9	0
92	63.0	63.0	0.0	0.0	0.0	0.0	249.1	491.2	0
94	59.7	59.7	0.0	0.0	0.0	0.0	324.4	465.2	0
96	62.9	62.9	0.0	0.0	0.0	0.0	290.8	490.2	0



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98	58.1	58.1	0.0	0.0	0.0	0.0	342.8	452.5	0
100	58.6	58.6	0.0	0.0	0.0	0.0	337.0	456.5	0
102	57.0	57.0	0.0	0.0	0.0	0.0	348.4	443.9	0
104	59.8	59.8	0.0	0.0	0.0	0.0	358.2	465.9	0
106	61.5	61.5	0.0	0.0	0.0	0.0	355.1	479.1	0
108	61.0	61.0	0.0	0.0	0.0	0.0	361.7	475.4	0
110	63.3	63.3	0.0	0.0	0.0	0.0	340.2	493.2	0
112	61.8	61.8	0.0	0.0	0.0	0.0	355.8	481.3	0
114	62.2	62.2	0.0	0.0	0.0	0.0	363.2	484.5	0
116	60.4	60.4	0.0	0.0	0.0	0.0	396.0	470.7	0
118	61.8	61.8	0.0	0.0	0.0	0.0	377.5	481.8	0

### .3.5 Redis benchmark van systeem met patches

"PING\_INLINE" ,"5688.28"  
"SET" ,"5740.53"  
"GET" ,"5561.74"  
"INCR" ,"5399.57"  
"LPUSH" ,"5875.44"  
"LPOP" ,"7434.94"  
"SADD" ,"10928.96"  
"SPOP" ,"11389.52"

### .3.6 Redis benchmark van systeem zonder patches

"PING\_INLINE" ,"6729.48"  
"SET" ,"6798.10"  
"GET" ,"6684.49"  
"INCR" ,"6920.42"  
"LPUSH" ,"6891.80"  
"LPOP" ,"6988.12"  
"SADD" ,"6770.48"  
"SPOP" ,"6281.41"

### 3.7 Vmstat tool van systeem met patches

Listing 5: Eerste 50 resultaten

procs		memory				swap		io		system			cpu			
r	b	swpd	free	buff	cache	si	so	bi	bo	in	cs	us	sy	id	wa	st
11	0	0	334156	25420	382460	0	0	697	511	406	2578	21	10	66		
3	0															
3	0	0	325904	25420	382460	0	0	0	0	927	6921	59	28	13		
0	0															
3	0	0	330268	25428	382456	0	0	0	120	807	5900	41	20	40		
0	0															
3	0	0	335052	25428	382468	0	0	0	0	812	5871	42	16	42		
0	0															
2	0	0	339792	25428	382472	0	0	0	0	844	5891	40	17	43		
0	0															
1	0	0	339848	25428	382476	0	0	0	0	824	5864	43	17	40		
0	0															
0	0	0	339848	25428	382480	0	0	0	0	796	5805	42	14	44		
0	0															
0	0	0	339848	25436	382476	0	0	0	12	827	5851	40	17	43		
0	0															
0	0	0	339848	25436	382488	0	0	0	0	784	5835	44	13	44		
0	0															
1	0	0	339848	25436	382492	0	0	0	0	836	5874	40	20	39		
0	0															
0	0	0	339848	25436	382496	0	0	0	0	803	5820	42	14	44		
0	0															
0	0	0	339848	25436	382500	0	0	0	0	803	5826	40	16	44		
0	0															
0	0	0	339848	25444	382492	0	0	0	12	821	5869	46	11	43		
0	0															
0	0	0	339848	25444	382504	0	0	0	0	802	5842	40	18	42		
0	0															
0	0	0	339844	25444	382508	0	0	0	0	846	5864	39	19	42		
0	0															
0	0	0	339848	25444	382512	0	0	0	0	834	5827	39	18	43		
0	0															
0	0	0	339848	25444	382516	0	0	0	0	822	5839	38	19	43		
0	0															
0	0	0	339848	25452	382512	0	0	0	12	827	5852	40	19	42		
0	0															
0	0	0	339848	25452	382524	0	0	0	0	849	5848	42	17	42		
0	0															
0	0	0	339848	25452	382528	0	0	0	0	806	5832	40	18	42		
0	0															
0	0	0	339848	25452	382532	0	0	0	0	833	5870	38	20	42		
0	0															
0	0	0	339848	25452	382536	0	0	0	0	813	5860	42	17	42		
0	0															
0	0	0	339848	25460	382532	0	0	0	116	839	5857	39	19	42		
0	0															
0	0	0	339848	25460	382544	0	0	0	0	835	5833	40	19	42		
0	0															
0	0	0	339848	25460	382548	0	0	0	0	842	5857	38	19	43		
0	0															
0	0	0	339848	25460	382548	0	0	0	0	822	5849	40	19	40		

[illegible]

### 3.8 Vmstat tool van systeem zonder patches

Listing 6: Eerste 50 resultaten

procs		memory				swap		io		system			cpu			
r	b	swpd	free	buff	cache	si	so	bi	bo	in	cs	us	sy	id	wa	st
0	0	0	829484	6836	88892	0	0	2562	13	335	1107	9	6	85		
0	0															
0	0	0	829220	6836	88896	0	0	0	0	717	1299	26	22	52		
0	0															
0	0	0	829220	6836	88900	0	0	0	0	663	1209	30	16	53		
0	0															
0	0	0	829220	6844	88904	0	0	0	92	735	1336	37	16	47		
0	0															
0	0	0	829296	6844	88904	0	0	0	0	703	1275	28	22	49		
0	0															
0	0	0	829400	6844	88908	0	0	0	0	703	1293	28	19	53		
0	0															
1	0	0	829420	6844	88912	0	0	0	0	729	1323	30	19	51		
0	0															
1	0	0	829416	6844	88916	0	0	0	0	687	1265	28	18	54		
0	0															
1	0	0	829060	6852	88920	0	0	0	16	710	1297	29	14	57		
0	0															
0	0	0	829420	6852	88924	0	0	0	0	715	1296	28	18	54		
0	0															
1	0	0	829344	6852	88928	0	0	0	0	713	1278	29	14	57		
0	0															
0	0	0	829344	6852	88932	0	0	0	0	704	1286	33	17	50		
0	0															
0	0	0	829360	6852	88936	0	0	0	0	700	1279	26	17	58		
0	0															
1	0	0	829364	6860	88940	0	0	0	16	728	1327	29	18	52		
0	0															
0	0	0	829348	6860	88944	0	0	0	0	726	1270	25	18	57		
0	0															
0	0	0	829348	6860	88948	0	0	0	0	727	1296	27	16	56		
0	0															
0	0	0	829240	6860	88952	0	0	0	80	715	1247	31	11	58		
0	0															
3	0	0	829220	6860	88952	0	0	0	0	717	1306	29	15	55		
0	0															
2	0	0	829004	6868	88956	0	0	0	16	726	1295	29	19	53		
0	0															
2	0	0	829004	6868	88960	0	0	0	0	680	1260	24	16	60		
0	0															
0	0	0	829240	6868	88964	0	0	0	0	681	1191	22	16	62		
0	0															
2	0	0	828880	6868	88968	0	0	0	8	673	1198	18	20	62		
0	0															
0	0	0	829240	6868	88972	0	0	0	0	673	1206	22	16	62		
0	0															
0	0	0	829224	6876	88976	0	0	0	32	680	1222	22	15	63		
0	0															
0	0	0	829096	6876	88980	0	0	0	0	659	1216	24	14	62		
0	0															
0	0	0	829096	6876	88984	0	0	0	0	664	1222	27	11	62		

[illegible]