

Linux: Disks diagnostic using smartctl

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Facing disk issues such as corruption or block defect is thankfully not happening frequently. However when it does, the diagnose may look sometimes like a real struggle. This is forgetting that disks integrate since years the S.M.A.R.T technology. Good point, it can easily be adressed in Linux command line through smartctl

What is S.M.A.R.T. exactly?

S.M.A.R.T., which stands for Self-Monitoring, Analysis and Reporting Technology (also called SMART), is a monitoring system for and integrated in hard disks allowing to detect and report various indicators of reliability.

SMART is the successor of various previous disk monitoring solution such as PFA (IBM, 1992) or IntelliSafe (Compaq, 1995). The join-work between Compaq, IBM, Seagate, Quantum, Conner and Western Digital resulted in the standard SMART.

SMART is part of AT Attachment (ATA) standard since 2004 and provides several information about disk such as:

- Status
- Manufacturer information (Brand, serial number...)
- Inability to read or Write data

In addition SMART collects data through an offline monitoring and use thresholds in order to warn about potential disk failures. Finally it allows to run different disk integrity tests.

More detailed information about the SMART standard can be found here:

<http://en.wikipedia.org/wiki/S.M.A.R.T>

Getting information out of SMART under Linux is pretty easy, as the binary smartctl is available.

Basic operations

Like for any tool under linux, you can get some help on the usage of smartctl.

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srvoeltest1:~ # smartctl --help

smartctl 5.39 2008-10-24 22:33 [x86_64-suse-linux-
gnu] (openSUSE RPM)

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href="
http://smartmo
ntools.sourceforge.net">
http://smartmontools.sourceforge.net

Usage: smartctl [options] device

=====
===== SHOW INFORMATION OPTIONS
=====

-h, --help, --usage

Display this help and exit
```

16

-V, --version, --copyright, --license

17

Print license, copyright, and version information
and exit

18

19

-i, --info

20

Show identity information for device

21

22

-a, --all

23

Show all SMART information for device

24

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=====
SMARTCTL RUN-TIME BEHAVIOR OPTIONS
=====

26

27

-q TYPE, --quietmode=TYPE (ATA)

Set smartctl quiet mode to one of: erroronly, silent,
noserial

...

...

...

A good idea is also to take a look on the man page of smartctl:

<http://smartmontools.sourceforge.net/man/smartctl.8.html>

Then the first basic operation is to get the basic information about a disk. To do so run: **smartctl -i /dev/<disk>**

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srvoeltest1:~ # smartctl -i /dev/sda

smartctl 5.39 2008-10-24 22:33 [x86_64-suse-linux-
gnu] (openSUSE RPM)

Copyright (C) 2002-8 by Bruce Allen, <a
href="
http://smartmontools.sourceforge.net">
http://smartmontools.sourceforge.net</a>

==== START OF INFORMATION SECTION ====

Device Model: GB1000EAMYC

Serial Number: WMATV9306345

Firmware Version: HPG3

User Capacity: 1,000,204,886,016 bytes

Device is: Not in smartctl database [for details use:
-P showall]

ATA Version is: 7

ATA Standard is: ATA/ATAPI-7 T13 1532D
revision 4a

Local Time is: Wed Sep 5 13:24:31 2012 CEST
```

```
SMART support is: Available - device has SMART capability.
```

```
SMART support is: Enabled
```

We can see, using the `-i` option, information such as the model, S/N, capacity and more interesting we can check if SMART is available and activated for the disk.

If it is not activated yet, you can do it with command: **`smartctl -s on /dev/<disk>`**

Check disks health

Now that we have the base information about the disks we may want to check their state. So let's check first if we simply still see them and can access them. This is done using the command: **`smartctl -H /dev/<disk>`**

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srvoeltest1:~ # smartctl -H /dev/sda
smartctl 5.39 2008-10-24 22:33 [x86_64-suse-linux-
gnu] (openSUSE RPM)
Copyright (C) 2002-8 by Bruce Allen, <a
href="
http://smartmo
ntools.sourceforge.net">
http://smartmontools.sourceforge.net</a>
==== START OF READ SMART DATA
SECTION ====
```

```
10 SMART overall-health self-assessment test result:
PASSED
11
srvoeltest1:~ # smartctl -H /dev/sdd
smartctl 5.39 2008-10-24 22:33 [x86_64-suse-linux-
gnu] (openSUSE RPM)
Copyright (C) 2002-8 by Bruce Allen, <a
href="
http://smartmo
ntools.sourceforge.net">
http://smartmontools.sourceforge.net</a>
Smartctl open device: /dev/sdd failed: No such
device
```

Remember that this check is a simple test of the disk availability. A PASSED result doesn't mean that the disk is healthy. On the other hand any other result than PASSED let you know to that you should replace it.

As second step, you may want to check the disk capabilities using: **smartctl -c /dev/<disk>**

```
1 srvoeltest1:~ # smartctl -c /dev/sda
2
3 smartctl 5.39 2008-10-24 22:33 [x86_64-suse-linux-
4 gnu] (openSUSE RPM)
5 Copyright (C) 2002-8 by Bruce Allen, <a
href="
http://smartmo
```

6 [ntools.sourceforge.net">](http://smartmontools.sourceforge.net)
http://smartmontools.sourceforge.net

7

8

9 ===== START OF READ SMART DATA
SECTION =====

10 General SMART Values:

11 Offline data collection status: (0x84) Offline data
collection activity

12

13 was suspended by an interrupting command from
host

14 Auto Offline Data Collection: Enabled.

15 Self-test execution status: (0) The previous self-test
routine complete

16

17 without error or no self-test has ever
been run.

18

19 Total time to complete Offline
data collection: (18000) seconds.

20

21 Offline data collection
capabilities: (0x7b) SMART execute Offline
immediate.

22

23 Auto Offline data collection on/off support.
Suspend Offline collection upon new

24

25 command.

26 Offline surface scan supported.

27 Self-test supported.

28 Conveyance Self-test supported.

29 Selective Self-test supported.

30 SMART capabilities: (0x0003) Saves SMART data
31 before entering
32 power-saving mode.

33 Supports SMART auto save timer.

34 Error logging capability: (0x01) Error logging
35 supported.

36 General Purpose Logging supported.

37 Short self-test routine
recommended polling time: (2) minutes.

Extended self-test routine
recommended polling time: (208) minutes.

Conveyance self-test routine
recommended polling time: (5) minutes.

SCT capabilities: (0x303f) SCT Status supported.

SCT Feature Control supported.

SCT Data Table supported.

Capabilities let us know different information:

- Offline data collection status
- Last self-test status
- Type of test available and their duration

In my example above, for instance, a short self-test would take approximately 2 minutes.

Going deeper in scope of the disk health check, drives us then to check out the so called disk attributes. These are metrics collected for the disk with their current value, the vendor warning value and threshold. They include counters helping to detect/prevent potential failures like:

- Raw Read Error Rate
- Reallocated sector Ct
- Seek Error Rate
- Reallocated Event Count

The current state of the attributes can be get using the command: **smartctl -A /dev/<disk>**

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srvoeltest1:~ # smartctl -A /dev/sdb

smartctl 5.39 2008-10-24 22:33 [x86_64-suse-linux-
gnu] (openSUSE RPM)

Copyright (C) 2002-8 by Bruce Allen, <a
href="
http://smartmo
ntools.sourceforge.net">
http://smartmontools.sourceforge.net</a>
```

7

8 ==== START OF READ SMART DATA
SECTION ====

9

10 SMART Attributes Data Structure revision number:
10

11 Vendor Specific SMART Attributes with
Thresholds:

12

13 ID# ATTRIBUTE_NAME VALUE WORST
THRESH TYPE UPDATED RAW_VALUE

14 1 Raw_Read_Error_Rate 080 063 044 Pre-fail
Always 115187504

15

16 3 Spin_Up_Time 093 093 000 Pre-fail Always 0

17 4 Start_Stop_Count 100 100 020 Old_age Always
26

18 5 Reallocated_Sector_Ct 100 100 036 Pre-fail
Always 1

19

20 7 Seek_Error_Rate 087 060 030 Pre-fail Always
534389509

21 9 Power_On_Hours 087 087 000 Old_age Always
12084

22

23 10 Spin_Retry_Count 100 100 097 Pre-fail Always
0

24 12 Power_Cycle_Count 100 100 020 Old_age
Always 26

25 180 Unknown_Attribute 100 100 000 Pre-fail

26	Always 1535031962
27	184 Unknown_Attribute 100 100 003 Old_age Always 0
28	187 Reported_Uncorrect 100 100 000 Old_age
29	Always 0
30	188 Unknown_Attribute 100 100 000 Old_age Always 0
31	189 High_Fly_Writes 100 100 000 Old_age Always 0
	190 Airflow_Temp_Cel 073 065 045 Old_age Always 27
	191 G-Sense_Error_Rate 100 100 000 Old_age Always 0
	192 Power-Off_Retract_Ct 100 100 000 Old_age Always 22
	193 Load_Cycle_Count 100 100 000 Old_age Always 26
	194 Temperature_Celsius 027 040 000 Old_age Always 27
	195 Hardware_ECC_Reco 034 025 000 Old_age Always 115187504
	196 Reallocated_Event_Ct 100 100 036 Pre-fail Always 1
	197 Curr_Pending_Sector 100 100 000 Old_age Always 0

```
198 Offline_Uncorrectable 100 100 000 Old_age  
Offline 0
```

```
199 UDMA_CRC_Error_Count 200 200 000  
Old_age Always 0
```

According to the attributes provided by SMART, this disk doesn't look in good shape. So why not looking to its SMART error log? Let's run **smartctl -l error /dev/<disk>**

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2 srvoeltest1:~ # smartctl -l error /dev/sdc  
3  
4 smartctl 5.39 2008-10-24 22:33 [x86_64-suse-linux-  
5 gnu] (openSUSE RPM)  
6  
7 Copyright (C) 2002-8 by Bruce Allen, <a  
8 href="  
9 http://smartmontools.sourceforge.net">  
10 http://smartmontools.sourceforge.net</a>  
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14 idle.

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16 After command completion occurred, registers
17 were:

18 ER ST SC SN CL CH DH
19 -----
20 40 51 08 95 58 37 e2 Error: UNC 8 sectors at LBA
21 = 0x02375895 = 37181589

22 Commands leading to the command that caused the
23 error were:

24 CR FR SC SN CL CH DH DC Powered_Up_Time
25 Command/Feature_Name
26 -----
27 c8 00 08 8e 58 37 e2 08 3d+10:30:59.131 READ
28 DMA
29 c8 00 08 86 58 37 e2 08 3d+10:30:59.042 READ
30 DMA
31 b0 d1 01 00 4f c2 00 08 3d+10:30:59.039 SMART
32 READ ATTRIBUTE THRESHOLDS [OBS-4]
33 c8 00 08 7e 58 37 e2 08 3d+10:30:58.713 READ
34 DMA
35 ec 00 00 00 00 00 a0 08 3d+10:30:58.688
36 IDENTIFY DEVICE

33

34

Error 14046 occurred at disk power-on lifetime:
5037 hours (209 days + 21 hours)

35

36

When the command that caused the error occurred,
the device was active or idle.

37

38

After command completion occurred, registers
were:

39

ER ST SC SN CL CH DH

40

40 51 08 7d 58 37 e2 Error: UNC 8 sectors at LBA
= 0x0237587d = 37181565

Commands leading to the command that caused the
error were:

CR FR SC SN CL CH DH DC Powered_Up_Time
Command/Feature_Name

c8 00 08 76 58 37 e2 08 3d+10:30:54.293 READ
DMA

ec 00 00 00 00 00 a0 08 3d+10:30:54.269
IDENTIFY DEVICE

ef 03 46 00 00 00 a0 08 3d+10:30:54.262 SET
FEATURES [Set transfer mode]

```
ec 00 00 00 00 00 a0 08 3d+10:30:54.253  
IDENTIFY DEVICE
```

```
c8 00 08 76 58 37 e2 08 3d+10:30:52.335 READ  
DMA
```

Running selftest checks

If you have issues with a disk a good idea is then to run a selftest. Different types of test are available with SMART

- short
Basic tests
- long
Extended SMART tests. Runs usually tens of minutes
- conveyance
Test dedicated to detection of damage during transport
- select
Selective self-test to test a range of disk Logical Block Addresses (LBA)

Run the test with the command: **smartctl -t <type> /dev/<disk>**

```
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6  
srvoeltest1:~ # smartctl -t short /dev/sdc  
  
smartctl 5.39 2008-10-24 22:33 [x86_64-suse-linux-  
gnu] (openSUSE RPM)  
  
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href="http://smartmontools.sourceforge.net">  
http://smartmontools.sourceforge.net</a>
```

```
7
8      === START OF OFFLINE IMMEDIATE AND
9      SELF-TEST SECTION ===
10
      Sending command: "Execute SMART Short self-
      test routine immediately in off-line mode".

      Drive command "Execute SMART Short self-test
      routine immediately in off-line mode" successful.

      Testing has begun.

      Please wait 2 minutes for test to complete.

      Test will complete after Wed Sep 5 11:44:26 2012
```

Once started the test will run in background. To check its results, use the command

smartctl -l selftest /dev/<disk>

```
1      srvoeltest1:~ # smartctl -l selftest /dev/sdc
2
3      smartctl 5.39 2008-10-24 22:33 [x86_64-suse-linux-
4      gnu] (openSUSE RPM)
5
6      Copyright (C) 2002-8 by Bruce Allen, <a
7      href="
      http://smartmo
      ntools.sourceforge.net">
      http://smartmontools.sourceforge.net</a>
```

```
8      === START OF READ SMART DATA
      SECTION ===

      SMART Self-test log structure revision number 1

      Num Test_Description  Status Remaining
      LifeTime(hours) LBA_of_first_error

      # 1 Short offline    Completed: read failure 90%
      6091 356245779
```

In the example above, we can see that the test failed after 10% on the Logical Block Address 356245779.

Last trick, the command to get the test output doesn't refresh itself automatically. Therefore you may have to run it several time until the test finished. A easy workaround is to run it as following: **watch smartctl -l selftest /dev/<disk>**

This will provide you an every 2 seconds refresh of the output.
I hope that this smartctl overview will help.

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