



LINUX FORENSICS FUNDAMENTALS

A report submitted by group NWB for Cyber Security and Digital Forensics



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INTRODUCTION

“Over the last quarter century, legal requirements have increased the prevalence of and reliance upon computer forensics.”

For forensic investigation, LINUX is a powerful tool. It helps in maintaining the integrity of evidence, chain of custody and also for memory acquisition.

Memory acquisition is becoming an armory for the incident response teams, forensic investigators and examiners. It is the procedure of copying the contents of physical memory to another storage device for preservation and investigation without interrupting the main memory. For modern systems it uses Kernel modules / objects. It also known as capturing, dumping, sampling.

PROBLEM STATEMENT

Memory acquisition on LINUX system

- On a partition-hard disk using *fdisk* command
- On volatile memory using LiME tool

PRE-REQUISITES AND TOOLS

1. Linux System (UBUNTU)
2. LiME (Linux Memory Extractor) Tool
3. Hashing Tools

PROCEDURE

For creating memory image of Disk

1. Open the Terminal. Use *fdisk* commands for view, create, delete, change, resize, copy and move partitions on a hard drive.
 - a. *fdisk -h* (To see the help message and listing of all options)
 - b. *fdisk -l* (to list the partitions on the system)
2. Use *dd* command for creating a memory image of a disk partition.

dd if=/dev/sbd2 of=image.001 bs=1M status=progress



For creating memory image of volatile memory (RAM)

1. Clone the LiME (Linux Memory Extractor) tool from GitHub. (*sudo git clone <https://github.com/504ensicsLabs/LiME.git>*)
2. Change the directory (*cd LiME/src/*).
3. Using *make* command create the Kernel object.
4. Now create the memory image (*sudo insmod ./lime-5.8.0-38-generic.ko "path=../memo.mem format=raw"*)
5. Using hashing methods generate a hash value (*md5sum memo.mem*)
6. These hash values are used as evidence in the court in place huge memory files.
7. These memory files are analyzed using tools like FATKit, WMFT, Volatility Framework.

RESULTS

```
veda@Ubuntu-VEDA:~$ fdisk -h

Usage:
  fdisk [options] <disk>      change partition table
  fdisk [options] -l [<disk>] list partition table(s)

Display or manipulate a disk partition table.

Options:
  -b, --sector-size <size>    physical and logical sector size
  -B, --protect-boot           don't erase bootbits when creating a new label
  -c, --compatibility[=<mode>] mode is 'dos' or 'nondos' (default)
  -L, --color[=<when>]         colorize output (auto, always or never)
                               colors are enabled by default
  -l, --list                   display partitions and exit
  -o, --output <list>         output columns
  -t, --type <type>           recognize specified partition table type only
  -u, --units[=<unit>]         display units: 'cylinders' or 'sectors' (default)
  -s, --getsz                  display device size in 512-byte sectors [DEPRECATED]
  --bytes                      print SIZE in bytes rather than in human readable format
  -w, --wipe <mode>           wipe signatures (auto, always or never)
  -W, --wipe-partitions <mode> wipe signatures from new partitions (auto, always or never)

  -C, --cylinders <number>    specify the number of cylinders
  -H, --heads <number>        specify the number of heads
  -S, --sectors <number>      specify the number of sectors per track

  -h, --help                   display this help
  -V, --version                display version

Available output columns:
gpt: Device Start End Sectors Size Type Type-UUID Attrs Name UUID
dos: Device Start End Sectors Cylinders Size Type Id Attrs Boot End-C/H/S
    Start-C/H/S
bsd: Slice Start End Sectors Cylinders Size Type Bsize Cpg Fsize
sgi: Device Start End Sectors Cylinders Size Type Id Attrs
sun: Device Start End Sectors Cylinders Size Type Id Flags

For more details see fdisk(8).
```

Fig 1. *fdisk -h* (To see the help message and listing of all options)



```
veda@Ubuntu-VEDA:~$ sudo fdisk -l
[sudo] password for veda:

Disk /dev/sdb: 28.67 GiB, 30765219840 bytes, 60088320 sectors
Disk model: SanDisk 3.2Gen1
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disklabel type: dos
Disk identifier: 0x8bb801f4

Device      Boot      Start        End    Sectors   Size Id Type
/dev/sdb1                2048 54224895 54222848 25.9G 83 Linux
/dev/sdb2      54226942 60086271  5859330  2.8G  5 Extended
/dev/sdb5      54226944 60086271  5859328  2.8G  b W95 FAT32
veda@Ubuntu-VEDA:~$ dd if=/dev/sdb2 of=image.001 bs=1M status=progress
dd: failed to open '/dev/sdb2': Permission denied
veda@Ubuntu-VEDA:~$ sudo dd if=/dev/sdb2 of=image.001 bs=1M status=progress
0+1 records in
0+1 records out
1024 bytes (1.0 kB, 1.0 KiB) copied, 0.0766292 s, 13.4 kB/s
veda@Ubuntu-VEDA:~$
```

Fig 2. List of the partitions and creating memory image

```
veda@Ubuntu-VEDA:~$ sudo git clone https://github.com/504ensicsLabs/LiME.git
Cloning into 'LiME'...
remote: Enumerating objects: 339, done.
remote: Total 339 (delta 0), reused 0 (delta 0), pack-reused 339
Receiving objects: 100% (339/339), 1.60 MiB | 645.00 KiB/s, done.
Resolving deltas: 100% (181/181), done.
veda@Ubuntu-VEDA:~$ cd LiME/src/
veda@Ubuntu-VEDA:~/LiME/src$ ls
deflate.c disk.c hash.c lime.h main.c Makefile Makefile.sample tcp.c
```

Fig 3. Cloning the *LiME* tool



```
veda@Veda:~$ cd LiME/src/
veda@Veda:~/LiME/src$ make
make -C /lib/modules/5.8.0-38-generic/build M="/home/veda/LiME/src" modules
make[1]: Entering directory '/usr/src/linux-headers-5.8.0-38-generic'
CC [M] /home/veda/LiME/src/tcp.o
/home/veda/LiME/src/tcp.c: In function 'setup_tcp':
/home/veda/LiME/src/tcp.c:49:12: warning: unused variable 'opt' [-Wunused-variable]
  49 |         int r, opt;
      |
CC [M] /home/veda/LiME/src/disk.o
CC [M] /home/veda/LiME/src/main.o
CC [M] /home/veda/LiME/src/hash.o
CC [M] /home/veda/LiME/src/deflate.o
LD [M] /home/veda/LiME/src/lime.o
MODPOST /home/veda/LiME/src/Module.symvers
CC [M] /home/veda/LiME/src/lime.mod.o
LD [M] /home/veda/LiME/src/lime.ko
make[1]: Leaving directory '/usr/src/linux-headers-5.8.0-38-generic'
strip --strip-unneeded lime.ko
mv lime.ko lime-5.8.0-38-generic.ko
veda@Veda:~/LiME/src$ ls
deflate.c  hash.o          lime.mod.o  Makefile.sample
deflate.o  lime-5.8.0-38-generic.ko  lime.o      modules.order
disk.c     lime.h          main.c      Module.symvers
disk.o     lime.mod        main.o      tcp.c
hash.c     lime.mod.c      Makefile    tcp.o
veda@Veda:~/LiME/src$ sudo insmod ./lime-5.8.0-38-generic.ko "path=../memo.mem format=raw"
veda@Veda:~/LiME/src$ veda@Veda:~/LiME$ ls -lha
total 1.7G
drwxrwxr-x 5 veda veda 4.0K Jan 30 09:30 .
drwxr-xr-x 21 veda veda 4.0K Jan 30 08:55 ..
drwxrwxr-x 2 veda veda 4.0K Jan 29 18:59 doc
drwxrwxr-x 8 veda veda 4.0K Jan 29 18:59 .git
-rw-rw-r-- 1 veda veda 101 Jan 29 18:59 .gitignore
-rw-rw-r-- 1 veda veda 18K Jan 29 18:59 LICENSE
-r--r--r-- 1 root root 1.7G Jan 30 09:31 memo.mem
-rw-rw-r-- 1 veda veda 4.4K Jan 29 18:59 README.md
drwxrwxr-x 2 veda veda 4.0K Jan 30 09:27 src
veda@Veda:~/LiME$ ls -lha
total 3.7G
drwxrwxr-x 5 veda veda 4.0K Jan 30 09:30 .
drwxr-xr-x 21 veda veda 4.0K Jan 30 08:55 ..
drwxrwxr-x 2 veda veda 4.0K Jan 29 18:59 doc
drwxrwxr-x 8 veda veda 4.0K Jan 29 18:59 .git
-rw-rw-r-- 1 veda veda 101 Jan 29 18:59 .gitignore
-rw-rw-r-- 1 veda veda 18K Jan 29 18:59 LICENSE
-r--r--r-- 1 root root 3.7G Jan 30 09:33 memo.mem
-rw-rw-r-- 1 veda veda 4.4K Jan 29 18:59 README.md
drwxrwxr-x 2 veda veda 4.0K Jan 30 09:27 src
veda@Veda:~/LiME$ ls -lha
total 8.0G
drwxrwxr-x 5 veda veda 4.0K Jan 30 09:30 .
drwxr-xr-x 21 veda veda 4.0K Jan 30 08:55 ..
drwxrwxr-x 2 veda veda 4.0K Jan 29 18:59 doc
drwxrwxr-x 8 veda veda 4.0K Jan 29 18:59 .git
-rw-rw-r-- 1 veda veda 101 Jan 29 18:59 .gitignore
-rw-rw-r-- 1 veda veda 18K Jan 29 18:59 LICENSE
-r--r--r-- 1 root root 8.0G Jan 30 09:39 memo.mem
-rw-rw-r-- 1 veda veda 4.4K Jan 29 18:59 README.md
drwxrwxr-x 2 veda veda 4.0K Jan 30 09:27 src
veda@Veda:~/LiME$
```

Fig 4. Creating Kernel object and memory image.

```
veda@Veda:~/LiME$ md5sum memo.mem
2d488c70f7b86c339b29d199fe448bd3 memo.mem
veda@Veda:~/LiME$
```

Fig 5. Creating hash value



CONCLUSION

Forensics professional should use these methods to investigate and identify attacks or malicious behaviors that do not leave detectable traces on hard drive. For further analyzing of the memory files, some tools like FATKit, WMFT, Volatility Framework must be used.

REFERENCES

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