PASEANDO POR LA MEMORIA DE UN ANDROID

Buenaventura Salcedo

WHOAMI

- Graduado en Ingeniería Informática (2019)
- CEO Servicio Técnico de Telefonía Movil e Informática (2004)
- Desarrollador de herramientas forenses para smartphones

AGRADECIMIENTOS

- A la Organización de BITUP
- Universidad de Alicante
- Colaboradores de BITUP
- Antonio Sanz y Roberto Hernández

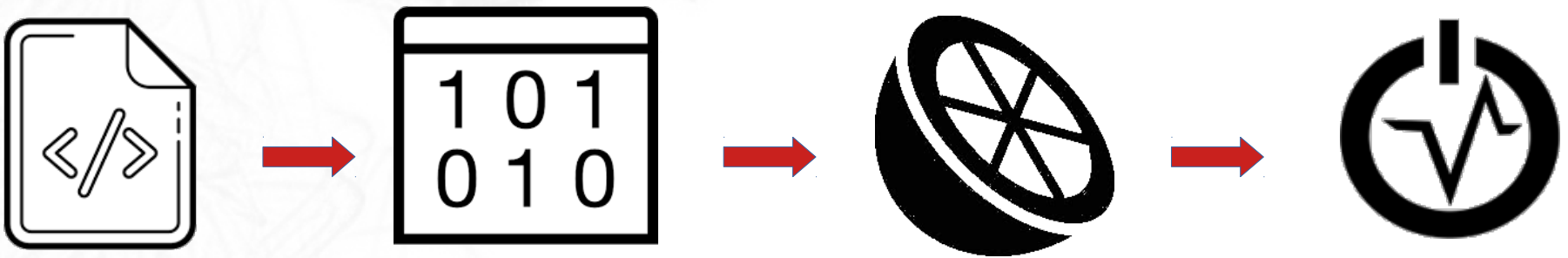
MOTIVACIONES

- Proceso largo: Compilar el kernel, LiME y el profile
- Deficiencias en el prototipo de ExereWare
- Estudio y análisis de memoria en Android
- Desarrollo de procesos automáticos para el análisis de memoria

ANÁLISIS DE RIESGOS

ÍNDICE

PROCESO SIMPLIFICADO



SOURCE CODE → **KERNEL** → **LIME** → **PROFILE**

ELEMENTOS CLAVE DE ENTRADA

- **JDK: Versión de java correcta para la compilación del kernel**
- **SDK: En el POC, nos dará soporte para que corra la MV**
- **Código fuente: De la versión del kernel**
- **NDK (toolchain): Cadena de herramientas para traducir y compilar**
- **Variables de entorno: ARCH – SUBARCH – CROSS_COMPILE**
- **.config: El fichero de configuración para generar el kernel**

ELEMENTOS CLAVE DE SALIDA

- **system.map: Tabla de símbolos(variables o funciones) con sus direcciones.**
- **zImage (o bzImage): Kernel con LKM que usaremos en el dispositivo.**
- **lime.ko: El módulo LiME (el LKM) que colgaremos en el kernel**
- **dump: Fichero que generaremos al volcar la memoria**
- **profile: El perfil estrictamente necesario para el análisis de memoria**

Volatility 3 ???

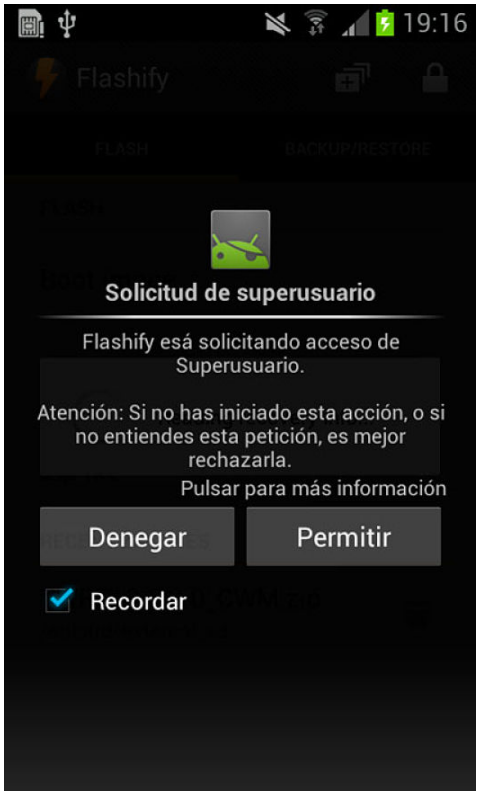
LKM = Loadable Kernel Module → Necesitará privilegios → Autorizado por la **Magic String**

ENTORNO PARA POC

- Ubuntu 14.04 (recomendado por Android Developers)
- Emulator de SDK de Android
- Android 4.2.2 arm
- Lime 1.4 (no funciona 1.8, digest parcheado K.O.)
- Volatility 2.3.1

PREPARAR EL DISPOSITIVO REAL

- ROOT
- Después necesitaríamos cargar el kernel nuevo en el boot, cada dispositivo tiene su procedimiento (flasher)



PREPARAR EL DISPOSITIVO VIRTUAL (i)

DISPOSITIVO VIRTUAL (POC)

- Configurar y construir el Android Build Environment

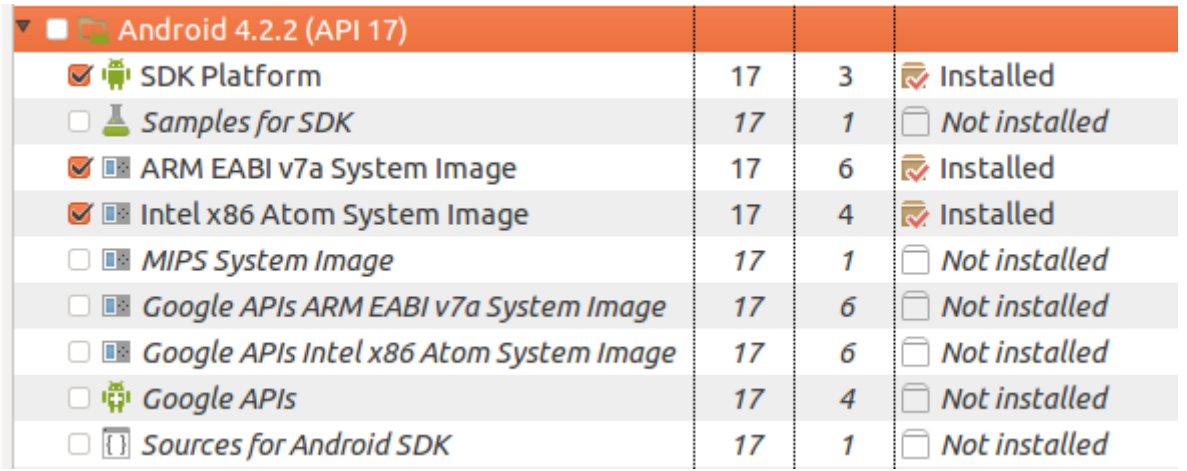
```
$ sudo apt-get install git-core gnupg flex
bison gperf build-essential zip curl zlib1g-
dev gcc-multilib g++-multilib libc6-dev-i386
lib32ncurses5-dev x11proto-core-dev libx11-
dev lib32z-dev libgl1-mesa-dev libxml2-utils
xsltproc unzip mesa-utils lib64stdc++6:i386
```

PREPARAR EL DISPOSITIVO VIRTUAL (ii)

DISPOSITIVO VIRTUAL (POC)

- Instalar JDK 6 (versión no importa para AVD)
- Instalar SDK 24.0.2 (vieja para que el proceso sea complicado)
- `$ ~/android-sdk/tools/android` `(sdk manager)`

- Platform-tools
- Build-tools
- System-Image (API)



PREPARAR EL DISPOSITIVO VIRTUAL (iii)

DISPOSITIVO VIRTUAL (POC)

- **Agregar al PATH el SDK (mejor en el `.bashrc`)**
  - tools
  - build-tools/XX.X.X
  - platform-tools

```
nomed@ub1406: ~
nomed@ub1406:~$ echo "export PATH=$PATH:~/android-sdk/tools:~/android-sdk/tools/
bin:~/android-sdk/build-tools/23.0.1/:~/android-sdk/platform-tools" >> ~/.bashrc

nomed@ub1406:~$
```

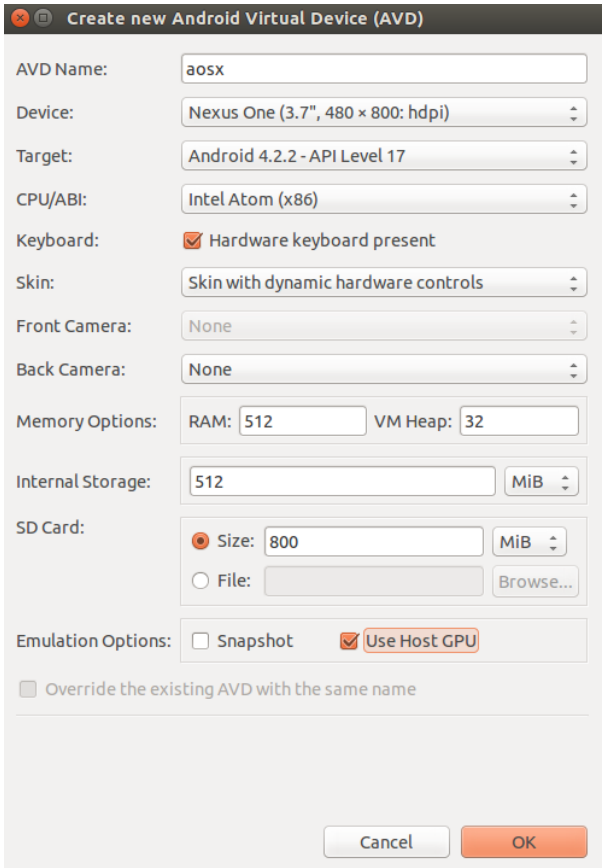
PREPARAR EL DISPOSITIVO VIRTUAL (iv)

DISPOSITIVO VIRTUAL (POC)

- Crear los dispositivos virtuales

```
$ android avd
```

  - Nexus one (3.7")
  - Android 4.2.2
  - arm o x86 (es más rápido)
  - RAM 512mb
  - Internal 512mb
  - SD Card 800mb



Si al crear sdcard da error debemos dar permisos a mksdcard de la carpeta tools

PREPARAR EL DISPOSITIVO VIRTUAL (v)

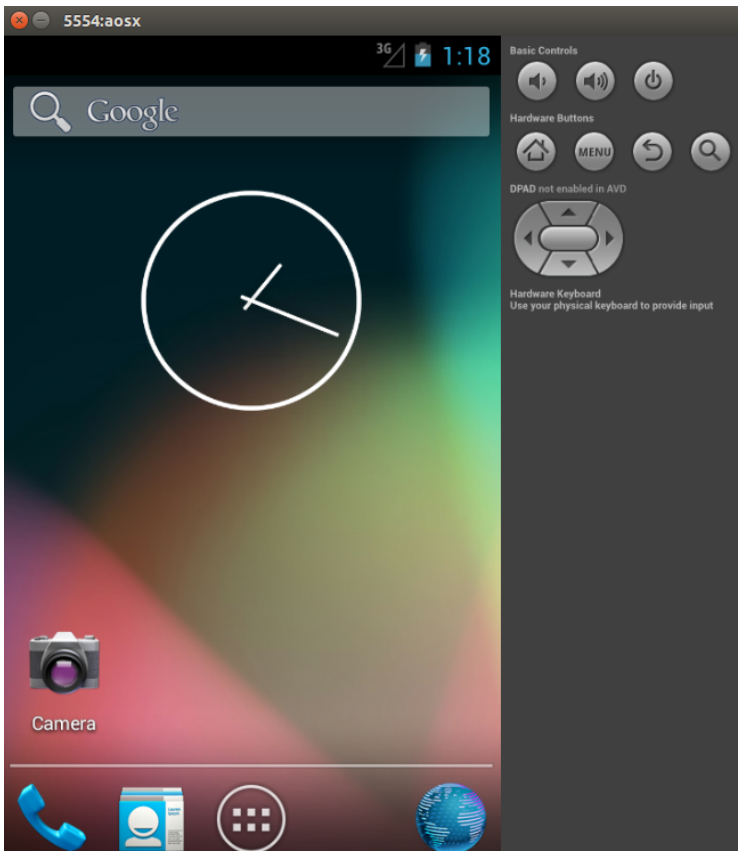
DISPOSITIVO VIRTUAL (POC)

- **Probar el dispositivo**

```
$ emulator @dispositivo
```

- **Probar y remontar con adb**

```
$ adb devices
$ adb root
$ adb connect 127.0.0.1:5554
$ adb remount
```

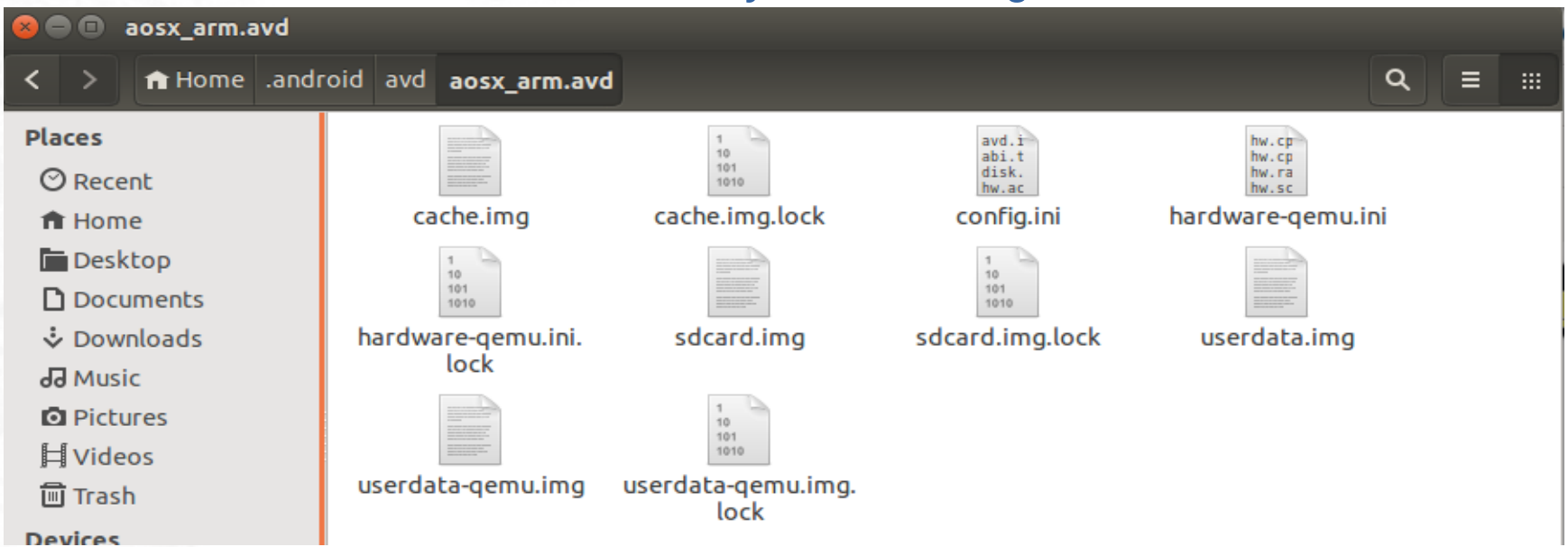


PREPARAR EL DISPOSITIVO VIRTUAL (vi)

DISPOSITIVO VIRTUAL (POC)

- El dispositivo se creará en `~/.android`
- Los ficheros base estarán en

`~/android-sdk/system-images`



INFORMACIÓN DEL KERNEL

```
$ adb shell cat /proc/version
$ adb shell getprop | grep ro.build
```

```
nomed@ub1406: ~/toolchains
nomed@ub1406:~/toolchains$ adb shell cat /proc/version
Linux version 3.4.67-01422-gd3ffcc7-dirty (digit@tyrion.par.corp.google.com) (gc
c version 4.8 (GCC) ) #1 PREEMPT Tue Sep 16 19:34:06 CEST 2014
nomed@ub1406:~/toolchains$ adb shell getprop | grep ro.build
[ro.build.characteristics]: [default]
[ro.build.date.utc]: [1530634644]
[ro.build.date]: [Tue Jul  3 16:17:24 UTC 2018]
[ro.build.description]: [sdk-eng 4.2.2 JB_MR1.1 4875371 test-keys]
[ro.build.display.id]: [sdk-eng 4.2.2 JB_MR1.1 4875371 test-keys]
[ro.build.fingerprint]: [generic/sdk/generic:4.2.2/JB_MR1.1/4875371:eng/test-key
s]
[ro.build.host]: [wped3.hot.corp.google.com]
[ro.build.id]: [JB_MR1.1]
[ro.build.product]: [generic]
[ro.build.tags]: [test-keys]
[ro.build.type]: [eng]
[ro.build.user]: [android-build]
[ro.build.version.codename]: [REL]
[ro.build.version.incremental]: [4875371]
[ro.build.version.release]: [4.2.2]
[ro.build.version.sdk]: [17]
nomed@ub1406:~/toolchains$
```

CÓDIGO FUENTE (i)

EMULATOR

https://android.googlesource.com/kernel/goldfish/

QUALCOMM

https://android.googlesource.com/kernel/msm/

SAMSUNG

http://opensource.samsung.com/reception/receptionSub.do?method=sub&sub=T&menu_item=mobile

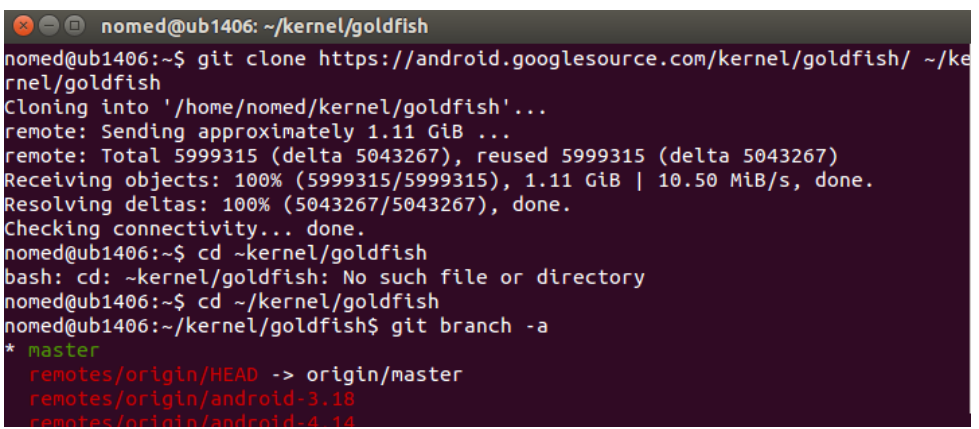
git – repo - zip

CÓDIGO FUENTE (ii)

```
$ git clone
https://android.googlesource.com/kernel/goldfish/ ~/kernels/goldfish
```

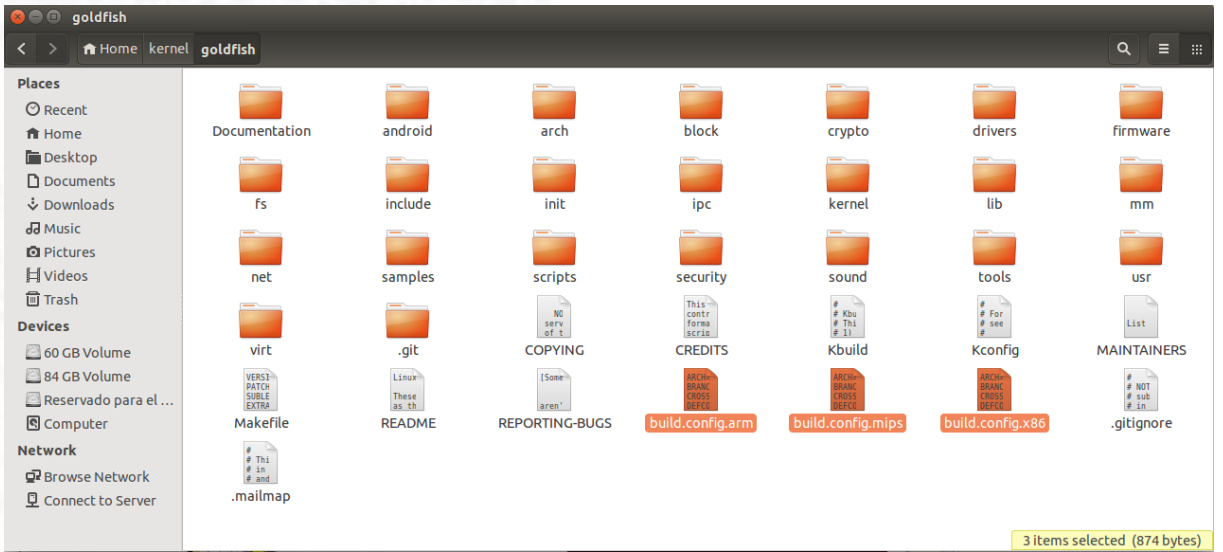
y 6 millones de deltas después...

```
$ cd ~/kernel/goldfish
$ git branch -a
$ git checkout -t remotes/origin/android-goldfish-3.4 -b goldfish34
```



CÓDIGO FUENTE (iii)

Hay que mirar bien los readme o ficheros de ayuda, en busca del **toolchain** que debemos utilizar, en vez de suponer que va a usar cualquiera.



el toolchain debe indicarse en CROSS_COMPILE con la ruta acabada con un guión

TOOLCHAINS (i)

CADENAS DE HERRAMIENTAS

Son unas librerías y módulos ejecutables que van a ir realizando la traducción y compilación de los drivers que incluyamos en el kernel que vamos a construir y que nos dejará todo preparado para la arquitectura en la que lo vamos a usar.

- http://www.codesourcery.com/
- https://dn.odroid.com/toolchains/
- https://bitbucket.org/matthewdalex/

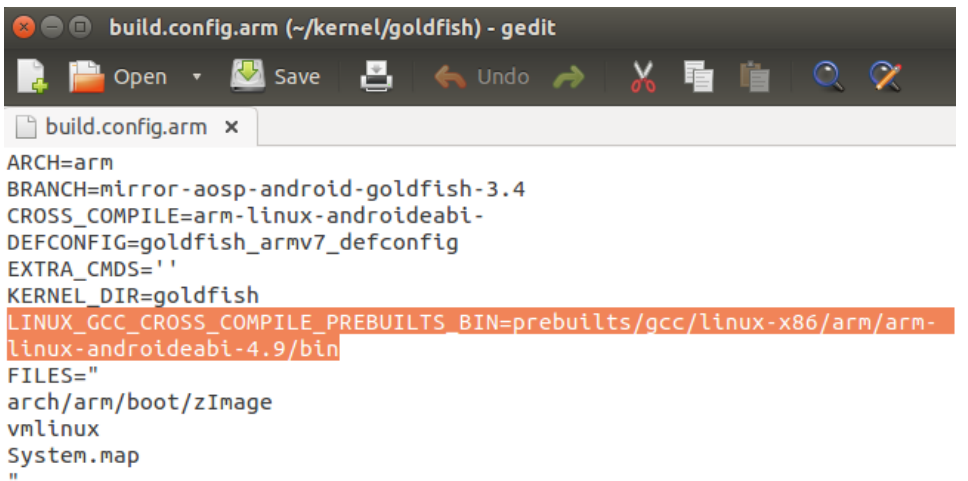
```
$ git clone
https://android.googlesource.com/platform
/prebuilts/<ruta_toolchain>
```

TOOLCHAINS (ii)

CADENAS DE HERRAMIENTAS

```
$ git clone
https://android.googlesource.com/platform/prebuilts/gcc/linux-
x86/arm/arm-linux-androideabi-4.9
```

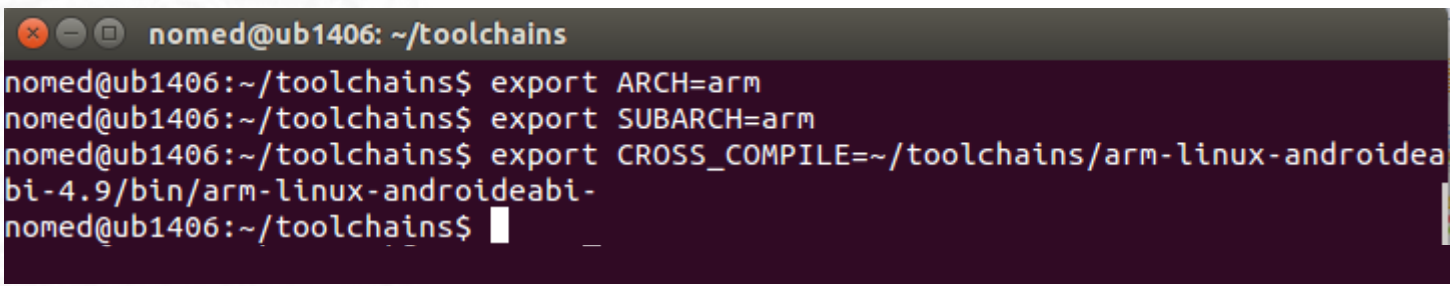
prebuilts = 3.3 Gb
más deltas??? NO, por favor!!!



COMPILACIÓN DEL KERNEL (i)

LAS VARIABLES

```
$ export ARCH=arquitectura
$ export SUBARCH=arquitectura
$ export CROSS_COMPILE=~/ruta/al/toolchain-
```

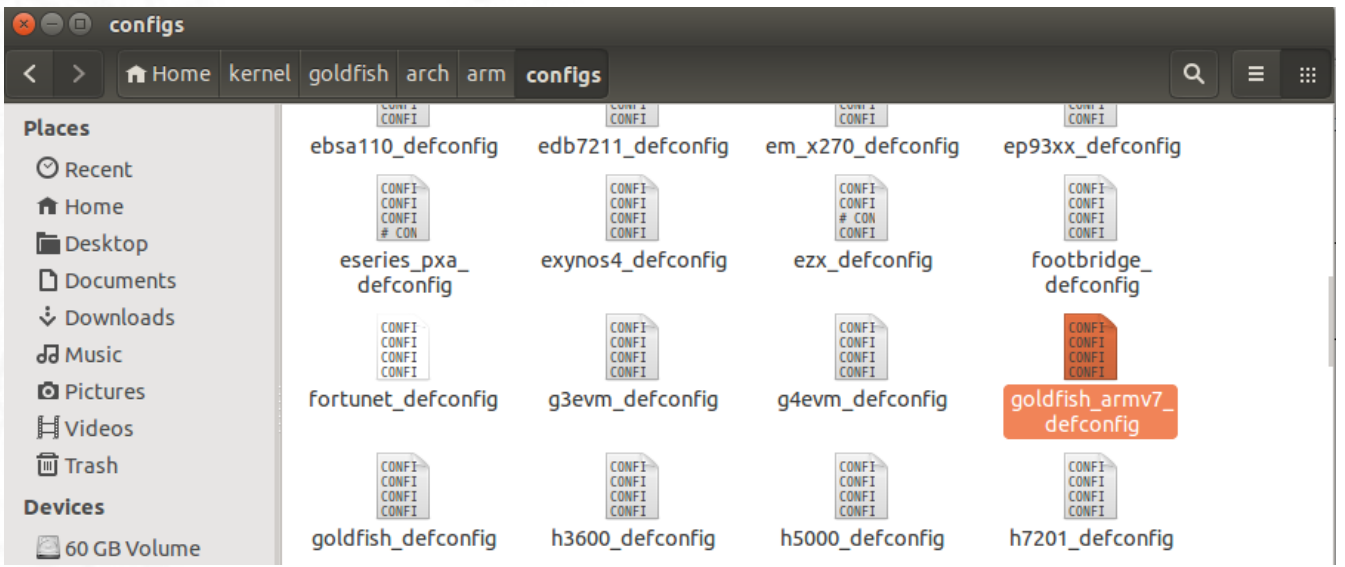


COMPILACIÓN DEL KERNEL (ii)

EL PERFIL DE KERNEL

Podemos usar:

- **~/kernel/goldfish/arch/x86/configs**
- **podemos usar el config.gz del propio dispositivo (renombrarlo)**



COMPILACIÓN DEL KERNEL (iii)

GENERAR EL .CONFIG

- **Seleccionamos nuestro perfil (o los asistentes como menuconfig):**

```
$ make goldfish_armv7_defconfig
```

- **Agregamos los atributos para poder colgar módulos**

al kernel en el fichero .config

CONFIG_MODULES=y

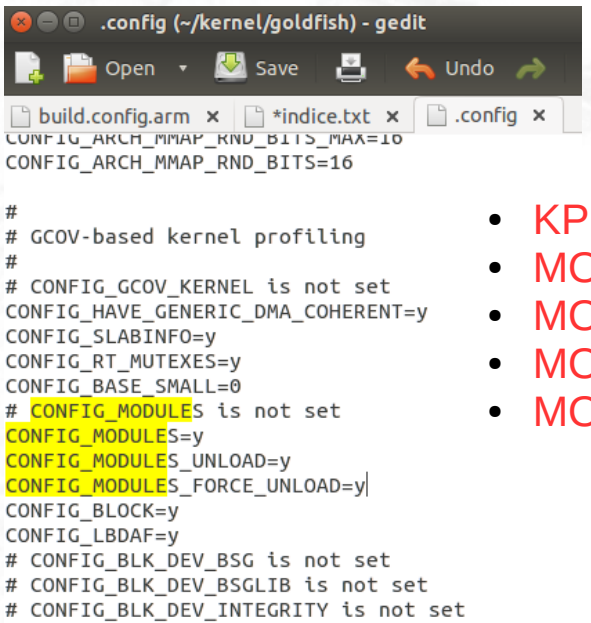
CONFIG_MODULES_UNLOAD=y

CONFIG_MODULES_FORCE_UNLOAD=y

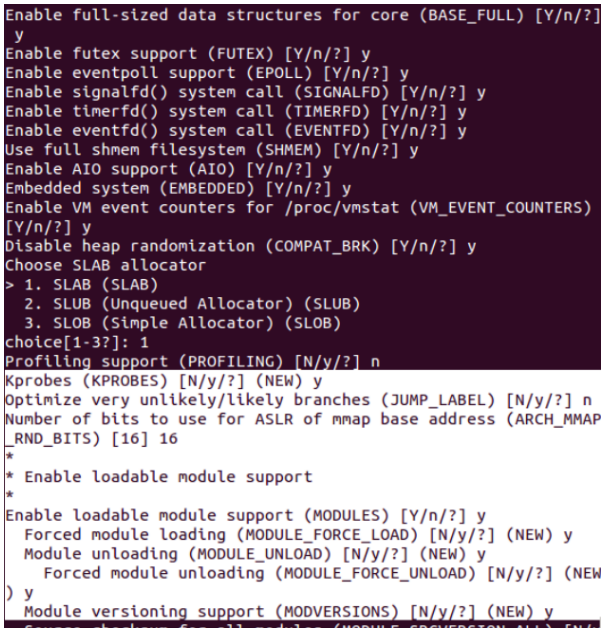
COMPILACIÓN DEL KERNEL (iv)

COMPILAR EL KERNEL

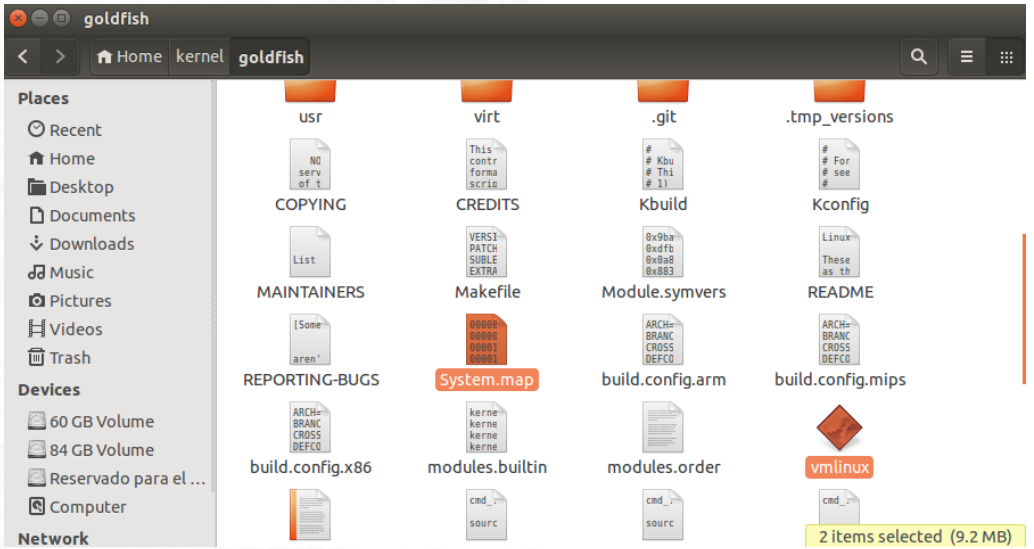
```
$ make -jX
```

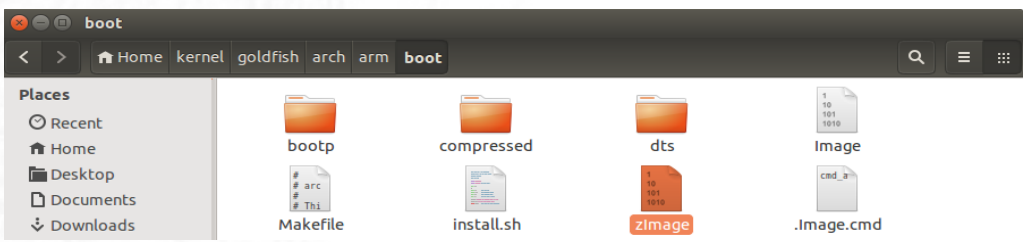


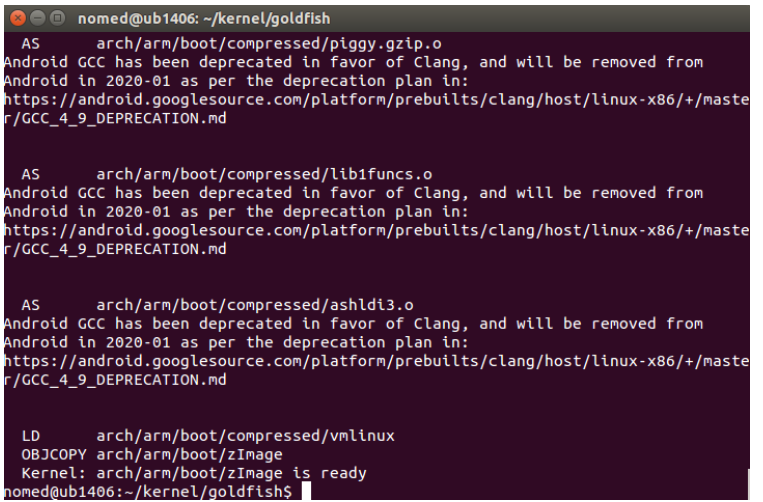
- KPROBES
- MODULE_FORCE_LOAD
- MODULE_UNLOAD
- MODULE_FORCE_UNLOAD
- MODVERSIONS



COMPILACIÓN DEL KERNEL (v)



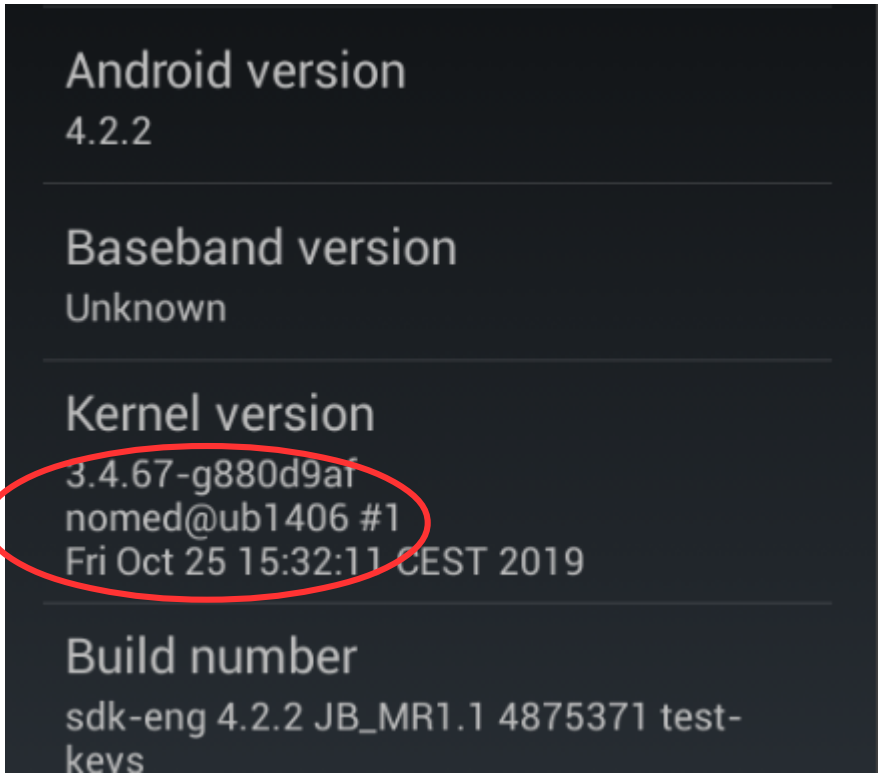




PROBANDO EL NUEVO KERNEL

```
$ emulator @aosx_arm -kernel
~/kernel/goldfish/arch/arm/boot/zImage -show-kernel
```

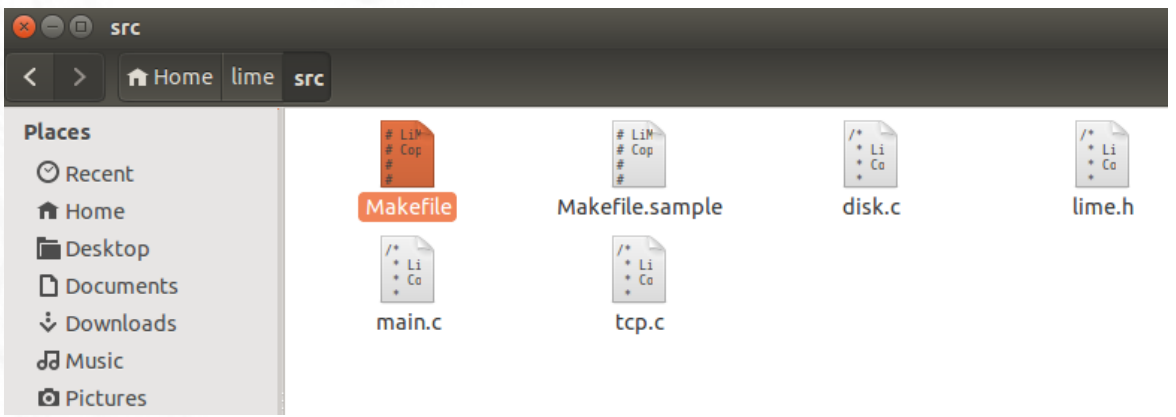
```
nomed@ub1406: ~
nomed@ub1406:~$ adb devices
List of devices attached
* daemon not running. starting it now on port 5037 *
* daemon started successfully *
emulator-5554   device

nomed@ub1406:~$ adb root
adbd is already running as root
nomed@ub1406:~$ adb connect 127.0.0.1:5554
connected to 127.0.0.1:5554
nomed@ub1406:~$ adb remount
remount succeeded
nomed@ub1406:~$ adb shell cat /proc/version
Linux version 3.4.67-g880d9af (nomed@ub1406) (gcc version 4.9.x 20150123 (prerel
ease) (GCC) ) #1 PREEMPT Fri Oct 25 15:32:11 CEST 2019
nomed@ub1406:~$
```



COMPILANDO LiME (i)

LiME es un extractor de memoria para sistemas basados en Linux. Android es un sistema basado en Linux por tanto nos sirve para realizar adquisiciones de memoria en sistemas vivos.

https://github.com/504ensicsLabs/LiME



COMPILANDO LiME (ii)

CONFIGURAR MAKEFILE

- KDIR
- CCPATH
- ARCH
- CROSS_COMPILE

Makefile (~/lime/src) - gedit

Open Save Undo

Makefile *indice.txt

```
obj-m := lime.o
lime-objs := tcp.o disk.o main.o

KDIR := ~/kernel/goldfish
CCPATH := ~/toolchains/arm-linux-androideabi-4.9/bin
PWD := $(shell pwd)

default:
	$(MAKE) ARCH=arm CROSS_COMPILE=$(CCPATH)/arm-linux-androideabi- -C $(KDIR)
EXTRA_CFLAGS=fno-pic M=$(PWD) modules
	mv lime.ko lime2.ko
```

Makefile Tab Width: 8 Ln 31, Col 72 INS

errata en la imagen = EXTRA_CFLAGS= -fno-pic

COMPILANDO LiME (iii)

COMPILAR LiME

```
$ cd ~/lime/src
$ make
```

```
nomed@ub1406: ~/lime/src
nomed@ub1406:~$ export ARCH=arm
nomed@ub1406:~$ export SUBARCH=arm
nomed@ub1406:~$ export CROSS_COMPILE=~/toolchains/arm-linux-androideabi-4.9/bin/
arm-linux-androideabi-
nomed@ub1406:~$ cd ~/lime/src
nomed@ub1406:~/lime/src$ make
make ARCH=arm CROSS_COMPILE=~/toolchains/arm-linux-androideabi-4.9/bin/arm-linux
-androideabi- -C ~/kernel/goldfish EXTRA_CFLAGS=-fno-pic M=/home/nomed/lime/src
modules
```

```
  LD [M]  /home/nomed/lime/src/lime.ko
make[1]: Leaving directory `/home/nomed/kernel/goldfish'
mv lime.ko lime2.ko
nomed@ub1406:~/lime/src$ ls
Makefile         Module.symvers  lime.h      lime.o     main.o          tcp.o
Makefile.sample  disk.c          lime.mod.c  lime2.ko   modules.order
Makefile~        disk.o          lime.mod.o  main.c     tcp.c
nomed@ub1406:~/lime/src$
```

VOLCADO DE LA MEMORIA (i)

COLGAR LiME EN EL KERNEL

```
$ adb push ./lime2.ko /sdcard/lime.ko
$ adb shell
# insmod /sdcard/lime.ko "path=/sdcard/lime.dump format=lime"
```

```
nomed@ub1406:~/lime/src$ adb push ./lime2.ko /sdcard/lime.ko
117 KB/s (7600 bytes in 0.062s)
nomed@ub1406:~/lime/src$ adb shell
root@android:/ # insmod /sdcard/lime.ko "path=/sdcard/lime.dump format=lime"
root@android:/ #
```

formatos: raw - padded - lime

VOLCADO DE LA MEMORIA (ii)

ADQUIRIR EL VOLCADO

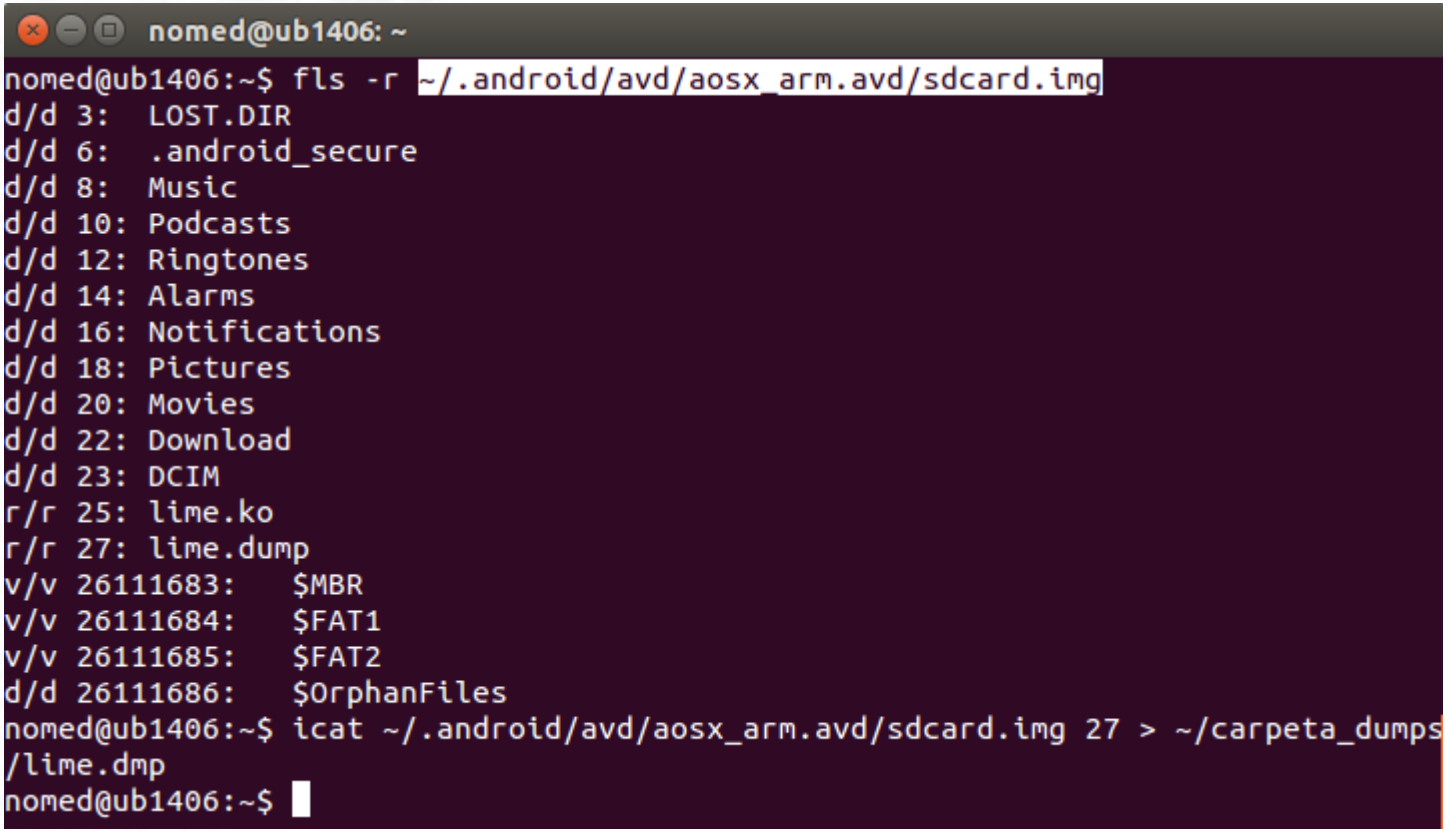
- **Forma rápida utilizando sleuthkit**

```
$ fls -r /ruta/al/fichero/sdcard.img
$ icat ~/ruta/al/fichero/sdcard.img XX > ~/carpeta_dumps/lime.dmp
```

- **Forma lenta, pero válida para cualquier dispositivo**

```
$ adb pull /sdcard/lime.dump
```

VOLCADO DE LA MEMORIA (iii)



VOLCADO DE LA MEMORIA (iv)

OTRA FORMA DE ADQUIRIR CON LiME

```
$ adb push ./lime2.ko /sdcard/lime.ko
$ $ adb forward tcp:4444 tcp:4444
$ adb shell
# insmod /sdcard/lime.ko "path=tcp:4444 format=lime"
```

desde otra terminal

```
$ nc localhost 4444 > ~/carpeta_dumps/lime.dmp
```

formatos: raw - padded - lime

CREANDO EL PROFILE DE VOLATILITY (i)

Volatility es la herramienta Open Source para analizar la memoria RAM por excelencia. Necesitamos un profile que conozca las direcciones del System.map

profile = fichero zip (modulo dwarf , fichero System.map)

`https://github.com/volatilityfoundation/volatility`

CREANDO EL PROFILE DE VOLATILITY (ii)

CONFIGURAR MAKEFILE

Necesitamos dwarfdump, lo que hace es traducir información para que se pueda entender por humanos, es decir, formatea la información de los profiles para presentarla de una forma legible.

- KDIR
- CCPATH
- DWARFDUMP
- ARCH
- CROSS_COMPILE

Makefile (~/volatility/tools/linux) - gedit

Open Save Undo

comandos.txt × Makefile ×

```
obj-m += module.o
KDIR := ~/kernel/goldfish
CCPATH := ~/toolchains/arm-linux-androideabi-4.9/bin
DWARFDUMP := /usr/bin/dwarfdump

-include version.mk

all: dwarf

dwarf: module.c
	$(MAKE) ARCH=arm CROSS_COMPILE=$(CCPATH)/arm-linux-androideabi- -C $(KDIR)
CONFIG_DEBUG_INFO=y M=$(PWD) modules
	$(DWARFDUMP) -di module.ko > module.dwarf
```

Makefile ▾ Tab Width: 8 ▾ Ln 12, Col 50 INS

CREANDO EL PROFILE DE VOLATILITY (iii)

COMPILAR EL MODULO DWARF

```
$ cd ~/volatility/tools/linux
$ make
```

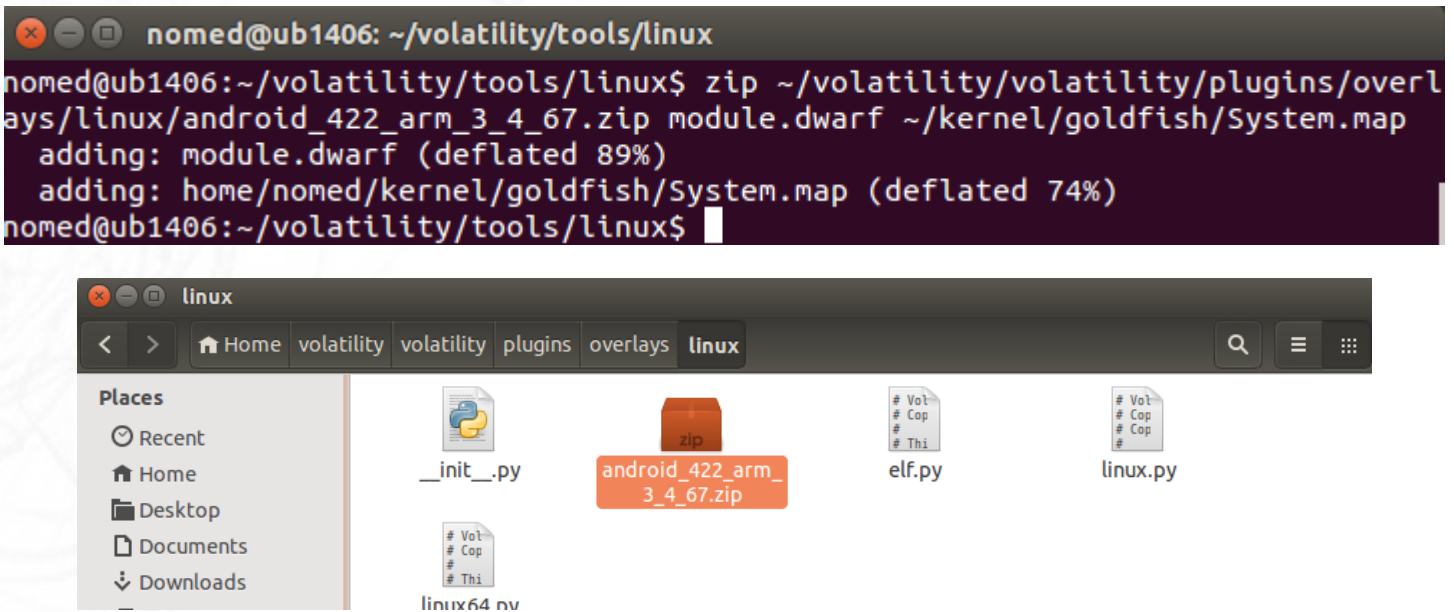
```
nomed@ub1406: ~/volatility/tools/linux
nomed@ub1406:~$ export ARCH=arm
nomed@ub1406:~$ export SUBARCH=arm
nomed@ub1406:~$ export CROSS_COMPILE=~/toolchains/arm-linux-androideabi-4.9/bin/
arm-linux-androideabi-
nomed@ub1406:~$ cd ~/volatility/tools/linux
nomed@ub1406:~/volatility/tools/linux$ make
make ARCH=arm CROSS_COMPILE=~/toolchains/arm-linux-androideabi-4.9/bin/arm-linux
-androideabi- -C ~/kernel/goldfish CONFIG_DEBUG_INFO=y M=/home/nomed/volatility/
tools/linux modules
```

```
  LD [M]  /home/nomed/volatility/tools/linux/module.ko
make[1]: Leaving directory `/home/nomed/kernel/goldfish'
/usr/bin/dwarfdump -di module.ko > module.dwarf
nomed@ub1406:~/volatility/tools/linux$
```

CREANDO EL PROFILE DE VOLATILITY (iv)

COMPRIMIR EL PROFILE (plugin)

```
$ zip
~/volatility/volatility/plugins/overlays/linux/android_422_arm_3_4_67.zip
module.dwarf ~/kernel/goldfish/System.map
```



ANALIZANDO CON VOLATILITY

POC

ANALIZANDO CON VOLATILITY (i)

```
$ python vol.py --info
```

nuestro profile = Linuxandroid_422_arm_3_4_67ARM

```
nomed@ub1406: ~/volatility

Profiles
--------
Linuxandroid_422_arm_3_4_67ARM - A Profile for Linux android_422_arm_3_4_67 ARM
VistaSP0x64                   - A Profile for Windows Vista SP0 x64
VistaSP0x86                   - A Profile for Windows Vista SP0 x86
VistaSP1x64                   - A Profile for Windows Vista SP1 x64
VistaSP1x86                   - A Profile for Windows Vista SP1 x86
VistaSP2x64                   - A Profile for Windows Vista SP2 x64
VistaSP2x86                   - A Profile for Windows Vista SP2 x86
```

ANALIZANDO CON VOLATILITY (ii)

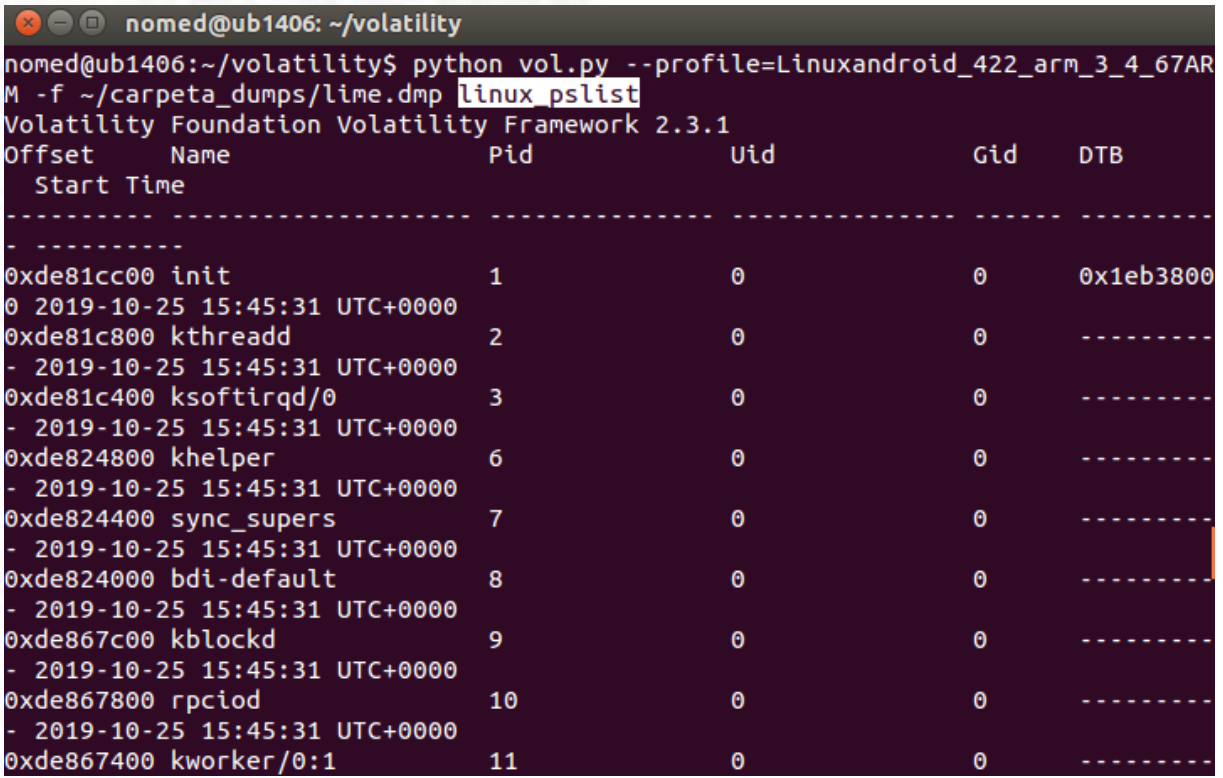
linux_arp	- Print the ARP table
linux_banner	- Prints the Linux banner information
linux_bash	- Recover bash history from bash process memory
linux_check_afinfo	- Verifies the operation function pointers of network protocols
linux_check_creds	- Checks if any processes are sharing credential structures
linux_check_evt_arm	- Checks the Exception Vector Table to look for syscall table hooking
linux_check_fop	- Check file operation structures for rootkit modifications
linux_check_idt	- Checks if the IDT has been altered
linux_check_modules	- Compares module list to sysfs info, if available
linux_check_syscall	- Checks if the system call table has been altered
linux_check_syscall_arm	- Checks if the system call table has been altered
linux_check_tty	- Checks tty devices for hooks
linux_cpuinfo	- Prints info about each active processor
linux_dentry_cache	- Gather files from the dentry cache
linux_dmesg	- Gather dmesg buffer
linux_dump_map	- Writes selected memory mappings to disk
linux_find_file	- Recovers tmpfs filesystems from memory
linux_ifconfig	- Gathers active interfaces
linux_iomem	- Provides output similar to /proc/iomem
linux_keyboard_notifier	- Parses the keyboard notifier call chain

ANALIZANDO CON VOLATILITY (iii)

linux_lsmod	- Gather loaded kernel modules
linux_lsof	- Lists open files
linux_memmap	- Dumps the memory map for linux tasks
linux_moddump	- Extract loaded kernel modules
linux_mount	- Gather mounted fs/devices
linux_mount_cache	- Gather mounted fs/devices from kmem_cache
linux_netstat	- Lists open sockets
linux_pidhashtable	- Enumerates processes through the PID hash table
linux_pkt_queues	- Writes per-process packet queues out to disk
linux_proc_maps	- Gathers process maps for linux
linux_psaux	- Gathers processes along with full command line and start time
linux_pslist	- Gather active tasks by walking the task_struct->task list
linux_pslist_cache	- Gather tasks from the kmem_cache
linux_pstree	- Shows the parent/child relationship between processes
linux_psxview	- Find hidden processes with various process listings
linux_route_cache	- Recovers the routing cache from memory
linux_sk_buff_cache	- Recovers packets from the sk_buff kmem_cache
linux_slabinfo	- Mimics /proc/slabinfo on a running machine
linux_tmpfs	- Recovers tmpfs filesystems from memory
linux_vma_cache	- Gather VMAs from the vm_area_struct cache
linux_volshell	- Shell in the memory image
linux_yarascan	- A shell in the Linux memory image

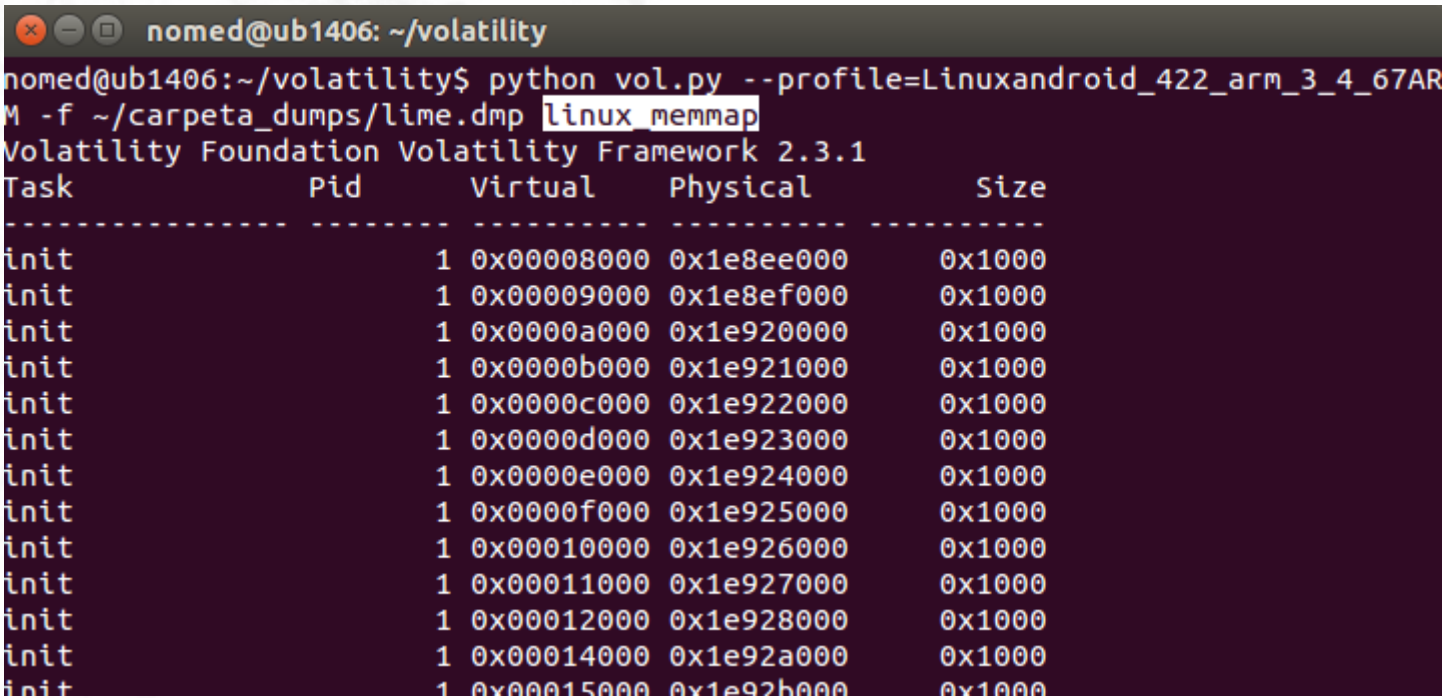
ANALIZANDO CON VOLATILITY (iv)

```
$ python vol.py --profile=Linuxandroid_422_arm_3_4_67ARM -f
~/carpeta_dumps/lime.dmp linux_pslist
```



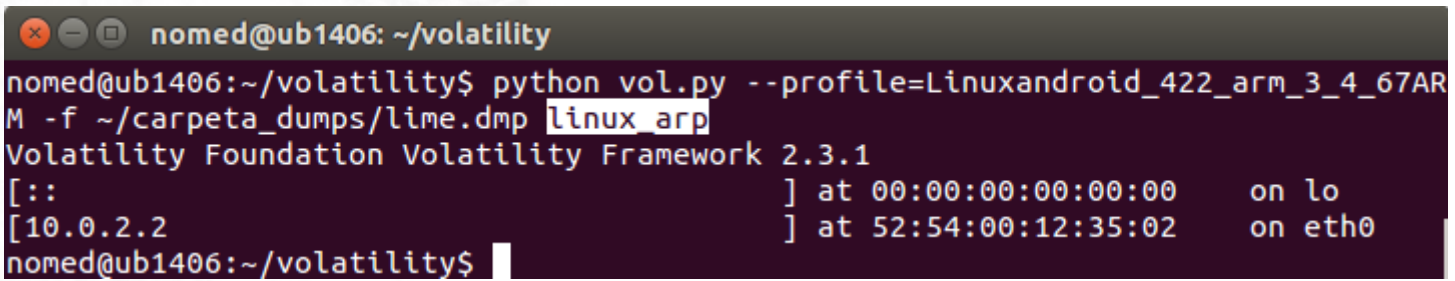
ANALIZANDO CON VOLATILITY (v)

```
$ python vol.py --profile=Linuxandroid_422_arm_3_4_67ARM -f
~/carpeta_dumps/lime.dmp linux_memmap
```



ANALIZANDO CON VOLATILITY (vi)

```
$ python vol.py --profile=Linuxandroid_422_arm_3_4_67ARM -f
~/carpeta_dumps/lime.dmp linux_arp
```



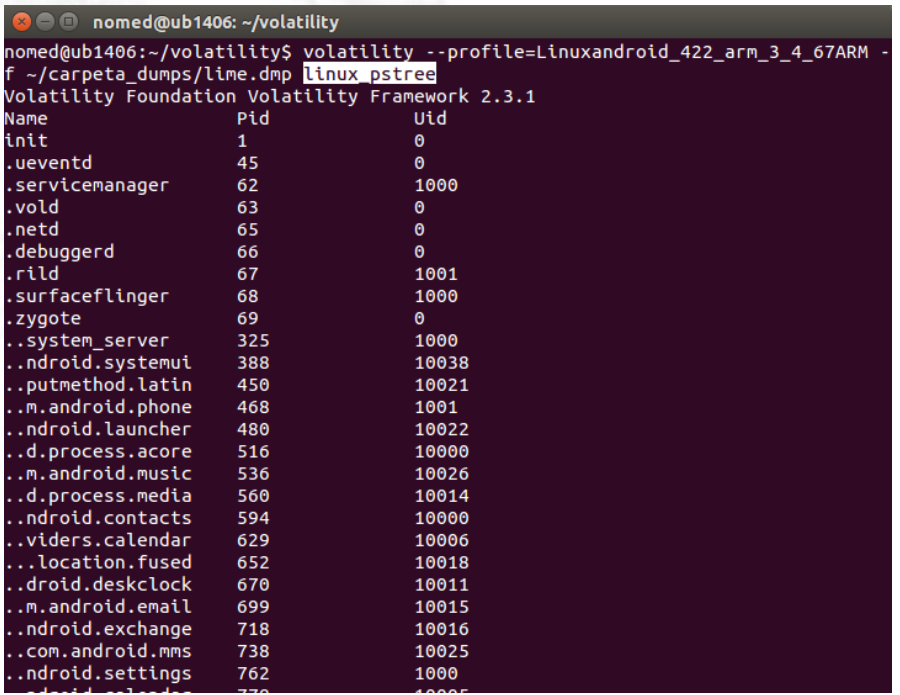
ANALIZANDO CON VOLATILITY (vii)

```
$ python vol.py --profile=Linuxandroid_422_arm_3_4_67ARM
-f ~/carpeta_dumps/lime.dmp linux_yarascan -Y "https:"
```

```
Volatility Foundation Volatility Framework 2.3.1
Task: zygote pid 1241 rule r1 addr 0x977d6e06
0x977d6e06  68 74 74 70 73 3a 00 66 65 65 64 73 3a 68 74 74   https:.feeds:htt
0x977d6e16  70 3a 00 66 65 65 64 73 3a 68 74 74 70 73 3a 00   p:.feeds:https:.
0x977d6e26  66 65 65 64 73 65 61 72 63 68 3a 68 74 74 70 3a   feedsearch:http:
0x977d6e36  00 66 65 65 64 73 65 61 72 63 68 3a 68 74 74 70   .feedsearch:http
Task: zygote pid 1241 rule r1 addr 0x977d6e1f
0x977d6e1f  68 74 74 70 73 3a 00 66 65 65 64 73 65 61 72 63   https:.feedsearc
0x977d6e2f  68 3a 68 74 74 70 3a 00 66 65 65 64 73 65 61 72   h:http:.feedsear
0x977d6e3f  63 68 3a 68 74 74 70 73 3a 00 52 65 66 72 65 73   ch:https:.Refres
0x977d6e4f  68 00 5f 73 65 6c 66 00 00 4e 6f 74 20 61 6c 6c   h._self..Not.all
Task: zygote pid 1241 rule r1 addr 0x977d6e42
0x977d6e42  68 74 74 70 73 3a 00 52 65 66 72 65 73 68 00 5f   https:.Refresh._
0x977d6e52  73 65 6c 66 00 00 4e 6f 74 20 61 6c 6c 6f 77 65   self..Not.allowe
0x977d6e62  64 20 74 6f 20 6c 6f 61 64 20 6c 6f 63 61 6c 20   d.to.load.local.
0x977d6e72  72 65 73 6f 75 72 63 65 3a 20 00 00 00 00 20 64   resource:......d
Task: zygote pid 1241 rule r1 addr 0x98a545b5
0x98a545b5  68 74 74 70 73 3a 2f 2f 00 68 74 74 70 3a 2f 2f   https://.http://
0x98a545c5  00 20 64 75 72 69 6e 67 20 53 53 4c 20 72 65 6e   ..during.SSL.ren
0x98a545d5  65 67 6f 74 69 61 74 69 6f 6e 00 30 20 3c 20 62   egotiation.0.<.b
0x98a545e5  75 66 5f 6c 65 6e 00 20 74 6f 20 43 4f 4e 4e 45   uf_len..to.CONNE
Task: zygote pid 1241 rule r1 addr 0x9a9fcbe8
0x9a9fcbe8  68 74 74 70 73 3a 00 08 68 74 74 70 73 3a 2f 2f   https:..https://
0x9a9fcbf8  00 0c 68 74 74 70 73 3a 2f 2f 77 77 77 2e 00 02   ..https://www...
0x9a9fcc08  68 75 00 03 68 75 65 00 08 68 75 6e 64 72 65 64   hu..hue..hundred
0x9a9fcc18  73 00 0d 68 77 41 63 63 65 6c 65 72 61 74 65 64   s..hwAccelerated
Task: zygote pid 1241 rule r1 addr 0x9a9fcbf0
```

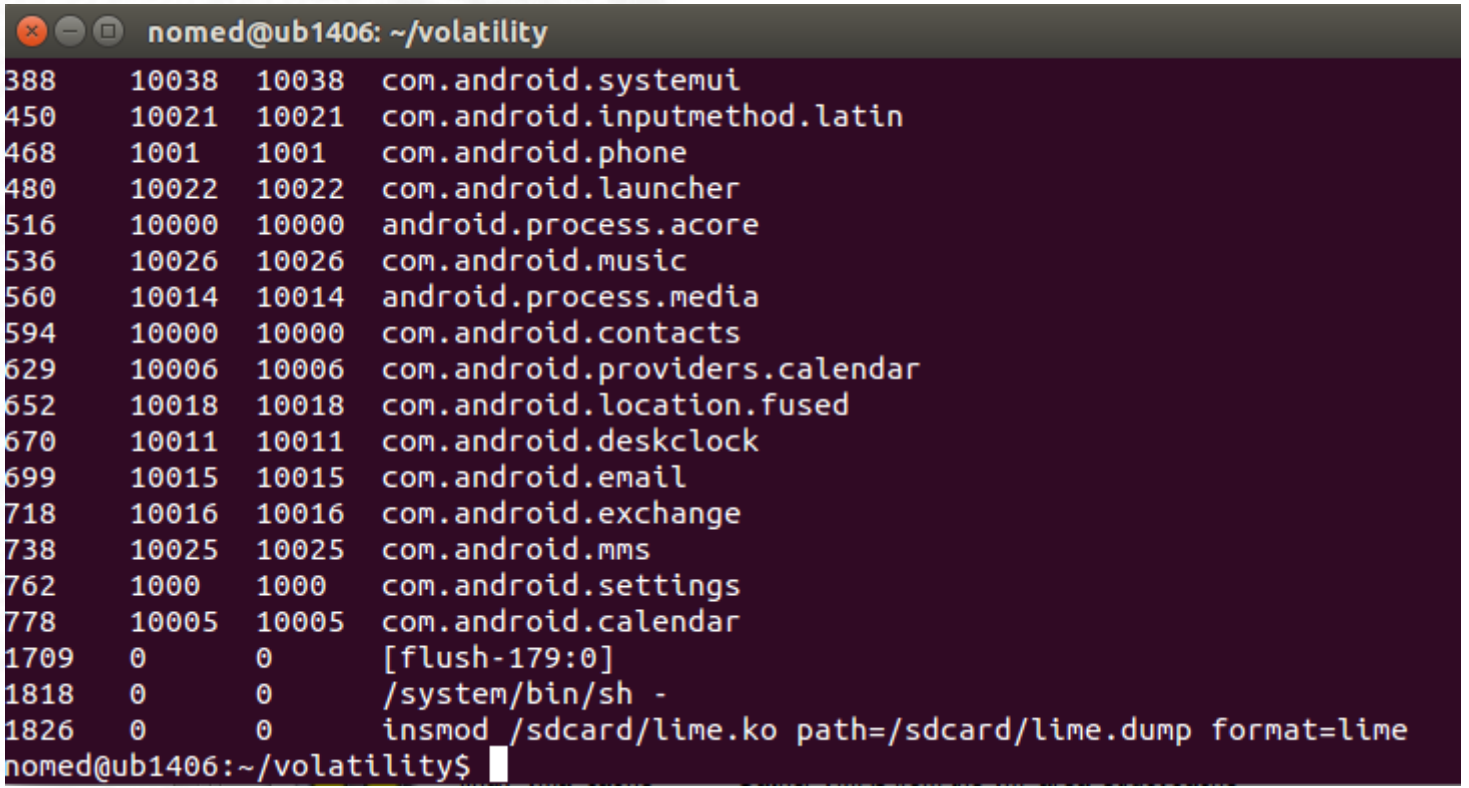
ANALIZANDO CON VOLATILITY (viii)

```
$ python vol.py --profile=Linuxandroid_422_arm_3_4_67ARM
-f ~/carpeta_dumps/lime.dmp linux_pstree
```



ANALIZANDO CON VOLATILITY (ix)

```
$ python vol.py --profile=Linuxandroid_422_arm_3_4_67ARM
-f ~/carpeta_dumps/lime.dmp linux_psaux
```



SIEMPRE NOS QUEDARÁ STRINGS

```
$ strings -n 20 -d ~/carpeta_dumps/lime.dmp -o |grep https
```

```
nomed@ub1406: ~/volatility
nomed@ub1406:~/volatility$ strings -n 20 -d ~/carpeta_dumps/lime.dmp -o |grep ht
tps
2201344425 https://autodiscover.
2335004176 ==https://www.google.com/webhp?client={CID}&source=android-home
2335016226 ))Can only download "http" or "https" URLs.
2335144007 s pot baixar URL "http" o "https".
2335170275  jako http nebo https.
2335212371 CCKan kun downloade webadresser, der starter med "http" eller https".
2335235452 56Nur Download von URLs mit "http" oder "https" m
2335327772 77Solo se pueden descargar URL del tipo "http" o "https".
2335354051 44Solo se pueden descargar URL de "http" o de "https".
2335376023 //Vain http- tai https-URL-osoitteista voi ladata
2335422432 charger que des URL de type "http" et "https".
2335517106 11Mogu se preuzeti samo "http" ili "https" URL-ovi.
2335544123 58Csak "http" vagy "https" URL-ek let
2335567251  possibile scaricare soltanto URL "http" o "https".
2335761534 22Kan alleen URL's met 'http' of 'https' downloaden.
2360673624 accessibility_script_injection_urlhttps://ssl.gstatic.com/accessibili
ty/javascript/android/AndroidVox_v1.js
2367757724 ""https://www.google.com/favicon.ico
```

CONCLUSIONES

- Los pasos son: compilar kernel, lime, el profile, volcar y analizar
- Es importante elegir el JDK correcto para las compilaciones:
  - Android inferiores a 4.4.X debemos utilizar Oracle 6 JDK, no sirve OpenJDK
  - Android 5 y 6 podemos utilizar tanto Oracle 7 JDK como OpenJDK 7
  - Android 7 o superior podemos utilizar OpenJDK 8 o superior
- Hay que usar el toolchain correcto, algunos van a dejar de tener soporte (clang)
- La extracción del dump de un dispositivo virtual es rápida con sleuthkit
- Hay versiones de LiME o Volatility que no funcionan para Android
- Podemos generar máquinas virtuales desde Cli y usarlas en scripts

LÍNEAS FUTURAS

- Generar los kernels LKM para los dispositivos virtuales
- Realizar procesos automatizados en análisis de malware (versiones nuevas)
- Documentar el impacto del uso de los toolchains clang en versiones viejas
- Uso en cloud de analizadores de malware
- Personalmente: mejorar ExereWare (versión 2) para análisis de riesgos.

REFERENCIAS

- TFG – Análisis de Malware en Smartphones Android: Prototipo y Estudio de Herramientas Buenaventura Salcedo Santos-Olmo
- Documents Guide Android Developers
- Android Security Internals - Nikolay Elenkov
- Android & Volatility - Volatility Foundation
- Malware en Android: Discovering, Reversing & Forensics- Miguel Ángel García del Moral
- Learning Pentesting for Android - Aditya Gupta
- Google Group Android-x86

PREGUNTAS