

Linux/Android Debugging and Profiling

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 - ◆ DS-5 streamline

Kernel debug

Kernel – printk

- /proc/sys/kernel/printk
- dev_xxx
- pr_xxx
- #define pr_fmt(fmt) "hw-breakpoint: " fmt

```
#define pr_fmt(fmt) "cn_test: " fmt

#include <linux/kernel.h>
#include <linux/module.h>
#include <linux/moduleparam.h>
#include <linux/skbuff.h>
#include <linux/slab.h>
#include <linux/timer.h>

#include <linux/connector.h>
```

Kernel – WARN_ON

- print_modules();
- dump_stack();
- print_oops_end_marker();

```
[ 1.276928] -----[ cut here ]-----  
[ 1.279558] WARNING: at /home/likewise-open/ASIA/bs14/workspace/prima2-android/kernel/drivers/gpio/gpiolib.c:99 gpio_ensure_requested+0x50/0x1a4()  
[ 1.292649] autorequest GPIO-60  
[ 1.295774] Modules linked in:  
[ 1.298812] Backtrace:  
[ 1.301261] [<c02df4b8>] (dump_backtrace+0x0/0x110) from [<c0652628>] (dump_stack+0x18/0x1c)  
[ 1.309663] r6:c0725458 r5:00000063 r4:d8c1bd8e r3:00000000  
[ 1.315313] [<c0652610>] (dump_stack+0x0/0x1c) from [<c02f8a3c>] (warn_slowpath_common+0x54/0x6c)  
[ 1.324166] [<c02f89e8>] (warn_slowpath_common+0x0/0x6c) from [<c02f8af8>] (warn_slowpath_fmt+0x38/0x40)  
[ 1.333618] r8:00000003c r7:00000001c r6:00000000 r5:c07989f4 r4:c0806410  
[ 1.340127] r3:00000009  
[ 1.342741] [<c02f8ac0>] (warn_slowpath_fmt+0x0/0x40) from [<c04a4494>] (gpio_ensure_requested+0x50/0x1a4)  
[ 1.352367] r3:0000003c r2:c07254ad  
[ 1.355935] [<c04a4444>] (gpio_ensure_requested+0x0/0x1a4) from [<c04a478c>] (gpio_direction_output+0x8c/0x160)  
[ 1.366009] [<c04a4700>] (gpio_direction_output+0x0/0x160) from [<c05a71f4>] (sirfsoc_int_audio_probe+0x500/0x640)  
[ 1.376336] [<c05a6cf4>] (sirfsoc_int_audio_probe+0x0/0x640) from [<c04e4378>] (platform_drv_probe+0x1c/0x20)  
[ 1.386229] [<c04e435c>] (platform_drv_probe+0x0/0x20) from [<c04e33bc>] (driver_probe_device+0xd0/0x18c)  
[ 1.395775] [<c04e32ec>] (driver_probe_device+0x0/0x18c) from [<c04e34e0>] (__driver_attach+0x68/0x8c)  
[ 1.405054] r7:000000000 r6:c07a702c r5:c077fc24 r4:c077fbf0  
[ 1.410705] [<c04e3478>] (__driver_attach+0x0/0x8c) from [<c04e256c>] (bus_for_each_dev+0x58/0x88)  
[ 1.419638] r6:c04e3478 r5:d8c1bef8 r4:c07a702c r3:00000000  
[ 1.425287] [<c04e2514>] (bus_for_each_dev+0x0/0x88) from [<c04e3050>] (driver_attach+0x20/0x28)  
[ 1.434045] r7:000000000 r6:c079c980 r5:d8e75600 r4:c07a702c  
[ 1.439695] [<c04e3030>] (driver_attach+0x0/0x28) from [<c04e2c54>] (bus_add_driver+0xa8/0x224)  
[ 1.448376] [<c04e2bac>] (bus_add_driver+0x0/0x224) from [<c04e3790>] (driver_register+0xb0/0x134)  
[ 1.457318] [<c04e36e0>] (driver_register+0x0/0x134) from [<c04e4ae0>] (platform_driver_register+0x4c/0x60)  
[ 1.467042] [<c04e4a94>] (platform_driver_register+0x0/0x60) from [<c001da24>] (sirfsoc_int_audio_init+0x14/0x1c)  
[ 1.477289] [<c001da10>] (sirfsoc_int_audio_init+0x0/0x1c) from [<c02d5518>] (do_one_initcall+0xbc/0x190)  
[ 1.486832] [<c02d545c>] (do_one_initcall+0x0/0x190) from [<c0008a2c>] (kernel_init+0xa0/0x150)  
[ 1.495501] r8:000000000 r7:000000013 r6:c02fbea4 r5:c002430c r4:c0024248  
[ 1.502193] [<c000898c>] (kernel_init+0x0/0x150) from [<c02fbea4>] (do_exit+0x0/0x704)  
[ 1.510082] r5:c000898c r4:000000000  
[ 1.513656] ---[ end trace 1d09b149419bf0f2 ]---
```

Kernel – BUG_ON/BUG

- printk("BUG: failure at %s:%d/%s()\n", __FILE__, __LINE__, __func__); \
- panic("BUG!"); \

Kernel – oops - bug

```
/kernel$ git diff
diff --git a/tools/cma/cma_test.c b/tools/cma/cma_test.c
index 7eb96db..ba02d35 100644
--- a/tools/cma/cma_test.c
+++ b/tools/cma/cma_test.c
@@ -44,6 +44,9 @@ @@ cma_test_read(struct file *file, char __user *buf,
size_t count, loff_t *ppos)

if (!alloc)
    return -EIDRM;
+
+    volatile int *p=0;
+    *p = 0;

dma_free_coherent(cma_dev, alloc->size, alloc->virt,
alloc->dma);
```

Kernel – oops - PC

```
sh-4.2# cat /dev/cma_test
[ 33.491284] Unable to handle kernel NULL pointer dereference at virtual address
00000000
[ 33.507357] pgd = cc914000
[ 33.507379] [00000000] *pgd=0c902831, *pte=00000000, *ppte=00000000
[ 33.513769] Internal error: Oops: 817 [#1] PREEMPT
[ 33.518538] last sysfs file: /sys/devices/system/cpu/cpu0/cpufreq/stats/time_in_state
[ 33.526350] Modules linked in: vxdkernel pvrsvrkm sirfsoc_gps sirfsocfb cma_test
[ 33.533729] CPU: 0 Not tainted (2.6.38.8-sirf #28)
[ 33.538857] PC is at cma_test_read+0x8c/0xec [cma_test]
[ 33.544067] LR is at vfs_read+0xb8/0x144
[ 33.547966] pc : [<bf06f1cc>] lr : [<c039d64c>] psr: a0000013
[ 33.547972] sp : cc90ff08 ip : cc90ff30 fp : cc90ff2c
[ 33.559421] r10: 00000000 r9 : 00000003 r8 : beafd890
[ 33.564631] r7 : cc90ff68 r6 : bf06f4ec r5 : 00000000 r4 : d3e16460
[ 33.571139] r3 : 00000000 r2 : 00000000 r1 : beafd890 r0 : cc8e6e20
[ 33.577650] Flags: NzCv IRQs on FIQs on Mode SVC_32 ISA ARM Segment
user
[ 33.584768] Control: 10c53c7d Table: 0c914059 DAC: 00000015
[ 33.590495]
[ 33.590498] LR: 0xc039d5cc:
```

Kernel – oops -backtrace

```
[ 34.152437] Backtrace:  
[ 34.154882] [<bf06f140>] (cma_test_read+0x0/0xec [cma_test]) from [<c039d64c>] (vfs_read  
+0xb8/0x144)  
[ 34.163982] r6:beafd890 r5:cc8e6e20 r4:00001000  
[ 34.168592] [<c039d594>] (vfs_read+0x0/0x144) from [<c039d724>] (sys_read+0x4c/0x108)  
[ 34.176394] r8:beafd890 r7:00001000 r6:beafd890 r5:cc8e6e20 r4:000a8c34  
[ 34.183093] [<c039d6d8>] (sys_read+0x0/0x108) from [<c02dc720>] (ret_fast_syscall  
+0x0/0x30)  
[ 34.191416] Code: 03e0002a 0a000012 e59f6058 e3a05000 (e5855000)  
[ 34.294365] ---[ end trace f0d7620b9f61d90d ]---
```

Kernel – oops - objdump

[33.538857] PC is at cma_test_read+0x8c/0xec [cma_test]

```
86 00000140 <cma_test_read>:
87 140: e1a0c00d    mov    ip, sp
88 144: e92dd870    push   {r4, r5, r6, fp, ip, lr, pc}
89 148: e24cb004    sub    fp, ip, #4
90 14c: e24dd00c    sub    sp, sp, #12
91 150: e1a0200d    mov    r2, sp
92 154: e3c23d7f    bic    r3, r2, #8128 ; 0x1fc0
93 158: e3c3303f    bic    r3, r3, #63 ; 0x3f
94 15c: e5932004    ldr    r2, [r3, #4]
95 160: e2822001    add    r2, r2, #1
96 164: e5832004    str    r2, [r3, #4]
97 168: e59f30a8    ldr    r3, [pc, #168] ; 218 <cma_test_read+0xd8>
98 16c: e5934000    ldr    r4, [r3]
99 170: e1540003    cmp    r4, r3
100 174: 03a04000   moveq r4, #0
101 178: 1894000c   ldmne r4, {r2, r3}
102 17c: 15823004   strne r3, [r2, #4]
103 180: 15832000   strne r2, [r3]
104 184: 159f2090   ldrne r2, [pc, #144] ; 21c <cma_test_read+0xdc>
105 188: 159f3090   ldrne r3, [pc, #144] ; 220 <cma_test_read+0xe0>
106 18c: 1884000c   stmne r4, {r2, r3}
107 190: e1a0200d    mov    r2, sp
108 194: e3c23d7f    bic    r3, r2, #8128 ; 0x1fc0
109 198: e3c3303f    bic    r3, r3, #63 ; 0x3f
110 19c: e5932004    ldr    r2, [r3, #4]
111 1a0: e2422001    sub    r2, r2, #1
112 1a4: e5832004    str    r2, [r3, #4]
113 1a8: e5933000    ldr    r3, [r3]
114 1ac: e3130002   tst    r3, #2
115 1b0: 0a000000   beq    1b8 <cma_test_read+0x78>
116 1b4: ebfffffe   bl     0 <preempt_schedule>
117 1b8: e3540000   cmp    r4, #0
118 1bc: 03e0002a   mvneq r0, #42 ; 0x2a
119 1c0: 0a000012   beq    210 <cma_test_read+0xd0>
120 1c4: e59f6058   ldr    r6, [pc, #88] ; 224 <cma_test_read+0xe4>
121 1c8: e3a05000   mov    r5, #0
122 1cc: e5055000   str    r5, [r5]
123 1d0: e5960000   ldr    r0, [r6]
```

Kernel – DEBUG options

.config - Linux/arm 2.6.38.8 Kernel Configuration

Search Results

Symbol: DEBUG_PINCTRL [=n]
Type : boolean
Prompt: Debug PINCTRL calls
Defined at drivers/pinctrl/Kconfig:23
Depends on: PINCTRL [=n] && DEBUG_KERNEL [=y]
Location:
 -> Device Drivers
 -> PINCTRL Support (PINCTRL [=n])

Symbol: PM_DEBUG [=n]
Type : boolean
Prompt: Power Management Debug Support
Defined at kernel/power/Kconfig:22
Depends on: PM [=y]
Location:
 -> Power management options
 -> Power Management support (PM [=y])

Symbol: JFFS2_FS_DEBUG [=]
Type : integer
Prompt: JFFS2 debugging verbosity (0 = quiet, 2 = noisy)
Defined at fs/jffs2/Kconfig:14
Depends on: MISC_FILESYSTEMS [=n] && JFFS2_FS [=n]
Location:
 -> File systems
 -> Miscellaneous filesystems (MISC_FILESYSTEMS [=n])
 -> Journalling Flash File System v2 (JFFS2) support (JFFS2_FS [=n])

Symbol: DEBUG_KMEMLEAK_EARLY_LOG_SIZE [=]
Type : integer
Prompt: Maximum kmemleak early log entries
Defined at lib/Kconfig.debug:400
Depends on: DEBUG_KMEMLEAK [=n]
Location:
 -> Kernel hacking
 -> Kernel memory leak detector (DEBUG_KMEMLEAK [=n])

< Exit >

(31%)

Kernel – PM_DEBUG and no_console_suspend

- Enable PM_DEBUG in Kconfig

- [*] Power Management support
 - ||

- [*] Power Management Debug Support

- ||

- [*] Extra PM attributes in sysfs for low-level debugging/testing

- ||

- [*] Verbose Power Management debugging

- ||

- Set no_console_suspend in bootargs

Kernel – Android init “untracked PID exited”

```
diff --git a/kernel/exit.c b/kernel/exit.c
index 7cdb3a6..36ead86 100644
--- a/kernel/exit.c
+++ b/kernel/exit.c
@@ -909,6 +909,16 @@ NORET_TYPE void do_exit(long code)
    struct task_struct *tsk = current;
    int group_dead;

+   /*
+    * we want to track the exit of "untracked PID exited" events in Android, eg,
+    * in the process of suspend/resume:
+    * [ 222.660982] task exit: tgid(PID):1293 pid:1302 name:synergy_service
+    * [ 222.731344] init: untracked pid 1293 exited
+    */
+   if (tsk->parent->tgid == 1)
+       printk(KERN_DEBUG "task exit: tgid(PID):%d pid:%d name:%s\n",
+             tsk->tgid, tsk->pid, tsk->comm);
+
profile_task_exit(tsk);

WARN_ON(atomic_read(&tsk->fs_excl));
```

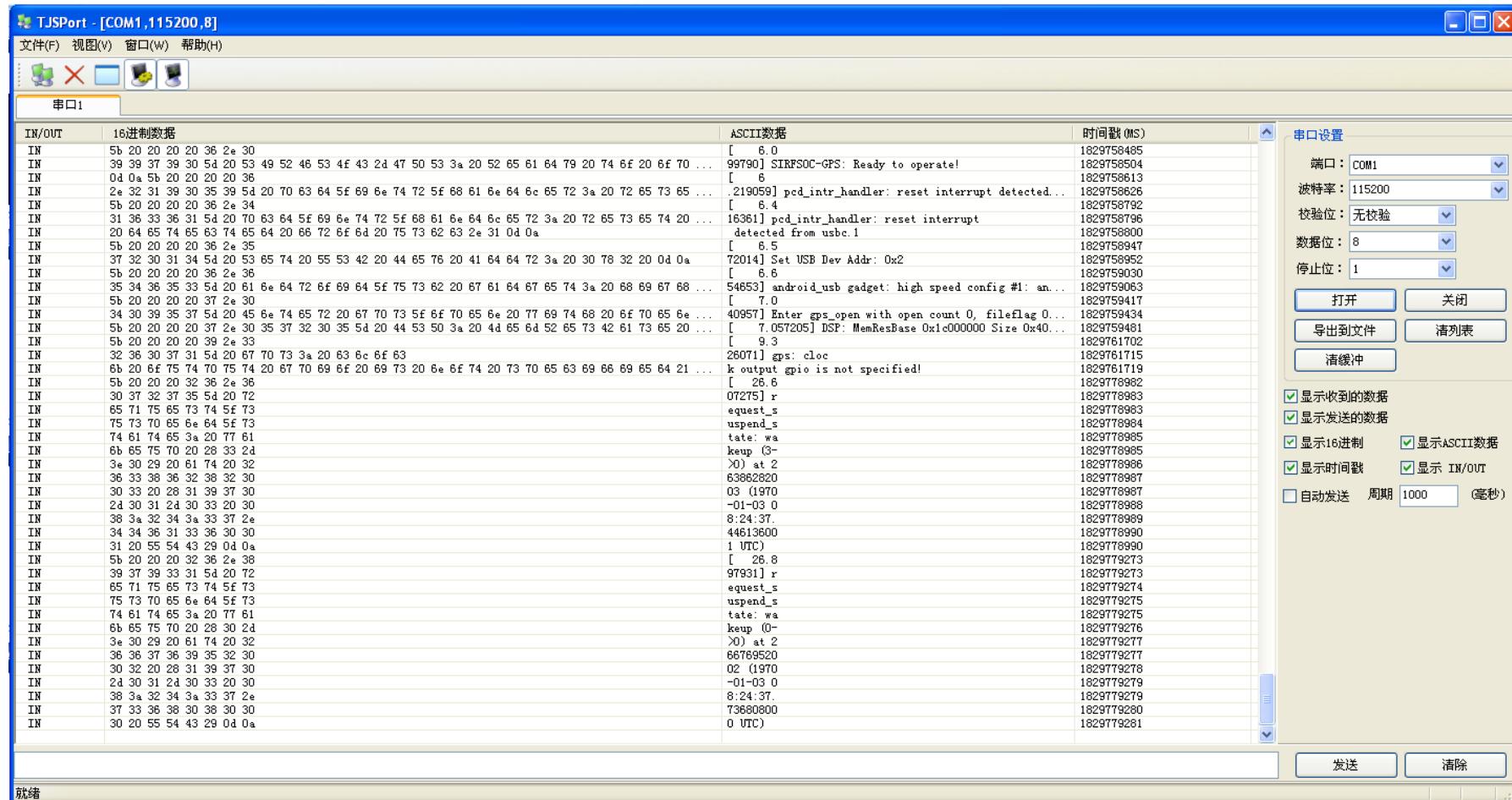
Kernel – /dev/ttyprintk

- ttyprintk is a pseudo TTY driver, which allows users to make printk messages

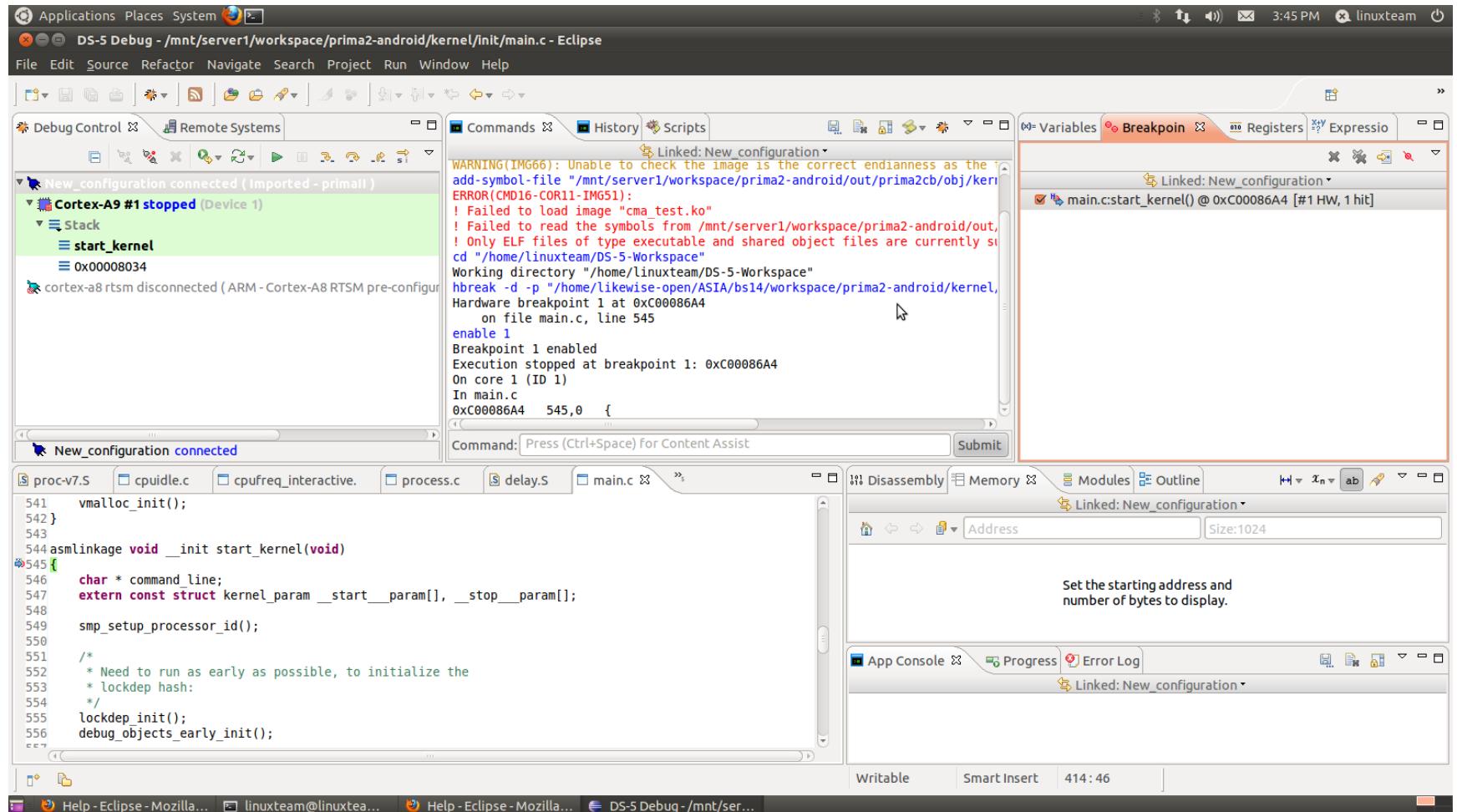
```
sh-4.2# echo "hello world" > /dev/ttyprintk  
[12005.502521] [U] hello world
```

Print with timestamp

➤ Tjsport and similar tools



DS-5 – debug kernel



DS-5 – debug module

➤ Target

```
sh-4.2# pwd  
/sys/module/cma_test/sections  
  
sh-4.2# ls -a  
. .note.gnu.build-id  
.. .rodata  
.bss .rodata.str1.1  
.data .strtab  
.exit.text .symtab  
.gnu.linkonce.this_module .text  
.init.text
```

```
sh-4.2# cat .text
```

0xbff06f000

```
sh-4.2# cat .data
```

0xbff06f36c

➤ Host

```
add-symbol-file kernel/tools/cma/cma_test.ko -s .text 0xbff06f000 -s .data 0xbff06f36c
```

```
b cma_test_read
```

DS-5 – get printk even after kernel hang

```
sh-4.2# grep __log_buf /proc/kallsyms  
c07f8ef8 b __log_buf
```

The screenshot shows the DS-5 Debug interface with the following details:

- File Menu:** Applications, Places, System, DS-5 Debug - /mnt/server1/workspace/prima2-android/kernel/arch/arm/mm/proc-v7.5 - Eclipse.
- Toolbar:** Includes icons for Open, Save, Cut, Copy, Paste, Find, Replace, Delete, Undo, Redo, Run, Stop, Break, Step Into, Step Out, Step Over, and Stop.
- Project Explorer:** Shows "New_configuration disconnected (Imported - primall)" and "barry-ds5-training connected (Imported - primall)".
- Debug Control:** Shows "Cortex-A9 #1 stopped (Device 1)" and "Stack".
- Commands View:** Displays the command "x/1/s 0xc07f8ef8" and its output: "0xC07F8EF8: 0x5B3E353C" and "x/1/s 0x8096 0xc07f8ef8".
- Variables View:** Shows variables for "barry-ds5-training" across Core, CP15, and VFP sections.
- Memory View:** Shows memory dump starting at address 0xc07f8ef8, with the first few lines:

```
0xC07FDE8 0x5D322324 0x3A4D5020 0x64644120 0x20676E69 0x6F666E69 0x726F6620 0x206F4E20 0x3A737542 0xA0316266 0xB3E353C  
0xC07FE010 0x20202020 0x39382E30 0x39373532 0x4953205D 0x4F534652 0x42462D43 0x616C203A 0x31726579 0x67657220 0x65747369
```
- Disassembly View:** Shows assembly code for the CPU_V7M section, including instructions like mov pc, wfi, and mcr p15.
- Registers View:** Shows registers for the Cortex-A9 core, with the value 32576 highlighted.
- Output Window:** Displays kernel printk messages, with the last few lines circled in red:

```
429] PM: Adding info for No Bus:fbl<5>[ 0.892579] SIRFSOC-FB: layer1 register <7>[ 0.896571] PM: Adding info for No Bus:fb2<5>[ 0.896729] SIRFSOC-FB: layer2 registered! <6>[ 0.900497] SIRFSOC-FB: set layer0 as top layer <7>[ 0.905049] PM: Removing info for No Bus:input2 <4>[ 0.905309] ts351x: probe of 0-00ze failed with error -1 <7>[ 0.910723] PM: Adding info for No Bus:uinput<6>[ 0.910819] SIRFSOC-FB: set top layer's color key as 0x100010 <7>[ 0.916501] PM: Adding info for No Bus:alarm <7>[ 0.943481] PM: Adding info for No Bus:rtc0.<7>[ 0.943706] PM: Adding info for platform:alarm <6>[ 0.943857] using rtc device, sirfsoc_rtc, for alarms <6>[ 0.945909] sirfsoc_rtc sirfsoc_rtc:0: rtc core: registered sirfsoc_rtc as rtc0 <6>[ 0.954648] i2c /dev entries driver <7>[ 0.957171] PM: Adding info for No Bus:i2c-0. <6>[ 0.957171]
```
- Bottom Status Bar:** Shows "Writable", "Insert", "52 : 23", and the GDBDebug session information.

GDB

GDB – compile with debug info

➤ -g

```
ASIA\bs14@shaunxand01:~/workspace/prima2-android/android/external/i2c-util$ git diff
diff --git a/Android.mk b/Android.mk
index 7e269c0..9153b8c 100644
--- a/Android.mk
+++ b/Android.mk
@@ -8,5 +8,7 @@ LOCAL_MODULE := i2c-util
 LOCAL_SRC_FILES += \
     i2c-util.c \
 
+LOCAL_CFLAGS:=-O2 -g
+
 include $(BUILD_EXECUTABLE)
```

➤ .../symbols/system/bin\$ file i2c-util

i2c-util: ELF 32-bit LSB executable, ARM, version 1 (SYSV), dynamically linked (uses shared libs), **not stripped**

GDB – ARM Native GDB

- Target

```
sh-4.2# gdb /system/bin/i2c-util
```

...

```
Reading symbols from /system/bin/i2c-util...done.
```

```
(gdb) r
```

```
Starting program: /system/bin/i2c-util
```

```
[ 1263.613036] init: untracked pid 1032 exited
```

```
BFD: /system/bin/linker: warning: sh_link not set for section `.ARM.exidx'
```

```
BFD: /system/bin/linker: warning: sh_link not set for section `.ARM.exidx'
```

```
warning: Unable to find dynamic linker breakpoint function.
```

```
GDB will be unable to debug shared library initializers
```

```
and track explicitly loaded dynamic code.
```

Program received signal SIGSEGV, Segmentation fault.

```
main (argc=1, argv=0xbea14a54) at external/i2c-util/i2c-util.c:131
```

```
131    external/i2c-util/i2c-util.c: No such file or directory.
```

```
    in external/i2c-util/i2c-util.c
```

```
(gdb) bt
```

```
#0 main (argc=1, argv=0xbea14a54) at external/i2c-util/i2c-util.c:131
```

- Known issues: can't recognize multi-threads.

GDB – gdbserver/gdb over ADB

➤ Target

```
sh-4.2# gdbserver :5039 /system/bin/i2c-util
Process /system/bin/i2c-util created; pid = 1059
Listening on port 5039
```

➤ Host

```
# adb forward tcp:5039 tcp:5039
prebuilt/linux-x86/toolchain/arm-eabi-4.4.3/bin/arm-eabi-gdb /mnt/server1/workspace/lianlab-android/android/out/target/product/lianlab-
armv7/symbols/system/bin/i2c-util

(gdb) target remote :5039
(gdb) set solib-absolute-prefix android/out/target/product/lianlab-armv7/symbols/
(gdb) set solib-search-path /mnt/server1/workspace/lianlab-android/android/out/target/product/lianlab-armv7/symbols/system/lib/
(gdb) c
Program received signal SIGSEGV, Segmentation fault.
main (argc=1, argv=0xbeeb3a74) at external/i2c-util/i2c-util.c:131
131      *p = 0;
(gdb) l
126      unsigned w_val;
127      unsigned char rw_val;
128
129      volatile unsigned int *p=0;
130
131      *p = 0;
132
133      if (argc < 5) {
134          printf("Usage:\n%s /dev/i2c-x start_addr reg_addr rw[0|1] [write_val]\n", argv[0]);
135          return 0;
```

GDB – attach one process

➤ Target

```
sh-4.2# ps  
PID USER      VSZ STAT COMMAND  
599 root      40256 S   /system/bin/mediaserver
```

```
sh-4.2# gdbserver :5039 --attach 599
```

```
Attached; pid = 599
```

```
Listening on port 5039
```

➤ Host

```
# adb forward tcp:5039 tcp:5039
```

```
prebuilt/linux-x86/toolchain/arm-eabi-4.4.3/bin/arm-eabi-gdb /mnt/server1/workspace/lianlab-android/android/out/target/product/lianlab-armv7/symbols/system/bin/mediaserver
```

```
(gdb) set solib-absolute-prefix /mnt/server1/workspace/lianlab-android/android/out/target/product/lianlab-armv7/symbols/
```

```
(gdb) set solib-search-path /mnt/server1/workspace/lianlab-android/android/out/target/product/lianlab-armv7/symbols/system/lib/
```

```
(gdb) target remote :5039
```

```
Remote debugging using :5039
```

```
...
```

```
Reading symbols from /mnt/server1/workspace/lianlab-android/android/out/target/product/lianlab-armv7/symbols/system/lib/libc.so...done.
```

```
Loaded symbols for /mnt/server1/workspace/lianlab-android/android/out/target/product/lianlab-armv7/symbols/system/lib/libc.so
```

```
...
```

```
_ioctl () at bionic/libc/arch-arm/syscalls/_ioctl.S:15
```

```
15      ldmfd  sp!, {r4, r7}
```

```
(gdb) info threads
```

```
[New Thread 617] ...
```

```
[New Thread 1019]
```

```
12 Thread 1019 _futex_syscall3 () at bionic/libc/arch-arm/bionic/atomics_arm.S:200 ...
```

```
* 1 Thread 599 _ioctl () at bionic/libc/arch-arm/syscalls/_ioctl.S:15
```

GDB – multi-threads

➤ Switch threads

```
(gdb) info threads
```

...

```
8 Thread 709 __ioctl () at bionic/libc/arch-arm/syscalls/__ioctl.S:15
7 Thread 627 __ioctl () at bionic/libc/arch-arm/syscalls/__ioctl.S:15
6 Thread 626 __futex_syscall3 () at bionic/libc/arch-arm/bionic/atomics_arm.S:200
* 5 Thread 623 __futex_syscall3 () at bionic/libc/arch-arm/bionic/atomics_arm.S:200
4 Thread 622 __futex_syscall3 () at bionic/libc/arch-arm/bionic/atomics_arm.S:200
```

```
(gdb) thread 8
```

```
[Switching to thread 8 (Thread 709)]#0 __ioctl () at bionic/libc/arch-arm/syscalls/__ioctl.S:15
```

```
15     ldmfd sp!, {r4, r7}
```

```
(gdb) info threads
```

...

```
9 Thread 710 __futex_syscall3 () at bionic/libc/arch-arm/bionic/atomics_arm.S:200
* 8 Thread 709 __ioctl () at bionic/libc/arch-arm/syscalls/__ioctl.S:15
7 Thread 627 __ioctl () at bionic/libc/arch-arm/syscalls/__ioctl.S:15
6 Thread 626 __futex_syscall3 () at bionic/libc/arch-arm/bionic/atomics_arm.S:200
5 Thread 623 __futex_syscall3 () at bionic/libc/arch-arm/bionic/atomics_arm.S:200
```

...

➤ Global mode

```
(gdb) set scheduler-locking off
```

➤ Single thread mode

```
(gdb) set scheduler-locking on
```

Core Dump

- sh-4.2# ulimit -c unlimited
- sh-4.2# /data/i2c-util /dev/i2c-0 0x10 1 0
Segmentation fault (core dumped)

```
[ sh-4.2# gdb -c core /data/i2c-util
[ GNU gdb (Linaro GDB) 7.3-2011.10
[ Copyright (C) 2011 Free Software Foundation, Inc.
[ License GPLv3+: GNU GPL version 3 or later <http://gnu.org/licenses/gpl.html>
[ This is free software: you are free to change and redistribute it.
[ There is NO WARRANTY, to the extent permitted by law. Type "show copying"
and "show warranty" for details.
[ This GDB was configured as "arm-none-linux-gnueabi".
[ For bug reporting instructions, please see:
<http://bugs.launchpad.net/gdb-linaro/>...
[ Reading symbols from /data/i2c-util...done.

[ warning: exec file is newer than core file.
[ [New LWP 1212]
[ BFD: /system/bin/linker: warning: sh_link not set for section `.'.ARM.exidx'
[ Core was generated by `/data/i2c-util /dev/i2c-0 0x10 1 0'.
[ Program terminated with signal 11, Segmentation fault.
[ #0  main (argc=5, argv=0xbbee58a54) at external/i2c-util/i2c-util.c:131
131      external/i2c-util/i2c-util.c: No such file or directory.
          in external/i2c-util/i2c-util.c
[ (gdb) bt
[ #0  main (argc=5, argv=0xbbee58a54) at external/i2c-util/i2c-util.c:131
[ ...
```

strace – trace the system call

```
sh-4.2# strace /system/bin/i2c-util
execve("/system/bin/i2c-util", ["/system/bin/i2c-util"], /* 25 vars */) = 0
...
stat64("/vendor/lib/libm.so", 0xbec7f6f8) = -1 ENOENT (No such file or directory)
stat64("/system/lib/libm.so", {st_mode=S_IFREG|0644, st_size=91328, ...}) = 0
open("/system/lib/libm.so", O_RDONLY|O_LARGEFILE) = 3
lseek(3, 0, SEEK_SET)          = 0
read(3, "\177ELF\1\1\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\000"..., 4096) = 4096
...
mmap2(NULL, 4096, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x40127000
mprotect(0x40127000, 4096, PROT_READ) = 0
--- SIGSEGV (Segmentation fault) @ 0 (0) ---

...
read(3, 0xbec7f724, 1)        = ? ERESTARTSYS (To be restarted)
--- SIGCONT (Continue) @ 0 (0) ---
read(3, "", 1)                = 0
close(3)                      = 0
sigaction(SIGSEGV, {SIG_IGN}, {0xb0005a91, [], SA_RESTART}, 0) = 0
sigreturn()                    = ? (mask now [QUIT TRAP FPE SEGV PIPE CHLD CONT])
--- SIGSEGV (Segmentation fault) @ 0 (0) ---
+++ killed by SIGSEGV +++
```

Memory usage and leak check

/proc/meminfo, vmstat

```
sh-4.2# cat /proc/meminfo
MemTotal:        402932 kB
MemFree:         179064 kB
Buffers:          3464 kB
Cached:          113412 kB
SwapCached:       0 kB
Active:          87160 kB
Inactive:        102080 kB
Active(anon):    72392 kB
Inactive(anon):   320 kB
Active(file):    14768 kB
Inactive(file):  101760 kB
Unevictable:      0 kB
Mlocked:          0 kB
SwapTotal:        0 kB
SwapFree:         0 kB
Dirty:             4 kB
Writeback:        0 kB
AnonPages:       72384 kB
Mapped:          53792 kB
Shmem:            352 kB
Slab:             8412 kB
SReclaimable:    3712 kB
SUnreclaim:      4700 kB
KernelStack:     2560 kB
PageTables:      6800 kB
NFS_Unstable:     0 kB
Bounce:           0 kB
WritebackTmp:     0 kB
CommitLimit:     201464 kB
Committed_AS:   1068032 kB
VmallocTotal:    495616 kB
VmallocUsed:     68784 kB
VmallocChunk:   420868 kB
```

```
sh-4.2# cat /proc/vmstat
nr_free_pages 44586
nr_inactive_anon 80
nr_active_anon 18131
nr_inactive_file 25541
nr_active_file 3730
nr_unevictable 0
nr_mlock 0
nr_anon_pages 18129
nr_mapped 13448
nr_file_pages 29358
nr_dirty 0
nr_writeback 0
nr_slab_reclaimable 939
nr_slab_unreclaimable 1174
nr_page_table_pages 1700
nr_kernel_stack 320
nr_unstable 0
nr_bounce 0
nr_vmscan_write 0
nr_writeback_temp 0
nr_isolated_anon 0
nr_isolated_file 0
nr_shmem 88
nr_dirtied 7341
nr_written 5992
nr_anon_transparent_hugepages 0
nr_dirty_threshold 14771
nr_dirty_background_threshold 3692
pgpgin 98138
pgpgout 26727
pswpin 0
pswpout 0
pgalloc_dma 88365
pgalloc_normal 55440
pgalloc_movable 0
pgfree 190675
pgactivate 3862
pgdeactivate 0
pgfault 217262
pgmajfault 726
pgrefill_dma 0
pgrefill_normal 0
pgrefill_movable 0
pgsteal_dma 0
pgsteal_normal 0
pgsteal_movable 0
pgscan_kswapd_dma 0
pgscan_kswapd_normal 0
pgscan_kswapd_movable 0
pgscan_direct_dma 0
pgscan_direct_normal 0
pgscan_direct_movable 0
pginodesteal 0
```

/proc/slabinfo

#	name	<active_objs>	<num_objs>	<objsize>	<objperslab>	<pagesperslab>	<tunables>	<limit>	<batchcount>	<sharedfactor>	: slabdata <act
	img-mmmap	221	312	48	78	1	tunables 120 60	0 : slabdata	4	4	0
	img-mm	310	468	48	78	1	tunables 120 60	0 : slabdata	6	6	0
	ext4_groupinfo_4k	8	37	104	37	1	tunables 120 60	0 : slabdata	1	1	0
	ext4_groupinfo_1k	64	80	96	40	1	tunables 120 60	0 : slabdata	2	2	0
	jbd2_1b	0	0	1024	4	1	tunables 54 27	0 : slabdata	0	0	0
	fan_receivers	0	0	40	92	1	tunables 120 60	0 : slabdata	0	0	0
	nf_conntrack_expect	0	0	160	24	1	tunables 120 60	0 : slabdata	0	0	0
	nf_conntrack_c08ce8a4	0	0	240	16	1	tunables 120 60	0 : slabdata	0	0	0
	dm_crypt_io	0	0	104	37	1	tunables 120 60	0 : slabdata	0	0	0
	xcopyd_job	0	0	304	13	1	tunables 54 27	0 : slabdata	0	0	0
	io	0	0	32	113	1	tunables 120 60	0 : slabdata	0	0	0
	dm_uevent	0	0	2464	3	2	tunables 24 12	0 : slabdata	0	0	0
	dm_rq_clone_bio_info	0	0	8	339	1	tunables 120 60	0 : slabdata	0	0	0
	dm_rq_target_io	0	0	248	16	1	tunables 120 60	0 : slabdata	0	0	0
	dm_target_io	0	0	16	203	1	tunables 120 60	0 : slabdata	0	0	0
	dm_io	0	0	24	145	1	tunables 120 60	0 : slabdata	0	0	0
	sd_ext_cdb	2	113	32	113	1	tunables 120 60	0 : slabdata	1	1	0
	cfq_io_context	71	118	64	59	1	tunables 120 60	0 : slabdata	2	2	0
	cfq_queue	71	72	160	24	1	tunables 120 60	0 : slabdata	3	3	0
	enqueue_inode_cache	1	8	480	8	1	tunables 54 27	0 : slabdata	1	1	0
	afs_direct_cache	0	0	72	53	1	tunables 120 60	0 : slabdata	0	0	0
	nfs_write_data	36	36	448	9	1	tunables 54 27	0 : slabdata	4	4	0
	nfs_read_data	32	36	416	9	1	tunables 54 27	0 : slabdata	4	4	0
	nfs_inode_cache	0	0	552	7	1	tunables 54 27	0 : slabdata	0	0	0
	nfs_page	0	0	64	59	1	tunables 120 60	0 : slabdata	0	0	0
	fat_inode_cache	18	22	360	11	1	tunables 54 27	0 : slabdata	2	2	0
	fat_cache	1	145	24	145	1	tunables 120 60	0 : slabdata	1	1	0
	jbd2_inode	97	145	24	145	1	tunables 120 60	0 : slabdata	1	1	0
	jbd2_journal_handle	16	145	24	145	1	tunables 120 60	0 : slabdata	1	1	0
	jbd2_journal_head	21	59	64	59	1	tunables 120 60	0 : slabdata	1	1	0
	jbd2_revocate_table	6	203	16	203	1	tunables 120 60	0 : slabdata	1	1	0
	jbd2_revoke_record	0	0	32	113	1	tunables 120 60	0 : slabdata	0	0	0
	ext4_inode_cache	959	959	536	7	1	tunables 54 27	0 : slabdata	137	137	0
	ext4_xattr	0	0	56	67	1	tunables 120 60	0 : slabdata	0	0	0
	ext4_free_data	0	0	40	92	1	tunables 120 60	0 : slabdata	0	0	0
	ext4_allocation_context	0	0	112	35	1	tunables 120 60	0 : slabdata	0	0	0
	ext4_prealloc_space	3	59	64	59	1	tunables 120 60	0 : slabdata	1	1	0
	ext4_system_zone	0	0	32	113	1	tunables 120 60	0 : slabdata	0	0	0
	ext4_io_end	0	0	576	7	1	tunables 54 27	0 : slabdata	0	0	0
	ext4_io_page	0	0	8	339	1	tunables 120 60	0 : slabdata	0	0	0
	kioctx	0	0	192	20	1	tunables 120 60	0 : slabdata	0	0	0
	kiocb	0	0	128	30	1	tunables 120 60	0 : slabdata	0	0	0
	inotify_event_private_data	0	0	16	203	1	tunables 120 60	0 : slabdata	0	0	0
	inotify_inode_mark	8	53	72	53	1	tunables 120 60	0 : slabdata	1	1	0
	fasync_cache	0	0	24	145	1	tunables 120 60	0 : slabdata	0	0	0
	ksm_mm_slot	0	0	24	145	1	tunables 120 60	0 : slabdata	0	0	0
	ksm_stable_node	0	0	24	145	1	tunables 120 60	0 : slabdata	0	0	0
	ksm_rmap_item	0	0	32	113	1	tunables 120 60	0 : slabdata	0	0	0
	ashmem_range_cache	7	113	32	113	1	tunables 120 60	0 : slabdata	1	1	0
	ashmem_area_cache	36	39	288	13	1	tunables 54 27	0 : slabdata	3	3	0
	asproxy	0	0	24	145	1	tunables 120 60	0 : slabdata	0	0	0
	posix_timers_cache	0	0	128	30	1	tunables 120 60	0 : slabdata	0	0	0
	uid_cache	21	59	64	59	1	tunables 120 60	0 : slabdata	1	1	0
	rpc_buffers	8	8	2048	2	1	tunables 24 12	0 : slabdata	4	4	0

/proc/pid/maps

```
sh-4.2# cat /proc/590/maps
00008000-0000a000 r-xp 00000000 b3:03 149      /system/bin/rild
0000a000-0000b000 rw-p 00002000 b3:03 149      /system/bin/rild
0000b000-0000e000 rw-p 00000000 00:00 0          [heap]
10000000-10001000 ---p 00000000 00:00 0
10001000-10100000 rw-p 00000000 00:00 0
400c5000-400cd000 r--s 00000000 00:0d 1633     /dev/_properties_(deleted)
400ce000-400cf000 r--p 00000000 00:00 0
400df000-400e0000 ---p 00000000 00:00 0
400e0000-401df000 rw-p 00000000 00:00 0
402aa000-403a8000 r--p 00000000 00:0d 1511     /dev/binder
a2c00000-a2c07000 r-xp 00000000 b3:03 305      /system/lib/libsirfsoc-ril.so
a2c07000-a2c08000 rw-p 00007000 b3:03 305      /system/lib/libsirfsoc-ril.so
a2c08000-a2c0c000 rw-p 00000000 00:00 0
a7e00000-a7e04000 r-xp 00000000 b3:03 491      /system/lib/libhardware_legacy.so
a7e04000-a7e05000 rw-p 00004000 b3:03 491      /system/lib/libhardware_legacy.so
a8100000-a8127000 r-xp 00000000 b3:03 479      /system/lib/libutils.so
a8127000-a8128000 rw-p 00027000 b3:03 479      /system/lib/libutils.so
a8200000-a821e000 r-xp 00000000 b3:03 485      /system/lib/libbinder.so
a821e000-a8224000 rw-p 0001e000 b3:03 485      /system/lib/libbinder.so
ae300000-ae304000 r-xp 00000000 b3:03 222      /system/lib/libnetutils.so
ae304000-ae305000 rw-p 00004000 b3:03 222      /system/lib/libnetutils.so
ae400000-ae402000 r-xp 00000000 b3:03 252      /system/lib/libwpa_client.so
ae402000-ae403000 rw-p 00002000 b3:03 252      /system/lib/libwpa_client.so
ae600000-ae607000 r-xp 00000000 b3:03 297      /system/lib/libril.so
ae607000-ae608000 rw-p 00007000 b3:03 297      /system/lib/libril.so
af700000-af714000 r-xp 00000000 b3:03 484      /system/lib/libz.so
af714000-af715000 rw-p 00014000 b3:03 484      /system/lib/libz.so
af900000-af90e000 r-xp 00000000 b3:03 224      /system/lib/libcutils.so
af90e000-af90f000 rw-p 0000e000 b3:03 224      /system/lib/libcutils.so
af90f000-af91e000 rw-p 00000000 00:00 0
afa00000-afa03000 r-xp 00000000 b3:03 285      /system/lib/liblog.so
afa03000-afa04000 rw-p 00003000 b3:03 285      /system/lib/liblog.so
afb00000-afb16000 r-xp 00000000 b3:03 286      /system/lib/libm.so
afb16000-afb17000 rw-p 00016000 b3:03 286      /system/lib/libm.so
afc00000-afc01000 r-xp 00000000 b3:03 301      /system/lib/libstdc++.so
afc01000-afc02000 rw-p 00001000 b3:03 301      /system/lib/libstdc++.so
afd00000-afd40000 r-xp 00000000 b3:03 493      /system/lib/libc.so
afd40000-afd43000 rw-p 00040000 b3:03 493      /system/lib/libc.so
afd43000-afd4e000 rw-p 00000000 00:00 0
b0001000-b0009000 r-xp 00001000 b3:03 112      /system/bin/linker
b0009000-b000a000 rw-p 00009000 b3:03 112      /system/bin/linker
b000a000-b0019000 rw-p 00000000 00:00 0
beb64000-beb85000 rw-p 00000000 00:00 0          [stack]
ffff0000-ffff1000 r-xp 00000000 00:00 0          [vectors]
```

free

```
sh-4.2# free
              total        used        free      shared  buffers  cached
Mem:       402924       209476      193448          0       4844    97796
-/+ buffers/cached:      106836      296088
Swap:          0          0          0
```

```
busybox: update free command to include page cache
eg.
sh-4.2$ free
              total        used        free      shared  buffers  cached
Mem:       402924       49232      353692          0       668    32160
-/+ buffers/cached:      16404      386520
Swap:          0          0          0
Change-Id: 1c9de9f8cd0051da8fd61ae8238a1d2573587223b
Signed-off-by: Barry Song <Baohua.Song@csr.com>

diff --git a/procps/free.c b/procps/free.c
index efbac5b..6abf1e8 100644
--- a/procps/free.c
+++ b/procps/free.c
@@ -29,11 +29,35 @@ static unsigned long long scale(unsigned long d)
        return ((unsigned long long)d * G.mem_unit) >> G_unit_steps;
 }

+static unsigned long get_cache_from_meminfo(void)
+{
+#define LINE_LEN 256
+    FILE *fp;
+    char str[LINE_LEN];
+    unsigned long long cached;
+    if((fp = fopen("/proc/meminfo", "rt")) == NULL) {
+        printf("Cantnot open /proc/meminfo");
+        exit(1);
+    }
+    while(1) {
+        fgets(str, LINE_LEN, fp);
+        if (!strncmp(str, "Cached:", strlen("Cached:")))
+            break;
+    }
+    cached = atoi(str + strlen("Cached:"));
+    fclose(fp);
+
+    return cached;
+}
```

showslab

```
COM1 - PuTTY
sh-4.2# showslab
Active / Total Objects (% used) : 51907 / 54853 (94.6%)
Active / Total Slabs (% used)   : 1818 / 1818 (100.0%)
Active / Total Caches (% used) : 82 / 158 (51.9%)
Active / Total Size (% used)   : 7157.48K / 7347.57K (97.4%)
Min / Avg / Max Object Size   : 0.01K / 0.13K / 4096.00K

OBJS ACTIVE USE OBJ SIZE SLABS OBJ/SLAB CACHE SIZE NAME
7797 7125 91% 0.03K 69 113 276K size-32
7020 6986 99% 0.05K 90 78 360K sysfs_dir_cache
6030 6030 100% 0.12K 201 30 804K dentry
5016 5016 100% 0.09K 114 44 456K vm_area_struct
4779 4755 99% 0.06K 81 59 324K buffer_head
4350 4310 99% 0.02K 30 145 120K anon_vma_chain
3341 3335 99% 0.30K 257 13 1028K inode_cache
2436 2374 97% 0.02K 12 203 48K anon_vma
1888 1888 100% 0.06K 32 59 128K size-64
1320 1257 95% 0.09K 33 40 132K size-96
1200 1140 95% 0.12K 40 30 160K filp
1068 1064 99% 0.32K 89 12 356K proc_inode_cache
931 931 100% 0.52K 133 7 532K ext4_inode_cache
858 858 100% 0.29K 66 13 264K radix_tree_node
560 554 98% 0.50K 70 8 280K size-512
sh-4.2#
```

showmap

# showmap 657								
virtual			shared	shared	private	private		
size	RSS	PSS	clean	dirty	clean	dirty	#	object
32	16	0	0	16	0	0	1	/dev/_properties_ (deleted)
36	28	5	24	0	0	4	2	/system/bin/linker
312	220	49	176	0	0	44	3	/system/lib/libc.so
92	12	4	8	0	0	4	2	/system/lib/libm.so
8	8	4	4	0	0	4	2	/system/lib/libstdc++.so
32	32	32	0	0	28	4	2	/usr/bin/gpsmc
64	16	16	0	0	0	16	2	[anon]
12	12	12	0	0	0	12	1	[heap]
1160	20	20	0	0	0	20	3	[stack]
4	4	4	0	0	0	4	1	[vectors]
virtual			shared	shared	private	private		
size	RSS	PSS	clean	dirty	clean	dirty	#	object
1752	368	146	212	16	28	112	19	TOTAL

procmem

sh-4.2# procmem 586

Vss	Rss	Pss	Uss	ShCl	ShDi	PrCl	PrDi	Name
error getting usage for map.								
56K	56K	56K	56K	OK	OK	56K	OK	/system/bin/vold
4K	4K	4K	4K	OK	OK	4K	OK	/system/bin/vold
24K	24K	24K	24K	OK	OK	24K	OK	[heap]
OK	OK	OK	OK	OK	OK	OK	OK	[heap]
4K	4K	4K	4K	OK	OK	4K	OK	[heap]
16K	16K	OK	OK	OK	16K	OK	OK	/dev/_properties_
4K	4K	4K	4K	OK	OK	4K	OK	/dev/_properties_
8K	8K	8K	8K	OK	OK	8K	OK	/dev/_properties_
OK	OK	OK	OK	OK	OK	OK	OK	/dev/_properties_
12K	12K	12K	12K	OK	OK	12K	OK	/dev/_properties_
4K	4K	4K	4K	OK	OK	4K	OK	/system/lib/libdiskconfig.so
4K	4K	4K	4K	OK	OK	4K	OK	/system/lib/libdiskconfig.so
16K	16K	8K	OK	16K	OK	OK	OK	/system/lib/libsysutils.so
4K	4K	4K	4K	OK	OK	4K	OK	/system/lib/libsysutils.so
136K	136K	27K	OK	136K	OK	OK	OK	/system/lib/libcrypto.so
16K	16K	12K	12K	4K	OK	12K	OK	/system/lib/libcrypto.so
OK	OK	OK	OK	OK	OK	OK	OK	/system/lib/libcrypto.so
8K	8K	OK	OK	8K	OK	OK	OK	/system/lib/libz.so
4K	4K	4K	4K	OK	OK	4K	OK	/system/lib/libz.so
20K	20K	1K	OK	20K	OK	OK	OK	/system/lib/libcutils.so
4K	4K	4K	4K	OK	OK	4K	OK	/system/lib/libcutils.so
OK	OK	OK	OK	OK	OK	OK	OK	/system/lib/libcutils.so
12K	12K	OK	OK	12K	OK	OK	OK	/system/lib/liblog.so
4K	4K	4K	4K	OK	OK	4K	OK	/system/lib/liblog.so
8K	8K	OK	OK	8K	OK	OK	OK	/system/lib/libm.so
4K	4K	4K	4K	OK	OK	4K	OK	/system/lib/libm.so
4K	4K	OK	OK	4K	OK	OK	OK	/system/lib/libstdc++.so
4K	4K	4K	4K	OK	OK	4K	OK	/system/lib/libstdc++.so
160K	160K	8K	4K	156K	OK	4K	OK	/system/lib/libc.so
12K	12K	8K	8K	4K	OK	8K	OK	/system/lib/libc.so
12K	12K	12K	12K	OK	OK	12K	OK	/system/lib/libc.so
24K	24K	1K	OK	24K	OK	OK	OK	/system/bin/linker
4K	4K	4K	4K	OK	OK	4K	OK	/system/bin/linker
16K	16K	16K	16K	OK	OK	16K	OK	/system/bin/linker
8K	8K	8K	8K	OK	OK	8K	OK	[stack]

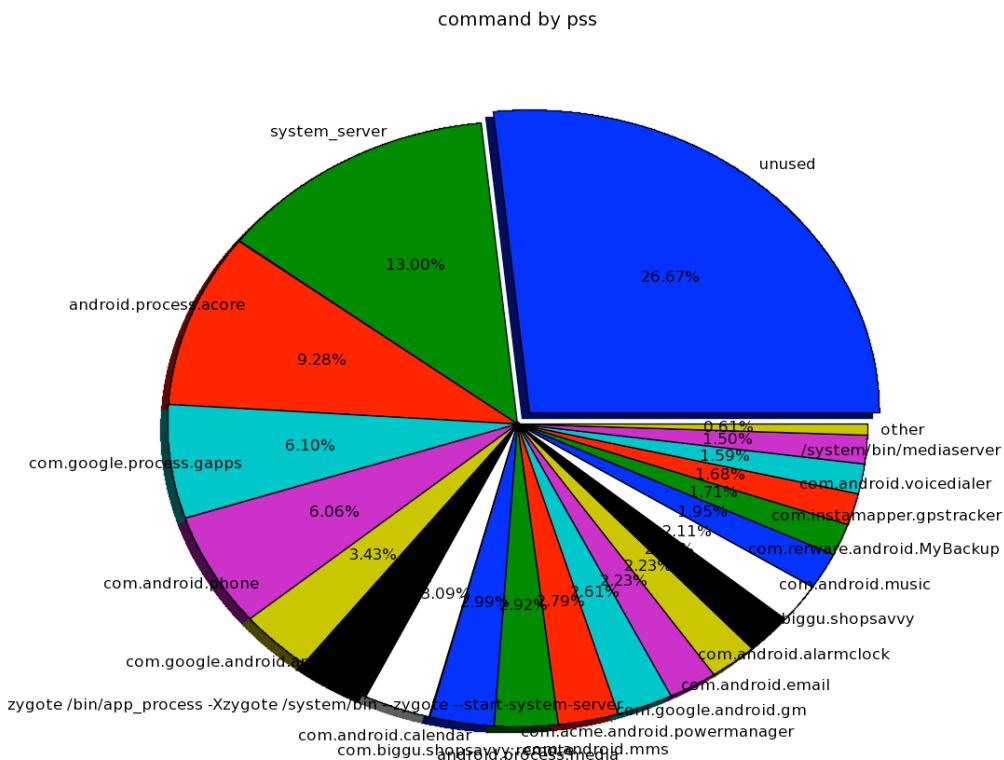
procrank

```
# procrank
  PID      Vss      Rss      Pss      Uss cmdline
  670    53300K   53276K   32149K   26776K system_server
  862    27024K   27000K   10006K   7128K com.android.launcher
  592    11372K   11372K   9191K   8064K /system/bin/mediaserver
  591    26772K   26708K   7793K   4588K zygote
  830    22624K   22580K   7260K   5776K android.process.acore
 1086    21468K   21440K   5926K   4472K com.android.settings
1017    20004K   19964K   5871K   4696K com.skype.rover
  881    20756K   20724K   5613K   4532K com.android.phone
  776    21908K   21892K   5604K   3456K com.android.systemui
  913    18652K   18616K   4504K   3628K android.process.media
  772    19248K   19236K   4461K   3440K com.android.inputmethod.latin
  950    18336K   18296K   4159K   3248K com.android.email
  975    18248K   18208K   3804K   2796K com.android.mms
 1036    17736K   17696K   3729K   2816K com.cooliris.media
  927    17116K   17072K   3345K   2588K com.android.providers.calendar
  963    16748K   16708K   3086K   2348K com.android.bluetooth
 1027    16320K   16280K   3065K   2276K com.android.quicksearchbox
  939    16680K   16640K   2966K   2200K com.android.deskclock
 1006    16376K   16336K   2922K   2084K com.pplive.androidphone
 1058    15636K   15596K   2708K   1912K com.android.music
  903    15164K   15120K   2320K   1580K com.csr.dvd
 1048    15192K   15152K   2271K   1508K com.android.protips
  629    3724K    1664K   1416K   1400K /usr/bin/gpsexec
  600    1160K    1160K    644K    308K /bin/sh
  597    1044K    1044K    528K    192K /bin/sh
 1104     680K    676K    482K    476K procrank
  654     640K    640K    381K    284K ash
  593     580K    576K    346K    320K /system/bin/dbus-daemon
  609     632K    632K    344K    232K /system/bin/linux_license_manager
  590     684K    684K    261K    208K /system/bin/rild
  586     616K    616K    253K    208K /system/bin/vold
  587     560K    560K    205K    160K /system/bin/netd
  601     176K    176K    164K    164K /sbin/adbd
  657     364K    364K    143K    136K /usr/bin/gpsmc
     1     184K    184K    130K    92K /init
  595     436K    432K    127K    92K /system/bin/keystore
  575     152K    152K    114K    76K /sbin/ueventd
  594     344K    340K    104K    96K /system/bin/installld
  588     272K    268K     82K    76K /system/bin/buggerd
  585     260K    256K     82K    76K /system/bin/servicemanager
  596     284K    280K     79K    72K /system/bin/logwrapper
  -----
  138655K  106580K  TOTAL
```

RAM: 402984K total, 140328K free, 7492K buffers, 140068K cached, 344K shmem, 8864K slab

smem – process memory

```
$ ./smemcap >memdata.tar  
$ adb pull /data/smem/memdata.tar .  
smem -S memdata.tar  
smem -S memdata.tar --pie=command
```



smem – the users of libraries

smem -S memdata.tar -m -M lib -s pids

Map	PIDs	AVGPSS	PSS
/lib/libcsrcert.so	1	12	12
/lib/libpthread-2.13.so	1	56	56
/system/lib/dejitter.so	1	8	8
/system/lib/gst/libGSTPlayerImpFactory.s	1	52	52
/system/lib/gst/libavcodec.so.52.72.2	1	104	104
/system/lib/gst/libavformat.so.52.64.2	1	40	40
/system/lib/gst/libavutil.so.50.15.1	1	16	16
/system/lib/gst/libglib-2.0.so.0.2400.1	1	440	440
/system/lib/gst/libgmodule-2.0.so.0.2400	1	20	20
/system/lib/gst/libgobject-2.0.so.0.2400	1	272	272
/system/lib/gst/libgstaudio-0.10.so.0.22	1	104	104
/system/lib/gst/libgstbase-0.10.so.0.27.	1	232	232
/system/lib/gst/libgstinterfaces-0.10.so	1	32	32
/system/lib/gst/libgstpbutils-0.10.so.0.	1	36	36
/system/lib/gst/libgststreamer-0.10.so.0.2	1	892	892
/system/lib/gst/libgsttriff-0.10.so.0.22.	1	12	12
/system/lib/gst/libgsttag-0.10.so.0.22.0	1	64	64
/system/lib/gst/libgstvideo-0.10.so.0.22	1	12	12
/system/lib/gst/libgthread-2.0.so.0.2400	1	20	20
/system/lib/gst/libogg.so.0.7.0	1	28	28
/system/lib/gst/libomx_core.so	1	148	148
/system/lib/gst/plugins/libgstaudioconve	1	56	56

smem –multi-processes using one library

smem -S memdata.tar -M libc

PID	User	Command	Swap	USS	PSS	RSS
567	1000	/system/bin/servicemanager	0	12	15	152
570	0	/system/bin/debuggerd	0	12	15	156
578	0	/system/bin/logwrapper /sys	0	12	16	172
640	0	/usr/bin/gpsmc	0	12	17	188
613	0	/usr/bin/gpsexec -triglite -	0	12	18	196
575	1002	/system/bin/dbus-daemon --s	0	16	19	160
1430	10006	android.process.media	0	8	20	404
1511	10004	com.csr.dvd	0	8	20	404
1522	10008	com.android.providers.calen	0	8	20	404
1536	10012	com.android.bluetooth	0	8	20	404
1544	10030	com.android.deskclock	0	8	20	404
1559	10032	com.pplive.androidphone	0	8	20	400
1578	10013	com.android.protips	0	8	20	404
1587	10016	com.android.music	0	8	20	404
1595	10029	com.android.quicksearchbox	0	8	20	404
572	0	/system/bin/rild	0	16	21	208
576	0	/system/bin/installld	0	16	21	196
1391	10005	com.android.inputmethod.pin	0	8	21	412
1396	10009	com.android.launcher	0	8	21	412

valgrind - memory leak detection

Push to /data/local/valgrind

```
# export VALGRIND_LIB=/data/local/valgrind/lib/valgrind
```

Run:

```
# /data/local/valgrind/bin/valgrind /system/bin/i2c-util
```

```
sh-4.2# ./valgrind /system/bin/i2c-util
==1139== Memcheck, a memory error detector
==1139== Copyright (C) 2002-2011, and GNU GPL'd, by Julian Seward et al.
==1139== Using Valgrind-3.7.0 and LibVEX; rerun with -h for copyright info
==1139== Command: /system/bin/i2c-util
==1139==
==1139== Invalid write of size 4
==1139==   at 0x8840: main (i2c-util.c:131)
==1139==   Address 0x0 is not stack'd, malloc'd or (recently) free'd
==1139==
==1139==
==1139== HEAP SUMMARY:
==1139==   in use at exit: 0 bytes in 0 blocks
==1139==   total heap usage: 0 allocs, 0 frees, 0 bytes allocated
==1139==
==1139== All heap blocks were freed -- no leaks are possible
==1139==
==1139== For counts of detected and suppressed errors, rerun with: -v
==1139== ERROR SUMMARY: 1 errors from 1 contexts (suppressed: 0 from 0)
```

valgrind - memory check

- Illegal read / Illegal write errors
- Use of uninitialised values
- Use of uninitialised or unaddressable values in system calls
- Illegal frees
- When a heap block is freed with an inappropriate deallocation function
- Overlapping source and destination blocks
- Memory leak detection

valgrind - issues

```
main()
{
{
    int x;
    printf ("x = %d\n", x);
}
{
    char* arr  = malloc(10);
    int* arr2 = malloc(sizeof(int));
    write( 1 /* stdout */, arr, 10 );
}
{
    char a[100];
    memcpy(a, a + 20, 40);
}
{
    char *q;
    q = malloc(1024*1024);

    q[1] = 1024;
}
{
    char *p;
    p = malloc(1024*1024);

    p[0] = p[0];
    p[1] = 1024;

    free(p);
    free(p);
}
}
```

valgrind - reports

```
/data/local/valgrind/bin/valgrind --leak-check=full --track-origins=yes /data/check
```

```
==995== Uninitialised value was created by a stack allocation
==995==    at 0x83D8: main (check.c:2)
==995==
==995== Use of uninitialised value of size 4
==995==    at 0x801048C8: memchr (mc_replace_strmem.c:743)
==995==    by 0xAFD19313: __sfvwrite (in /system/lib/libc.so)
==995== Uninitialised value was created by a stack allocation
==995==    at 0x83D8: main (check.c:2)
==995==
==995== Conditional jump or move depends on uninitialised value(s)
==995==    at 0x801048D0: memchr (mc_replace_strmem.c:743)
==995==    by 0xAFD19313: __sfvwrite (in /system/lib/libc.so)
==995== Uninitialised value was created by a stack allocation
==995==    at 0x83D8: main (check.c:2)
==995==
==995== Syscall param write(buf) points to uninitialised byte(s)
==995==    at 0xAFDB47C: write (in /system/lib/libc.so)
==995== Address 0x480902d is 5 bytes inside a block of size 4,096 alloc'd
==995==    at 0x80103318: malloc (vg_replace_malloc.c:263)
==995==    by 0xAFD195ED: __smakebuf (in /system/lib/libc.so)
==995== Uninitialised value was created by a stack allocation
==995==    at 0x83D8: main (check.c:2)
==995==
X = -1107445340
==995== Source and destination overlap in memcpy(0xbdfdb908, 0xbdfdb91c, 40)
==995==    at 0x80106A64: memcpy (mc_replace_strmem.c:838)
==995==    by 0x843B: main (check.c:14)
==995==
==995== Invalid free() / delete / delete[] / realloc()
==995==    at 0x80102E1C: free (vg_replace_malloc.c:427)
==995==    by 0x849B: main (check.c:30)
==995== Address 0x490a100 is 0 bytes inside a block of size 1,048,576 free'd
==995==    at 0x80102E1C: free (vg_replace_malloc.c:427)
==995==    by 0x8493: main (check.c:29)
==995==
==995==
==995== HEAP SUMMARY:
==995==     in use at exit: 1,052,686 bytes in 4 blocks
==995==     total heap usage: 5 allocs, 2 frees, 2,101,262 bytes allocated
==995==
==995== 4 bytes in 1 blocks are definitely lost in loss record 1 of 4
==995==    at 0x80103318: malloc (vg_replace_malloc.c:263)
==995==    by 0x8407: main (check.c:9)
==995==
==995== 10 bytes in 1 blocks are definitely lost in loss record 2 of 4
==995==    at 0x80103318: malloc (vg_replace_malloc.c:263)
==995==    by 0x83F7: main (check.c:8)
==995==
==995== 1,048,576 bytes in 1 blocks are definitely lost in loss record 4 of 4
==995==    at 0x80103318: malloc (vg_replace_malloc.c:263)
==995==    by 0x8443: main (check.c:18)
==995==
==995== LEAK SUMMARY:
==995==    definitely lost: 1,048,590 bytes in 3 blocks
==995==    indirectly lost: 0 bytes in 0 blocks
```

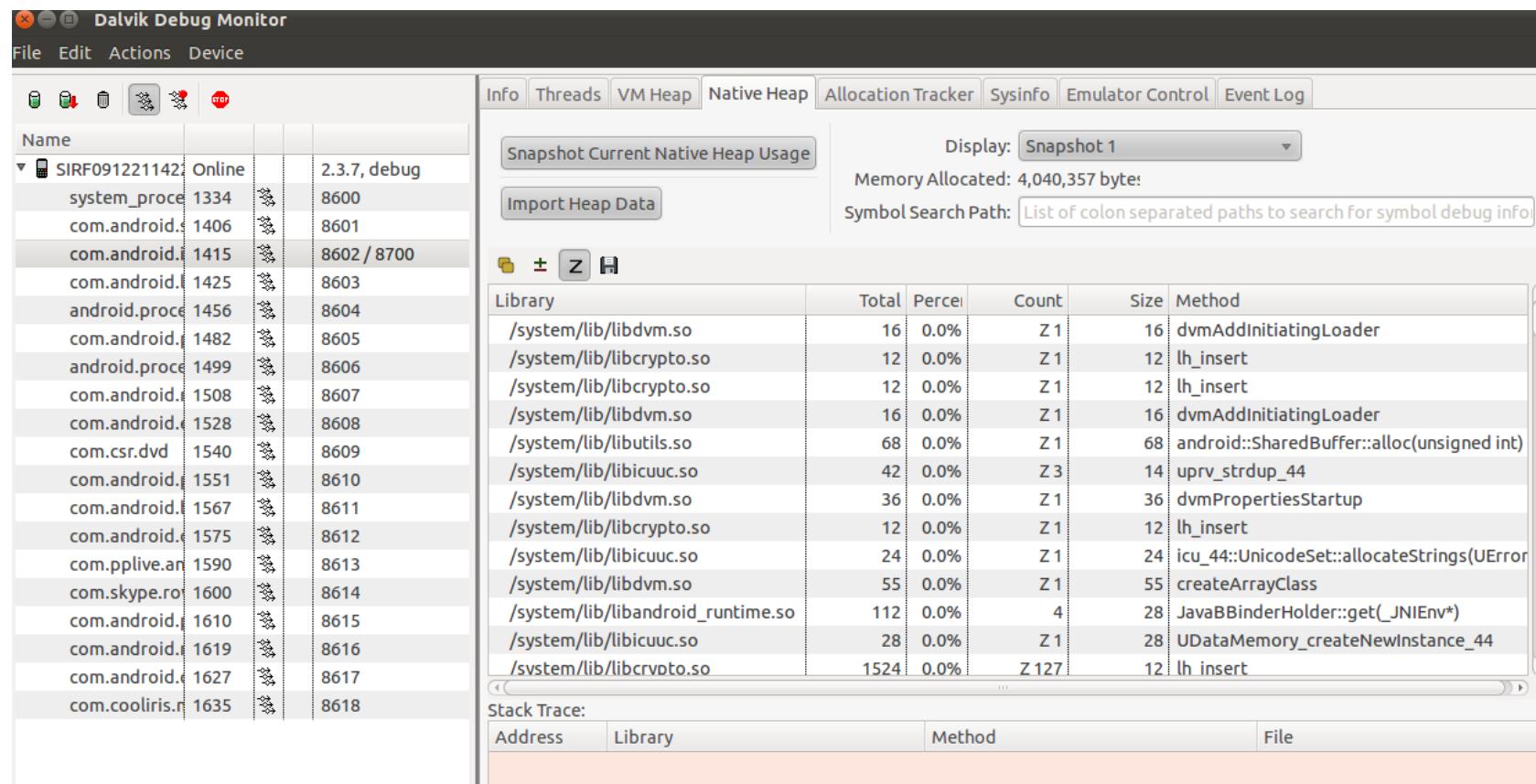
valgrind on Android

To start an application (eg Firefox), a message is sent via a socket to the Zygote. This creates a child with fork(), and the child then goes on to load the relevant bytecode and (presumably) native code and “becomes” Firefox. So there’s no exec() boundary for Valgrind to enter at.

the AOSP folks modified Zygote so that it can start selected processes under the control of a **user-specified wrapper**, which is precisely the hook we need.

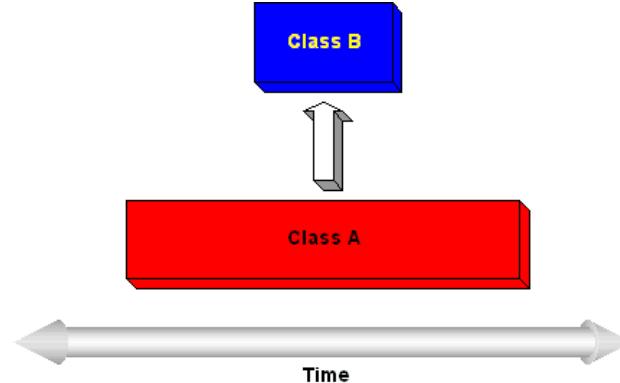
Android JNI native memory leak

```
add "native=true" in ~/.android/ ddms.cfg  
adb shell setprop libc.debug.malloc 1  
adb shell stop  
adb shell start  
export ANDROID_PRODUCT_OUT=/mnt/server1/workspace/lianlab-android/android/  
out/target/product/lianlab-armv7
```

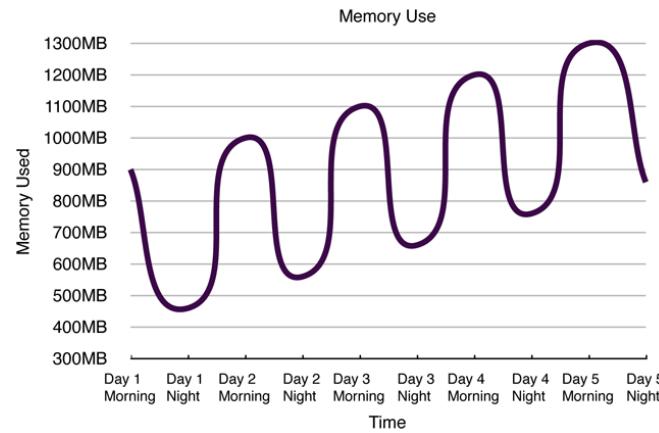


Java memory leak

- Java is that they no longer have to worry about allocating and freeing memory
- Unused but still referenced -> memory leak



- Memory leak diagram



- hprof : heap dump

Minor utilities

logcat

➤ Logcat usage

Usage: logcat [options] [filterspecs]

options include:

-s Set default filter to silent.

Like specifying filterspec '*:s'

-f <filename> Log to file. Default to stdout

-r [<kbytes>] Rotate log every kbytes. (16 if unspecified). Requires -f

-n <count> Sets max number of rotated logs to <count>, default 4

-v <format> Sets the log print format, where <format> is one of:

brief process tag thread raw time threadtime long

-c clear (flush) the entire log and exit

-d dump the log and then exit (don't block)

-t <count> print only the most recent <count> lines (implies -d)

-g get the size of the log's ring buffer and exit

-b <buffer> request alternate ring buffer

('main' (default), 'radio', 'events')

-B output the log in binary

logwrapper

- Init will redirect service stdin, stdout, stderr to /dev/null
- Logwrapper will read all printf/perror and call LOG(LOG_INFO, tag, "%s", &buffer[a]);
dup2(child_ptty, 1);
dup2(child_ptty, 2);
- Examples:

```
service license-manager /system/bin/logwrapper /system/bin/linux_license_manager  
oneshot
```

Log in CPP

```
/*
 * Simplified macro to send a verbose log message using the current LOG_TAG.
 */

#ifndef LOGV
#if LOG_NDEBUG
#define LOGV(...) ((void)0)
#else
#define LOGV(...) ((void)LOG(LOG_VERBOSE, LOG_TAG, __VA_ARGS__))
#endif
#endif

#ifndef LOGV_IF
#if LOG_NDEBUG
#define LOGV_IF(cond, ...) ((void)0)
#else
#define LOGV_IF(cond, ...) \
( (CONDITION(cond)) \  
 ? ((void)LOG(LOG_VERBOSE, LOG_TAG, __VA_ARGS__)) \  
 : (void)0 )
#endif
#endif
```

webkit/WebCore/platform/brew/CursorBrew.cpp:#define LOG_TAG "WebCore"

webkit/WebCore/platform/android/CursorAndroid.cpp:#define LOG_TAG "WebCore"

Log in JAVA

DownloaderActivity.java: private final static String LOG_TAG = "Downloader";

quake/src/com/android/quake/DownloaderActivity.java: Log.i(LOG_TAG, "Versions match, no need to download.");
quake/src/com/android/quake/DownloaderActivity.java: Log.e(LOG_TAG, "Unable to read local config file", e);
quake/src/com/android/quake/DownloaderActivity.java: Log.i(LOG_TAG, "Download succeeded");
quake/src/com/android/quake/DownloaderActivity.java: Log.e(LOG_TAG, "Download stopped: " + reason);
quake/src/com/android/quake/DownloaderActivity.java: Log.i(LOG_TAG, "Network connectivity issue, retrying.");
quake/src/com/android/quake/DownloaderActivity.java: Log.i(LOG_TAG, "Couldn't find local config.");
quake/src/com/android/quake/DownloaderActivity.java: Log.i(LOG_TAG, "Local version out of sync. Wanted " +
quake/src/com/android/quake/DownloaderActivity.java: Log.i(LOG_TAG, "Creating directory " + mDataPath);

I2C testing utility (using i2c-dev driver)

- Read/write registers in I2C client at userspace

```
/system/bin/i2c-util /dev/i2c-2 0x11 0x22 0  
/system/bin/i2c-rw /dev/i2c-2 0x11 0x22 1 0xff
```

SPI testing utility (using spidev driver)

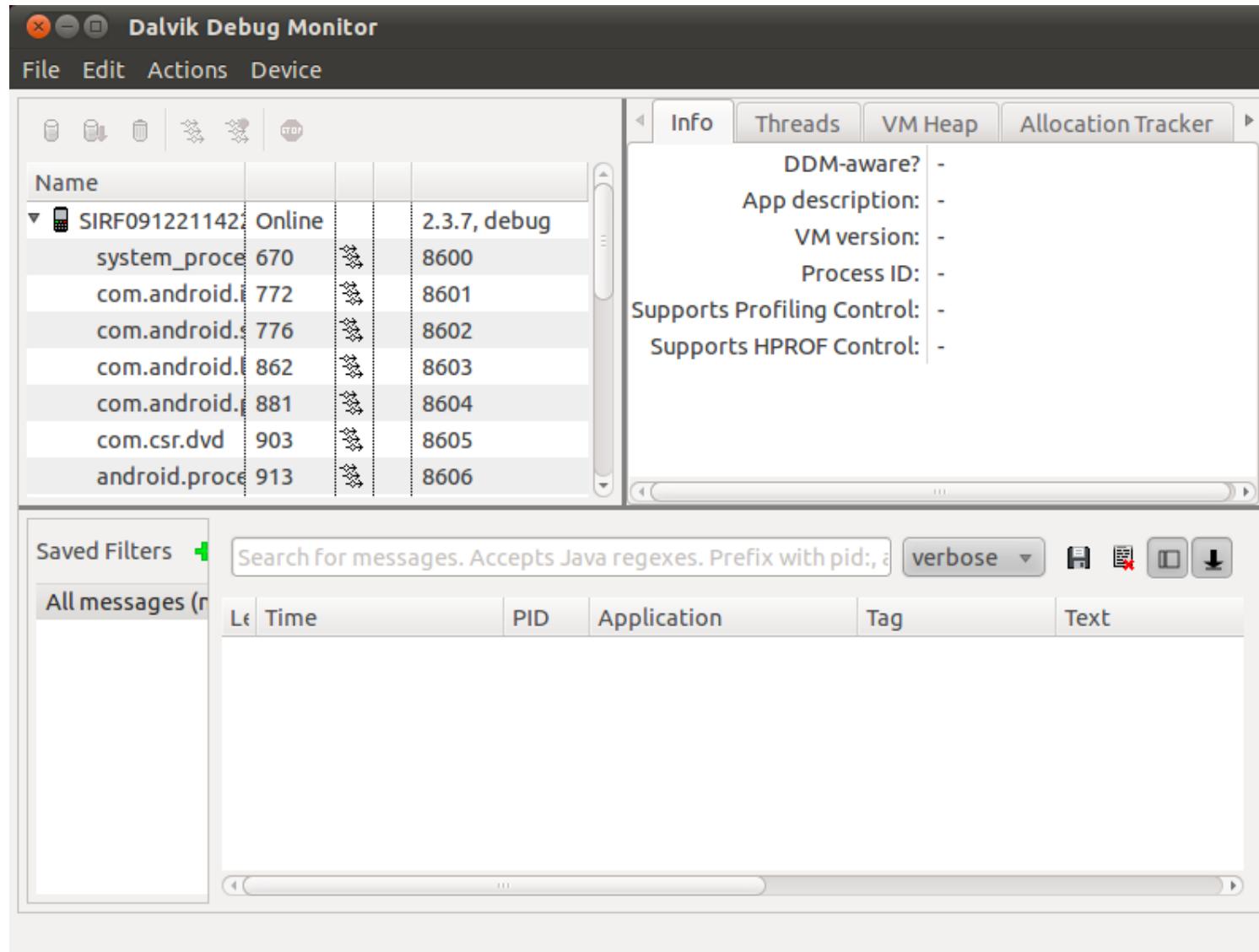
➤ Documentation/spi/spidev_test.c

```
int main(int argc, char *argv[])
{
    fd = open(device, O_RDWR);
    ...

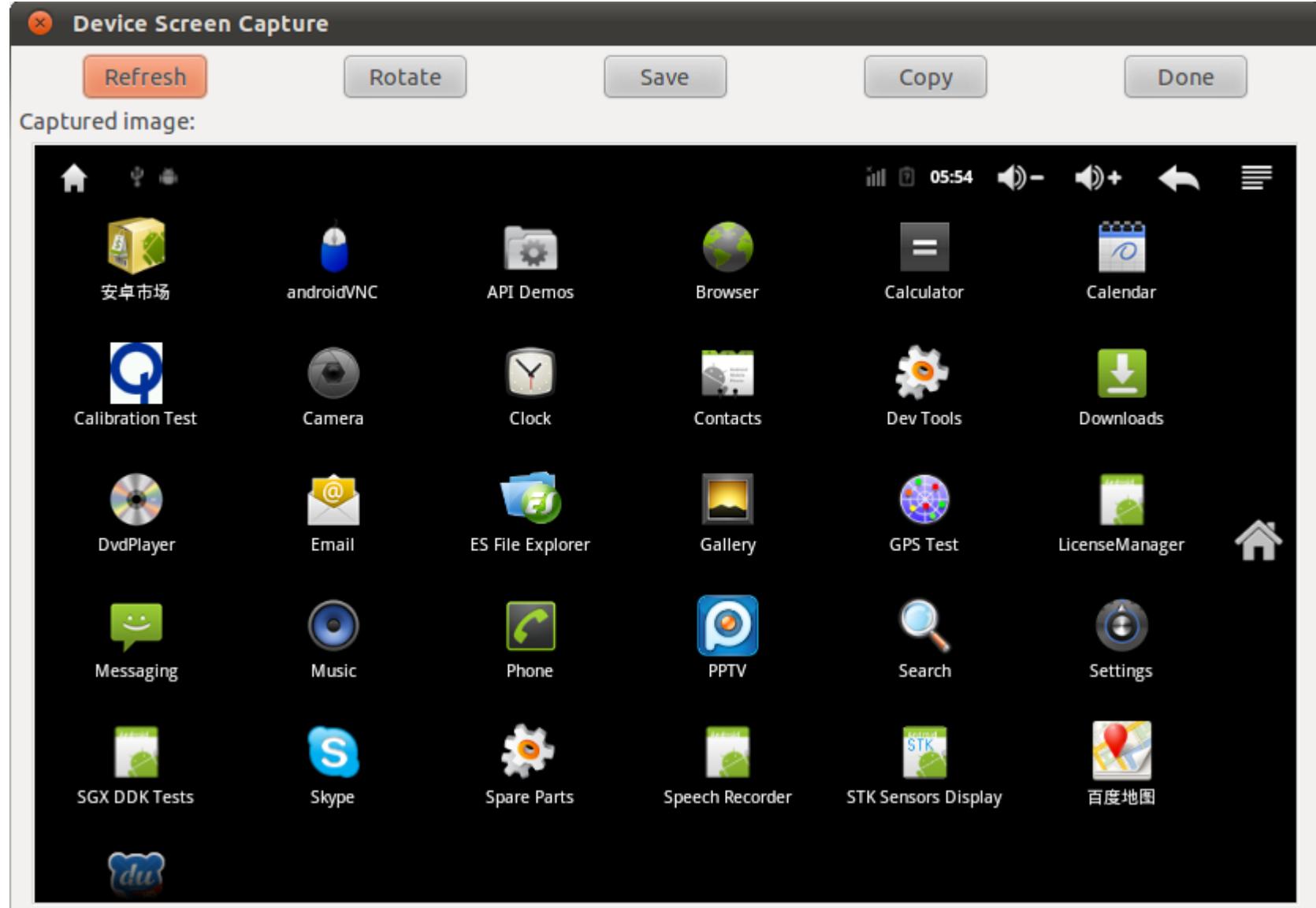
    ret = ioctl(fd, SPI_IOC_WR_MODE, &mode);
    ret = ioctl(fd, SPI_IOC_RD_MODE, &mode);
    ret = ioctl(fd, SPI_IOC_WR_BITS_PER_WORD, &bits);
    ret = ioctl(fd, SPI_IOC_RD_BITS_PER_WORD, &bits);
    ret = ioctl(fd, SPI_IOC_WR_MAX_SPEED_HZ, &speed);
    ret = ioctl(fd, SPI_IOC_RD_MAX_SPEED_HZ, &speed);
    transfer(fd);
}
```

Android DDMS

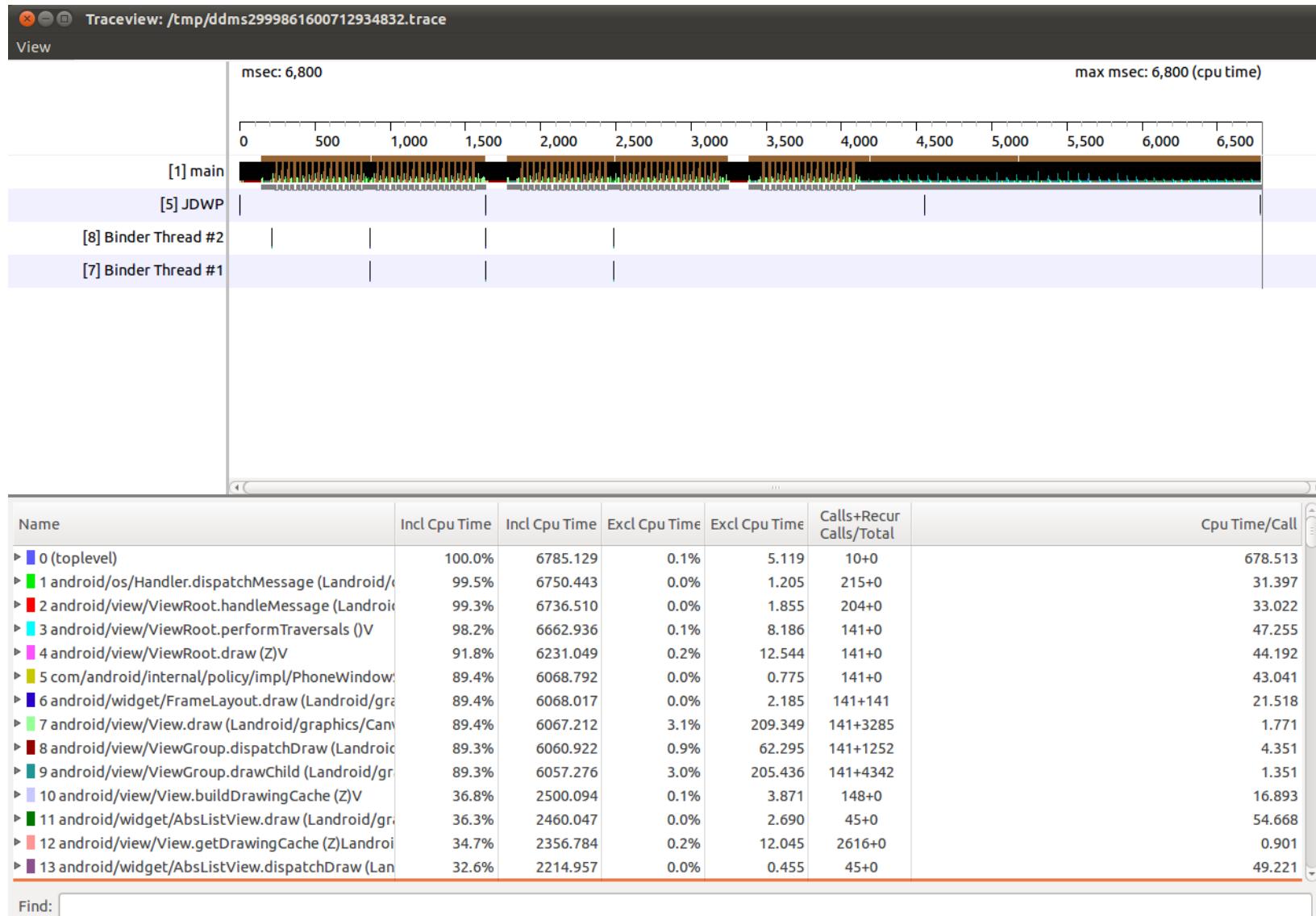
DDMS - Dalvik Debug Monitor Service



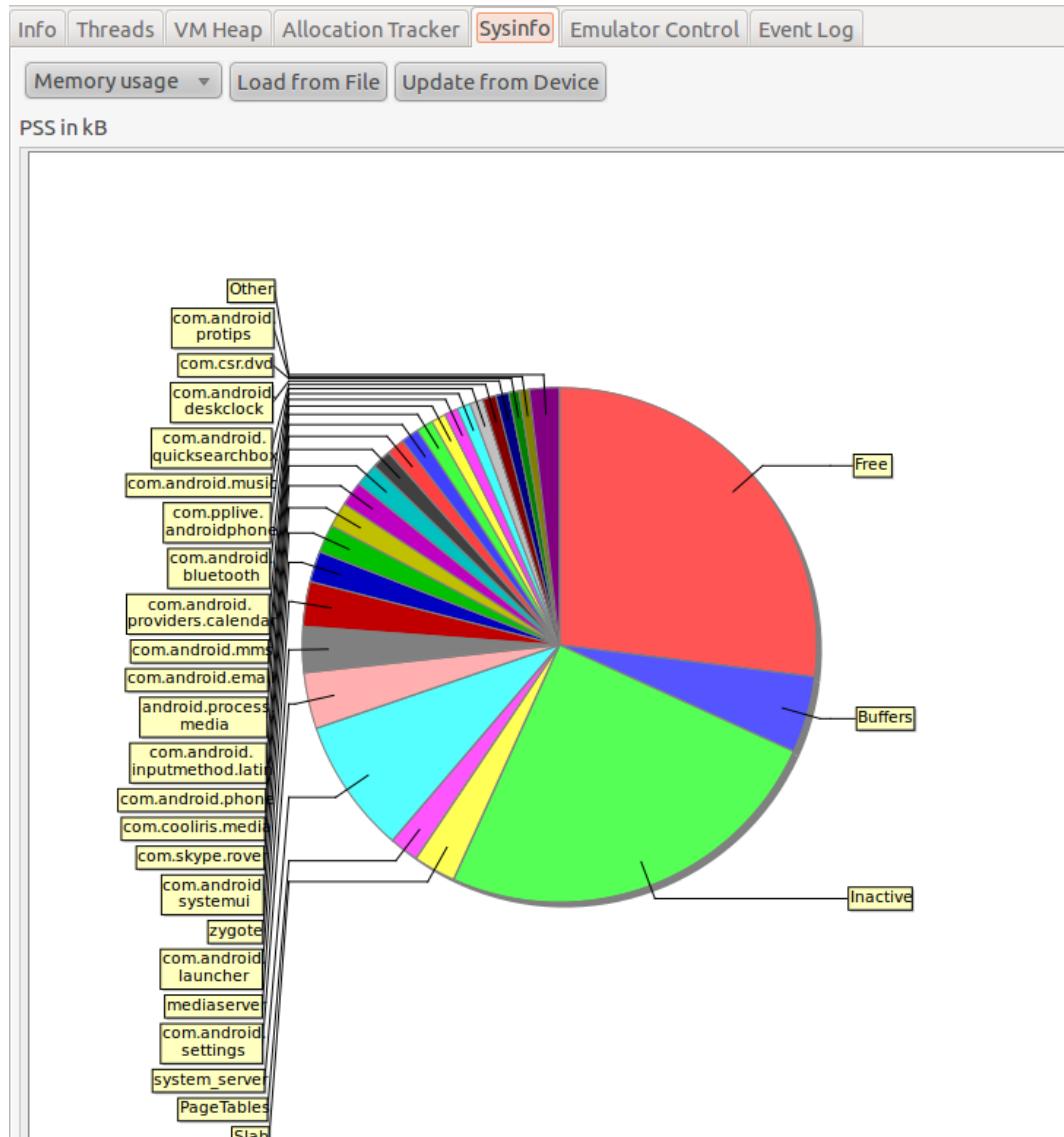
DDMS – Capture Framebuffer



DDMS – traceview



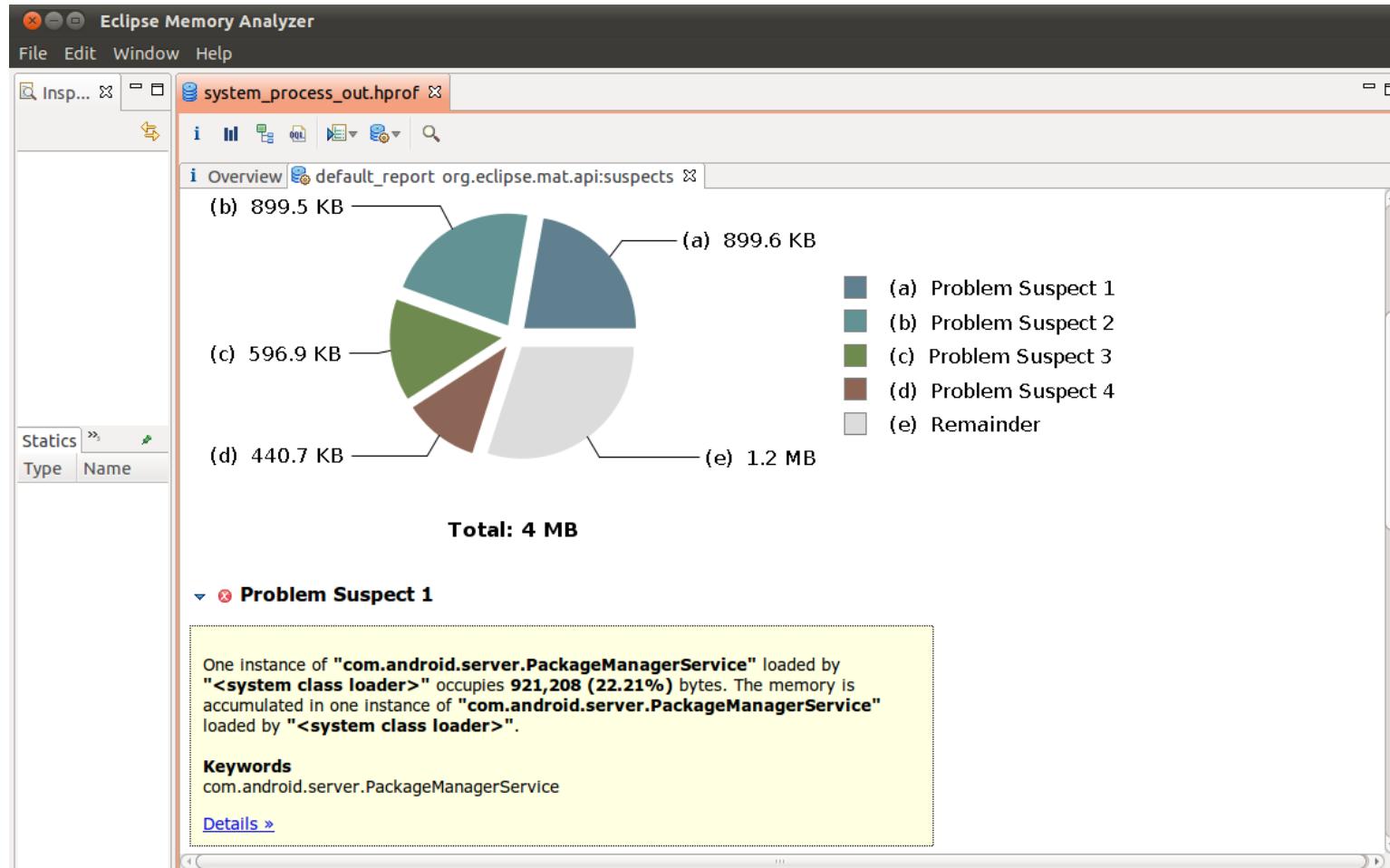
DDMS – sysinfo



DDMS-hprof

➤ vmuser@ubuntu:/data/android-sdk-linux/tools\$./hprof-conv system_process.hprof system_process_out.hprof

Refer to: <http://wenku.baidu.com/view/bf788a02b52acfc789ebc9c4.html>



Performance profiling

top

User 0%, System 0%, IOW 0%, IRQ 0%

User 2 + Nice 0 + Sys 3 + Idle 297 + IOW 1 + IRQ 0 + SIRQ 0 = 303

PID	CPU%	S	#THR	VSS	RSS	PCY	UID	Name
1017	1%	R	1	964K	376K	fg	root	top
615	0%	S	11	16076K	1796K	fg	root	/usr/bin/gpsexec
574	0%	S	10	39756K	7576K	fg	root	/system/bin/mediaserver
555	0%	S	1	0K	0K	fg	root	jbd2/mmcblk0p2-
584	0%	S	10	14756K	2356K	fg	root	/system/bin/ synergy_service
6	0%	S	1	0K	0K	fg	root	khelper
13	0%	S	1	0K	0K	fg	root	suspend
14	0%	S	1	0K	0K	fg	root	kworker/0:1
198	0%	S	1	0K	0K	fg	root	sync_supers
200	0%	S	1	0K	0K	fg	root	bdi-default

iostat - storage input and output statistics

```
sh-4.2# iostat -c -d -t -k 1
Linux 2.6.38.8-sirf (localhost)          01/00/00      _armv7l_      (1 CPU)

01/03/70 08:44:27
avg-cpu: %user  %nice %system %iowait  %steal  %idle
          1.55    0.09    0.93    1.69    0.00   95.74

Device:     tps   kB_read/s   kB_wrtn/s   kB_read   kB_wrtn
mmcblk0    2.40     78.68     12.17   95686    14805
mmcblk0p1   0.00     0.00     0.00       4        0
mmcblk0p2   0.64     5.56     0.83    6760     1004
mmcblk0p3   0.85    38.57     0.05   46911      56
mmcblk0p5   0.86    30.95    11.30   37641   13744
mmcblk0p7   0.00     0.00     0.00       4        0
mmcblk0p8   0.05     3.57     0.00   4346      1

01/03/70 08:44:28
avg-cpu: %user  %nice %system %iowait  %steal  %idle
          0.00    0.00    2.97    0.00    0.00   97.03

Device:     tps   kB_read/s   kB_wrtn/s   kB_read   kB_wrtn
mmcblk0    0.99     0.00     70.30       0       71
mmcblk0p1   0.00     0.00     0.00       0        0
mmcblk0p2   0.99     0.00     70.30       0       71
mmcblk0p3   0.00     0.00     0.00       0        0
mmcblk0p5   0.00     0.00     0.00       0        0
mmcblk0p7   0.00     0.00     0.00       0        0
mmcblk0p8   0.00     0.00     0.00       0        0

01/03/70 08:44:29
avg-cpu: %user  %nice %system %iowait  %steal  %idle
          0.00    0.00    2.00    8.00    0.00   90.00

Device:     tps   kB_read/s   kB_wrtn/s   kB_read   kB_wrtn
mmcblk0    2.00     0.00     11.00       0       11
mmcblk0p1   0.00     0.00     0.00       0        0
mmcblk0p2   2.00     0.00     11.00       0       11
mmcblk0p3   0.00     0.00     0.00       0        0
mmcblk0p5   0.00     0.00     0.00       0        0
mmcblk0p7   0.00     0.00     0.00       0        0
mmcblk0p8   0.00     0.00     0.00       0        0
```

vmstat - memory, processes, interrupts, paging

# vmstat														
procs	memory	system						cpu						
		r	b	free	mapped	anon	slab	in	cs	flt	us	ni	sy	id
0	0	194296	55644	70424	8016	261	340	0	0	0	1	99	0	0
0	0	194296	55648	70428	8016	279	352	0	0	0	0	99	0	0
0	0	194296	55648	70428	8016	269	350	0	0	0	1	99	0	0
0	0	194296	55648	70428	8016	267	339	0	0	0	0	99	0	0
0	0	194296	55648	70428	8016	278	360	0	0	0	0	99	1	0
0	0	194296	55648	70428	8016	270	351	0	1	0	1	98	0	0
0	0	194296	55648	70428	8016	268	337	0	0	0	1	99	0	0
0	0	194296	55648	70428	8016	274	361	0	2	0	0	98	0	0
1	0	194296	55648	70428	8016	266	373	0	0	0	1	99	0	0
0	0	194296	55648	70428	8016	271	386	0	3	0	0	98	0	0
0	0	194296	55648	70428	8016	268	380	0	1	0	1	98	0	0
0	0	194296	55648	70428	8016	279	402	0	2	0	0	97	1	0
0	0	194296	55648	70428	8016	268	375	0	0	0	0	99	0	0
0	0	194296	55648	70428	8016	267	346	0	0	0	1	99	0	0
0	0	194296	55648	70428	8016	269	356	0	0	0	0	99	0	0
0	0	194296	55648	70428	8016	266	356	0	0	0	1	99	0	0
0	0	194296	55648	70428	8016	278	387	0	0	0	2	98	1	0
0	0	194296	55648	70428	8016	275	377	0	0	0	1	99	0	0
0	0	194296	55648	70428	8016	264	359	0	0	0	0	99	0	0
0	0	194296	55648	70428	8016	269	377	0	0	0	0	99	0	0
procs														
memory	system						cpu							
	r	b	free	mapped	anon	slab	in	cs	flt	us	ni	sy	id	wa
1	0	194176	55652	70568	8016	1270	3161	0	18	0	7	76	0	0
0	0	196396	52908	70684	8016	1266	3347	0	34	0	6	60	0	0
0	0	196336	52908	70684	8020	279	393	0	1	0	1	97	1	0
0	0	196336	52908	70684	8020	266	369	0	0	0	1	99	0	0
1	0	193936	52916	73512	8012	376	961	0	24	0	1	75	1	0
1	0	193936	52916	73528	8016	463	1487	0	86	0	14	0	0	0
0	0	195076	52916	72176	8016	390	896	0	35	0	8	57	0	0
1	0	193876	52916	73568	8016	481	1403	0	92	0	6	2	0	0
0	0	195016	52916	72204	8012	405	917	0	47	0	4	48	1	0
0	0	195076	52916	72136	8012	269	357	0	2	0	1	98	0	0
0	0	195076	52916	72136	8012	266	381	0	0	0	1	99	0	0

netstat – socket communication status

Active UNIX domain sockets (w/o servers)					
Proto	RefCnt	Flags	Type	State	I-Node Path
unix	3	[]	STREAM	CONNECTED	3096 @jdwpx-control
unix	3	[]	STREAM	CONNECTED	3094
unix	3	[]	STREAM	CONNECTED	3076 @jdwpx-control
unix	3	[]	STREAM	CONNECTED	3074
unix	3	[]	STREAM	CONNECTED	3054 @jdwpx-control
unix	3	[]	STREAM	CONNECTED	3052
unix	3	[]	STREAM	CONNECTED	3035 @jdwpx-control
unix	3	[]	STREAM	CONNECTED	3033
unix	3	[]	STREAM	CONNECTED	3010 @jdwpx-control
unix	3	[]	STREAM	CONNECTED	3008
unix	3	[]	STREAM	CONNECTED	2978 @jdwpx-control
unix	3	[]	STREAM	CONNECTED	2976
unix	3	[]	STREAM	CONNECTED	2955 @jdwpx-control
unix	3	[]	STREAM	CONNECTED	2953
unix	3	[]	STREAM	CONNECTED	2928 @jdwpx-control
unix	3	[]	STREAM	CONNECTED	2926
unix	3	[]	STREAM	CONNECTED	2908 @jdwpx-control
unix	3	[]	STREAM	CONNECTED	2906
unix	3	[]	STREAM	CONNECTED	2869 @jdwpx-control
unix	3	[]	STREAM	CONNECTED	2867
unix	3	[]	STREAM	CONNECTED	2831 @jdwpx-control
unix	3	[]	STREAM	CONNECTED	2829
unix	3	[]	STREAM	CONNECTED	2631 @jdwpx-control
unix	3	[]	STREAM	CONNECTED	2629
unix	3	[]	STREAM	CONNECTED	2615 @jdwpx-control
unix	3	[]	STREAM	CONNECTED	2613
unix	3	[]	STREAM	CONNECTED	2565 /dev/socket/rild
unix	3	[]	STREAM	CONNECTED	2564
unix	3	[]	STREAM	CONNECTED	2543 @jdwpx-control
unix	3	[]	STREAM	CONNECTED	2541
unix	3	[]	STREAM	CONNECTED	2478 @jdwpx-control
unix	3	[]	STREAM	CONNECTED	2476
unix	3	[]	STREAM	CONNECTED	2425 @jdwpx-control
unix	3	[]	STREAM	CONNECTED	2423
unix	3	[]	STREAM	CONNECTED	2419 @jdwpx-control
unix	3	[]	STREAM	CONNECTED	2417
unix	3	[]	STREAM	CONNECTED	2401 @jdwpx-control
unix	3	[]	STREAM	CONNECTED	2399
unix	3	[]	STREAM	CONNECTED	2397 /dev/socket/zygote

mpstat – show multi-core CPUs

```
barry@lianlab:~$ mpstat -P ALLLinux 2.6.32-39-server (lianlab)
```

04/12/2012		_x86_64_		(16 CPU)		01:54:06 PM		CPU	%usr	
%nice	%sys	%iowait	%irq	%soft	%steal	%guest	%idle	01:54:06 PM	all	
1.49	0.00	0.16	0.08	0.00	0.01	0.00	0.00	98.27	01:54:06 PM	0
1.98	0.00	0.23	0.49	0.00	0.03	0.00	0.00	97.27	01:54:06 PM	1
2.05	0.00	0.28	0.48	0.00	0.02	0.00	0.00	97.17	01:54:06 PM	2
1.79	0.00	0.27	0.03	0.00	0.00	0.00	0.00	97.91	01:54:06 PM	3
1.93	0.00	0.29	0.03	0.00	0.00	0.00	0.00	97.74	01:54:06 PM	4
1.44	0.00	0.15	0.02	0.00	0.00	0.00	0.00	98.40	01:54:06 PM	5
1.38	0.00	0.15	0.02	0.00	0.00	0.00	0.00	98.45	01:54:06 PM	6
1.34	0.00	0.13	0.01	0.00	0.00	0.00	0.00	98.52	01:54:06 PM	7
1.52	0.00	0.16	0.01	0.00	0.00	0.00	0.00	98.30	01:54:06 PM	8
1.28	0.00	0.12	0.04	0.00	0.01	0.00	0.00	98.55	01:54:06 PM	9
1.34	0.00	0.13	0.04	0.00	0.00	0.00	0.00	98.49	01:54:06 PM	10
1.37	0.00	0.14	0.02	0.00	0.00	0.00	0.00	98.47	01:54:06 PM	11
1.38	0.00	0.13	0.02	0.00	0.00	0.00	0.00	98.46	01:54:06 PM	12
1.31	0.00	0.13	0.01	0.00	0.00	0.00	0.00	98.55	01:54:06 PM	13
1.20	0.00	0.11	0.01	0.00	0.00	0.00	0.00	98.67	01:54:06 PM	14
1.17	0.00	0.10	0.01	0.00	0.00	0.00	0.00	98.72	01:54:06 PM	15
1.29	0.00	0.12	0.01	0.00	0.00	0.00	0.00	98.58		

time – measures the runtime of a

- – Three figures provided
 - real
 - user
 - sys

Benchmark tools

- lmbench

Microbenchmark for operating system functions

- iozone

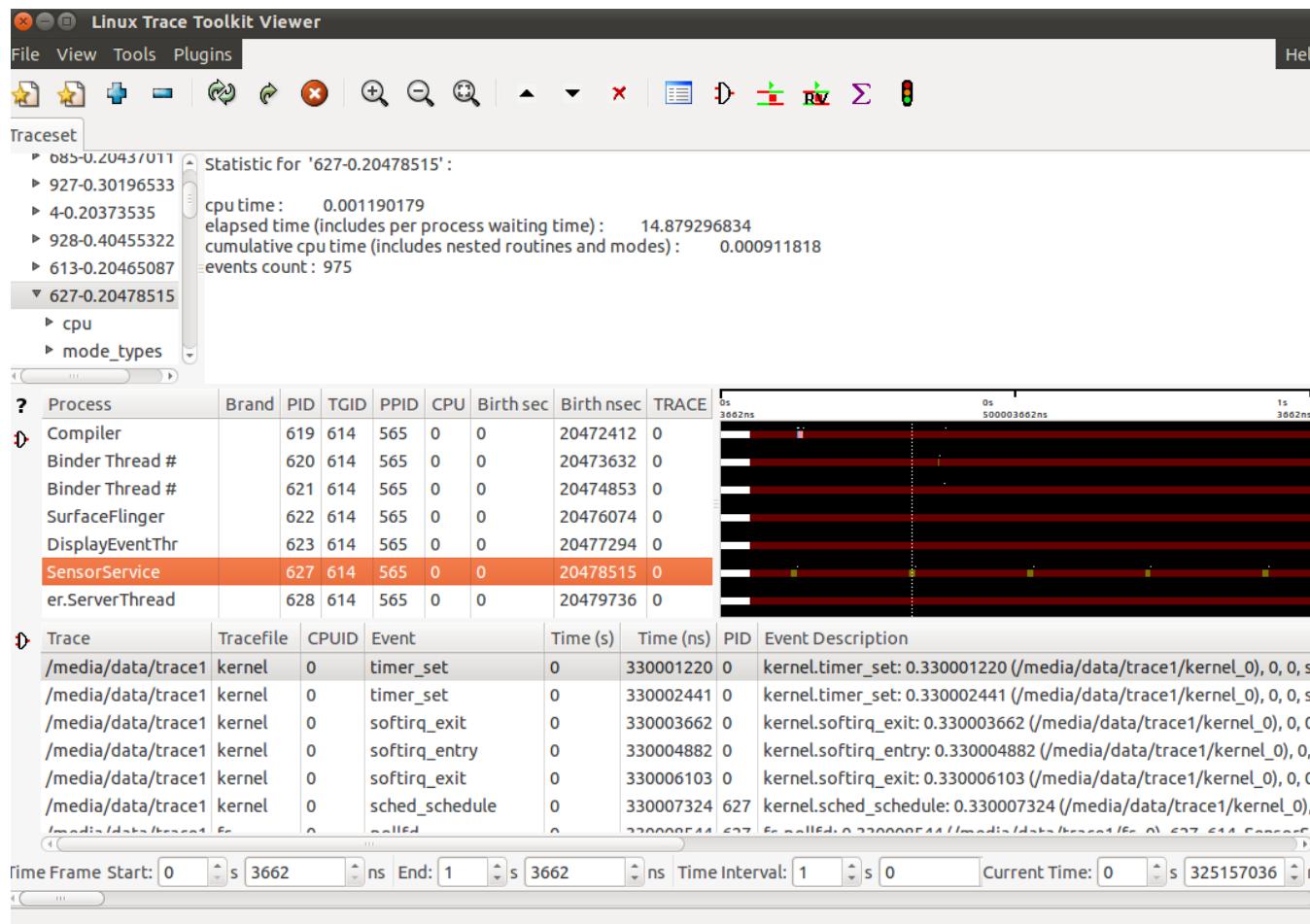
File system benchmark

- Netperf

Network performance benchmark

LTTng - usage

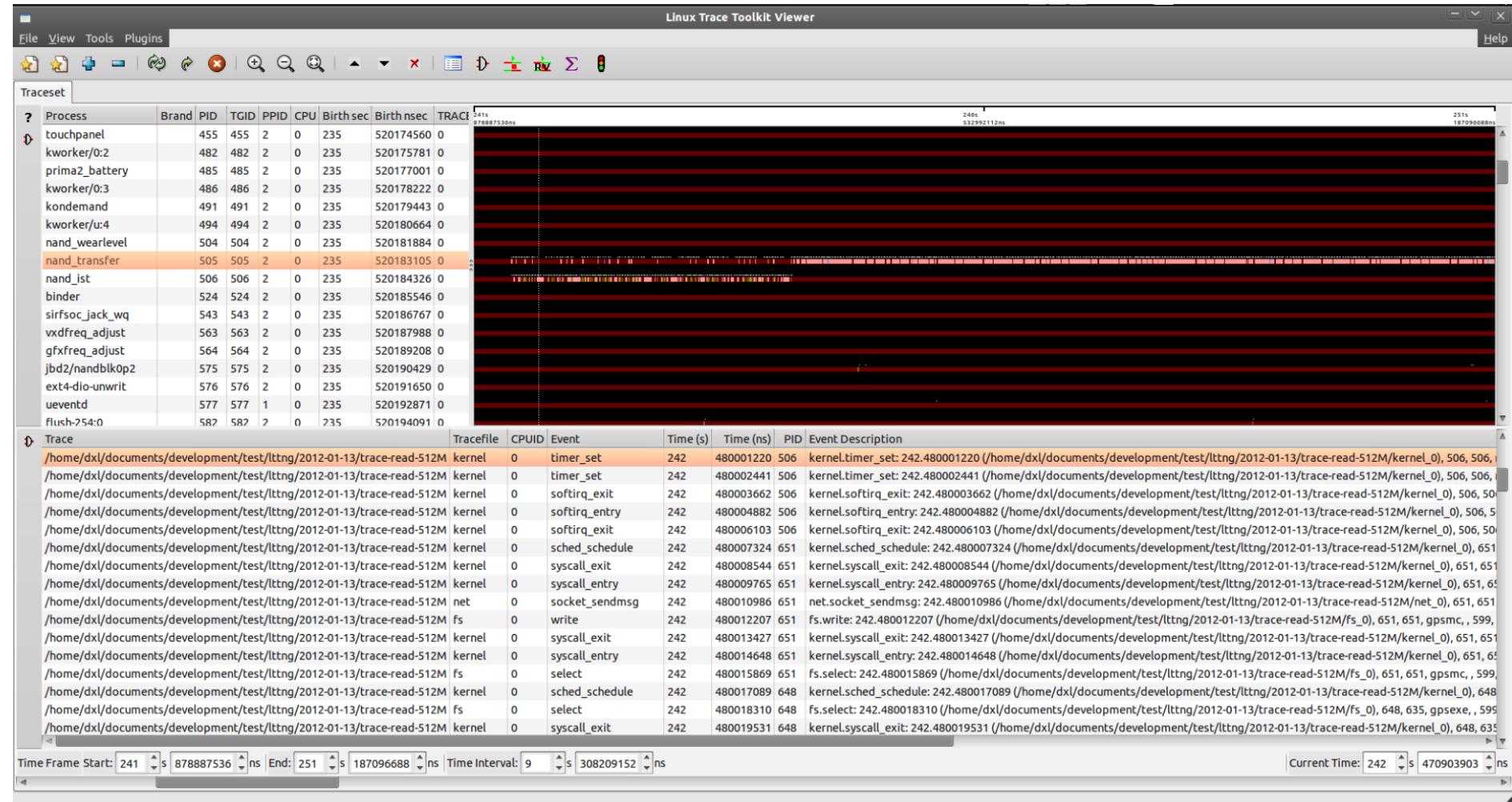
- # ltt-armall
- # lttctl -C -w /mnt/obb/trace1 trace1
- # lttctl -D trace1
- ltv -m batchAnalysis -s -m textDump -s -t trace
- ltv-gui



lttv-gui - color

	White : mode unknown or unnamed
	Green : running in user mode
	Pale blue : running in a system call
	Yellow : running in a trap
	Orange : servicing an IRQ
	Pink : running a softirq handler
	Dark red : waiting for I/O
	Dark yellow : waiting for CPU
	Dark purple : zombie
	Dark green : waiting for fork
	Magenta : process has exited

LTTng –NAND performance



Oprofile -usage

- # modprobe oprofile
- # grep "_text" /proc/kallsyms
c02d6000 T _text
- # grep "_etext" /proc/kallsyms
c07bc000 A _etext
- # opcontrol --vmlinux=/vmlinux --kernel-range=0xc02d6000,0xc07bc000 --quick
- opcontrol --vmlinux=/vmlinux --kernel-range=0xc02d6000,0xc07bc000 --event=DCACHE_ACCESS:1000 --event=L1_DATA_MISS:1000 --event=L1_INST_MISS:1000
- # opcontrol --start
- # opcontrol --dump
- # opreport -la

```
Counted CPU_CYCLES events (Number of CPU cycles) with a unit mask of 0x00 (No unit mask) count 150000
samples  cum. samples %   cum. %   app name          symbol name
5934    5934    53.7257 53.7257  libskia.so        /system/lib/libskia.so
1600    7534    14.4862 68.2119  libdvm.so         /system/lib/libdvm.so
1070    8604    9.6876 77.8995  libc.so           /system/lib/libc.so
317     8921    2.8701 80.7696  libcutils.so      /system/lib/libcutils.so
165     9086    1.4939 82.2635  vmlinux           schedule
126     9212    1.1408 83.4043  vmlinux           memzero
102     9314    0.9235 84.3278  libutils.so       /system/lib/libutils.so
100     9414    0.9054 85.2331  vmlinux           sirfsoc_enter_idle
35      9499    0.7696 86.0027  vmlinux           l2x0_flush_all
79      9578    0.7153 86.7180  libGLESv1_CM_POWERVR_SGX531_110.so.1.1.16.4117 /system/lib/egl/libGLESv1_CM_POWERVR_SGX531_110.so.1.1.16.4117
76      9654    0.6881 87.4061  vmlinux           do_softirq
69      9723    0.6247 88.0308  libandroid_runtime.so /system/lib/libandroid_runtime.so
64      9787    0.5794 88.6102  pvrsvrkm        /pvrsvrkm
58      9845    0.5251 89.1354  libui.so          /system/lib/libui.so
39      9884    0.3531 89.4885  dalvik-jit-code-cache (deleted) /dev/ashmem/dalvik-jit-code-cache (deleted)
31      9915    0.2807 89.7691  vmlinux           free_hot_cold_page
29      9944    0.2626 90.0317  libsurfaceflinger.so /system/lib/libsurfaceflinger.so
28      9972    0.2535 90.2852  vmlinux           get_page_from_freelist
25      9997    0.2263 90.5115  vmlinux           do_page_fault
25      10022   0.2263 90.7379  vmlinux           ring_buffer_consume
23      10045   0.2082 90.9461  vmlinux           vma_adjust
21      10066   0.1901 91.1363  libsurfaceflinger_client.so /system/lib/libsurfaceflinger_client.so
21      10087   0.1901 91.3264  vmlinux           __dabt_usr
21      10108   0.1901 91.5165  vmlinux           __wake_up_sync_key
20      10128   0.1811 91.6976  vmlinux           try_to_wake_up
19      10147   0.1720 91.8696  vmlinux           vector_sw1
18      10165   0.1630 92.0326  gpsexe            /usr/bin/gpsex
18      10183   0.1630 92.1956  libbinder.so      /system/lib/libbinder.so
17      10200   0.1539 92.3495  vmlinux           tick_nohz_stop_sched_tick
16      10216   0.1449 92.4943  oprofile          /oprofile
15      10231   0.1358 92.6301  libsrv_um.so.1.1.16.4117 /system/lib/libsrv_um.so.1.1.16.4117
15      10246   0.1358 92.7660  vmlinux           finish_task_switch.clone.99.clone.117
15      10261   0.1358 92.9018  vmlinux           v7_coherent_user_range
14      10275   0.1268 93.0285  libandroid_servers.so /system/lib/libandroid_servers.so
14      10289   0.1268 93.1553  vmlinux           __queue_work
14      10303   0.1268 93.2820  vmlinux           v7_flush_kern_dcache_area
13      10316   0.1177 93.3997  vmlinux           release_pages
13      10329   0.1177 93.5174  vmlinux           unmmap_vmas
12      10341   0.1086 93.6261  vmlinux           __fp
```

Oprofile - events

```
sh-4.2# opcontrol --list-events
name          : meaning
-----
PMNC_SW_INCR      : Software increment of PMNC registers
IFETCH_MISS       : Instruction fetch misses from cache or normal cacheable memory
ITLB_MISS         : Instruction fetch misses from TLB
DCACHE_REFILL     : Data R/W operation that causes a refill from cache or normal cacheable memory
DCACHE_ACCESS      : Data R/W from cache
DTLB_REFILL       : Data R/W that causes a TLB refill
DREAD             : Data read architecturally executed (note: architecturally executed = for instructions that are unconditional or that pass the condition code)
DWRITE             : Data write architecturally executed
INSTR_EXECUTED    : All executed instructions
EXC_TAKEN         : Exception taken
EXC_EXECUTED      : Exception return architecturally executed
CID_WRITE          : Instruction that writes to the Context ID Register architecturally executed
PC_WRITE           : SW change of PC, architecturally executed (not by exceptions)
PC_IMM_BRANCH     : Immediate branch instruction executed (taken or not)
PC_PROC_RETURN     : Procedure return architecturally executed (not by exceptions)
UNALIGNED_ACCESS   : Unaligned access architecturally executed
PC_BRANCH_MIS_PRED: Branch mispredicted or not predicted. Counts pipeline flushes because of misprediction
PC_BRANCH_MIS_USED: Branch or change in program flow that could have been predicted
WRITE_BUFFER_FULL  : Any write buffer full cycle
L2_STORE_MERGED    : Any store that is merged in L2 cache
L2_STORE_BUFF      : Any bufferable store from load/store to L2 cache
L2_ACCESS          : Any access to L2 cache
L2_CACHE_MISS      : Any cacheable miss in L2 cache
AXI_READ_CYCLES    : Number of cycles for an active AXI read
AXI_WRITE_CYCLES   : Number of cycles for an active AXI write
MEMORY_REPLAY       : Any replay event in the memory subsystem
UNALIGNED_ACCESS_REPLAY: Unaligned access that causes a replay
L1_DATA_MISS        : L1 data cache miss as a result of the hashing algorithm
L1_INST_MISS        : L1 instruction cache miss as a result of the hashing algorithm
L1_DATA_COLORING    : L1 data access in which a page coloring alias occurs
L1_NEON_DATA        : NEON data access that hits L1 cache
L1_NEON_CACH_DATA  : NEON cacheable data access that hits L1 cache
L2_NEON             : L2 access as a result of NEON memory access
L2_NEON_HIT         : Any NEON hit in L2 cache
L1_INST             : Any L1 instruction cache access, excluding CP15 cache accesses
PC_RETURN_MIS_PRED : Return stack misprediction at return stack pop (incorrect target address)
PC_BRANCH_FAILED    : Branch prediction misprediction
PC_BRANCH_TAKEN     : Any predicted branch that is taken
PC_BRANCH_EXECUTED  : Any taken branch that is executed
OP_EXECUTED         : Number of operations executed (in instruction or multi-cycle instruction)
CYCLES_INST_STALL   : Cycles where no instruction available
CYCLES_INST         : Number of instructions issued in a cycle
CYCLES_NEON_DATA_STALL: Number of cycles the processor waits on MRC data from NEON
CYCLES_NEON_INST_STALL: Number of cycles the processor waits on NEON instruction queue or NEON load queue
NEON_CYCLES         : Number of cycles NEON and integer processors are not idle
PMU0_EVENTS          : Number of events from external input source PMUEXTIN[0]
PMU1_EVENTS          : Number of events from external input source PMUEXTIN[1]
PMU_EVENTS           : Number of events from both external input sources PMUEXTIN[0] and PMUEXTIN[1]
CPU_CYCLES          : Number of CPU cycles
```

DS-5 – streamline

➤ Target

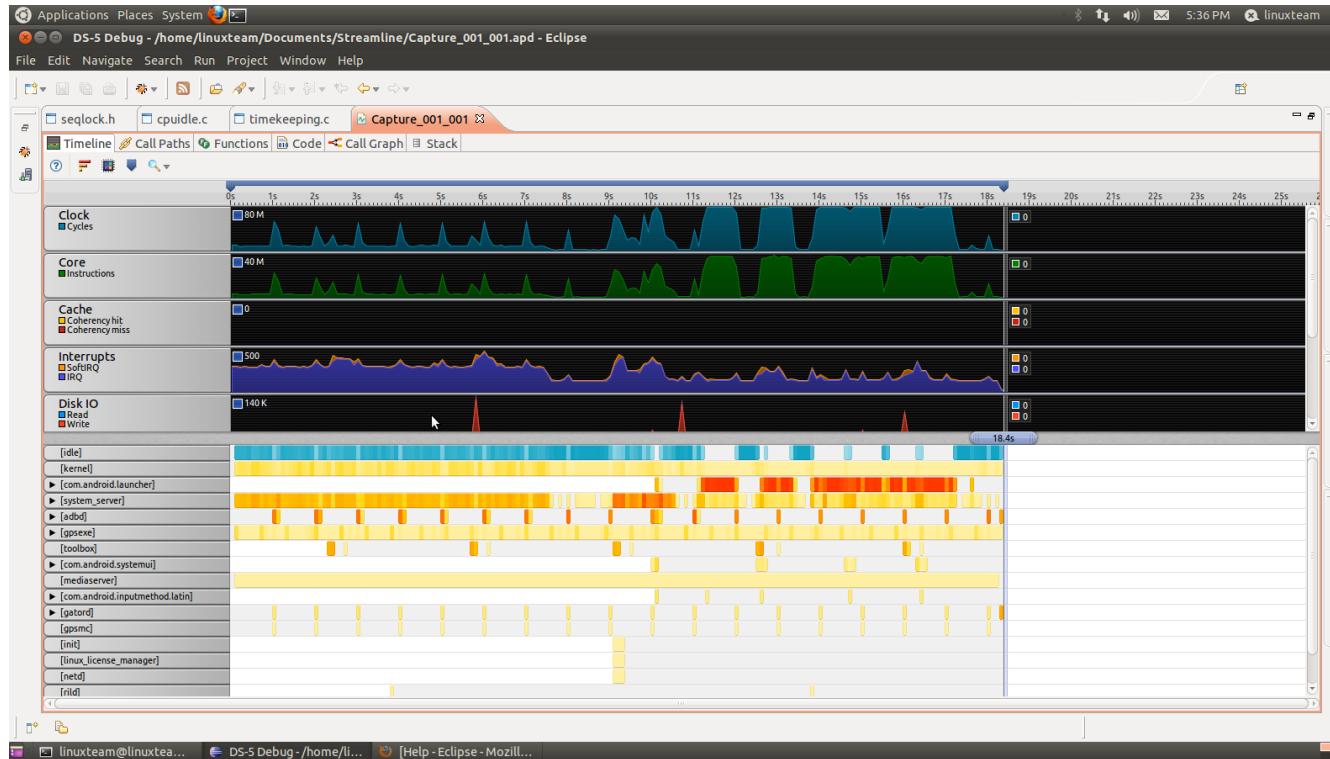
modprobe gator

gatord 5039

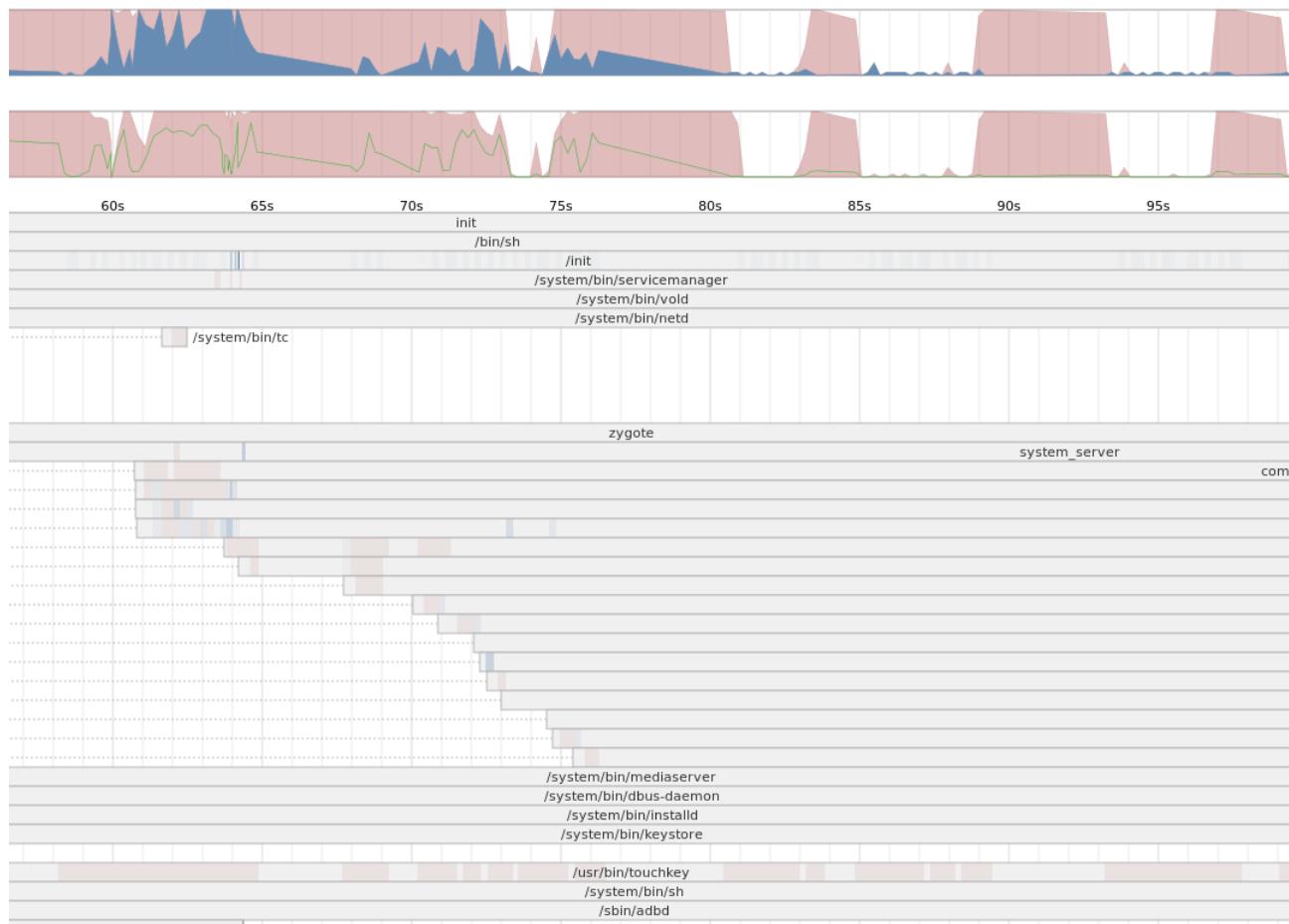
➤ Host

adb forward tcp:5039 tcp:5039

Use localhost:5039 to do capture



Bootchart



Latencytop

➤ /system/xbin/latencytop

Latencies across all processes:				
Maximum	Average	Count	Reason	
323.71 ms	18.06 ms	437	sync_page	
121.00 ms	13.24 ms	14	sys_mmap_pgoff	
86.77 ms	5.39 ms	95	sync_buffer	
67.00 ms	24.93 ms	45	jbd2_log_wait_commit	
61.59 ms	43.56 ms	6	call_usermodehelper_exec	
37.67 ms	1.09 ms	1953	binder_thread_read	
36.19 ms	2.78 ms	138	binder_ioctl	
34.19 ms	18.06 ms	2	LinuxLockMutex	
21.85 ms	16.01 ms	10	do_get_write_access	
21.29 ms	21.29 ms	1	do_lookup	
19.37 ms	14.17 ms	3	synchronize_rcu	
14.65 ms	14.65 ms	1	jbd2_journal_stop	
12.82 ms	6.72 ms	6	sys_munmap	
12.44 ms	1.94 ms	35	sys_mprotect	
6.71 ms	0.52 ms	40	do_page_fault	
5.00 ms	0.80 ms	613	LinuxEventObjectWait	
4.99 ms	0.63 ms	3724	futex_wait_queue_me	
4.84 ms	1.29 ms	288	sys_epoll_wait	
4.47 ms	0.54 ms	73	unix_stream_recvmsg	
4.20 ms	1.45 ms	3	flush_work	
4.11 ms	1.46 ms	3	inotify_read	
4.11 ms	0.21 ms	84	poll_schedule_timeout	
3.98 ms	2.18 ms	28	hrtimer_nanosleep	
3.45 ms	1.18 ms	5	get_user_pages_fast	
2.95 ms	0.88 ms	4	binder_open	
1.41 ms	1.41 ms	1	__copy_to_user_memcpy	
0.52 ms	0.52 ms	1	misc_open	
0.03 ms	0.03 ms	1	do_wait	
0.00 ms	0.00 ms	1	pipe_lock_nested.clone.3	

DVFS- powertop

➤ /system/bin/powertop

```
COM1 - PuTTY
PowerTOP 1.98 Overview Idle stats Frequency stats Device stats Tunab

Summary: 208.1 wakeups/second, 0.0 GPU ops/second, 0.0 VFS ops/sec and 2.4% CPU

Power est. Usage Events/s Category Description
238 mW 513.8 us/s 60.2 kWork layer_frame_irq
188 mW 586.7 us/s 47.3 kWork flush_to_ldisc
123 mW 1.3 ms/s 30.6 Process /system/bin/mediaserver
112 mW 1.7 ms/s 27.6 Interrupt [30] SIRFSOC-FB
63.5 mW 0.7 ms/s 15.8 Timer hrtimer_wakeup
51.6 mW 637.0 us/s 12.8 Timer tick_sched_timer
40.3 mW 0.9 ms/s 9.9 Interrupt [18] sirfsoc-uart
13.7 mW 6.3 ms/s 1.0 Process /system/bin/powertop
8.51 mW 460.5 us/s 2.0 Process system_server
4.19 mW 2.7 ms/s 0.00 Interrupt [0] sirfsoc_timer0
3.95 mW 34.5 us/s 1.0 kWork vxdufreq_adjust
3.81 mW 2.4 ms/s 0.00 Interrupt [1] timer(softirq)
3.04 mW 1.9 ms/s 0.00 Process [kworker/u:0]
2.60 mW 1.7 ms/s 0.00 Process [kworker/0:1]
1.52 mW 1.0 ms/s 0.00 Process [ksoftirqd/0]
1.31 mW 0.8 ms/s 0.00 kWork do_dbs_timer
375 uW 240.6 us/s 0.00 Interrupt [9] RCU(softirq)

<ESC> Exit |
```

```
COM1 - PuTTY
PowerTOP 1.98 Overview Idle stats Frequency stats Device stats Tunab

          Package |          CPU 0
800 Mhz  0.0% | 800 Mhz  0.0%
600 Mhz  0.1% | 600 Mhz  0.1%
400 Mhz  0.0% | 400 Mhz  0.0%
200 Mhz  1.9% | 200 Mhz  1.9%
Idle     98.0% | Idle    98.0%

<ESC> Exit |
```

```
COM1 - PuTTY
PowerTOP 1.98 Overview Idle stats Frequency stats Device stats Tunab

          Package |          CPU 0
WFI      81.1% | WFI      81.1%   3.5 ms

|
```

DVFS – cpufreq-bench

```
/usr/sbin/cpufreq-bench -l 50000 -s 100000 -x 50000 -y 100000 -g ondemand -r 5 -n 5 -v
```

Ondemand:

- Round 1 - 39.74%
- Round 2 - 36.35%
- Round 3 - 47.91%
- Round 4 - 54.22%
- Round 5 - 58.64%

Interactive:

- Round 1 - 72.95%
- Round 2 - 87.20%
- Round 3 - 91.21%
- Round 4 - 94.10%
- Round 5 - 94.93%

THANK
YOU