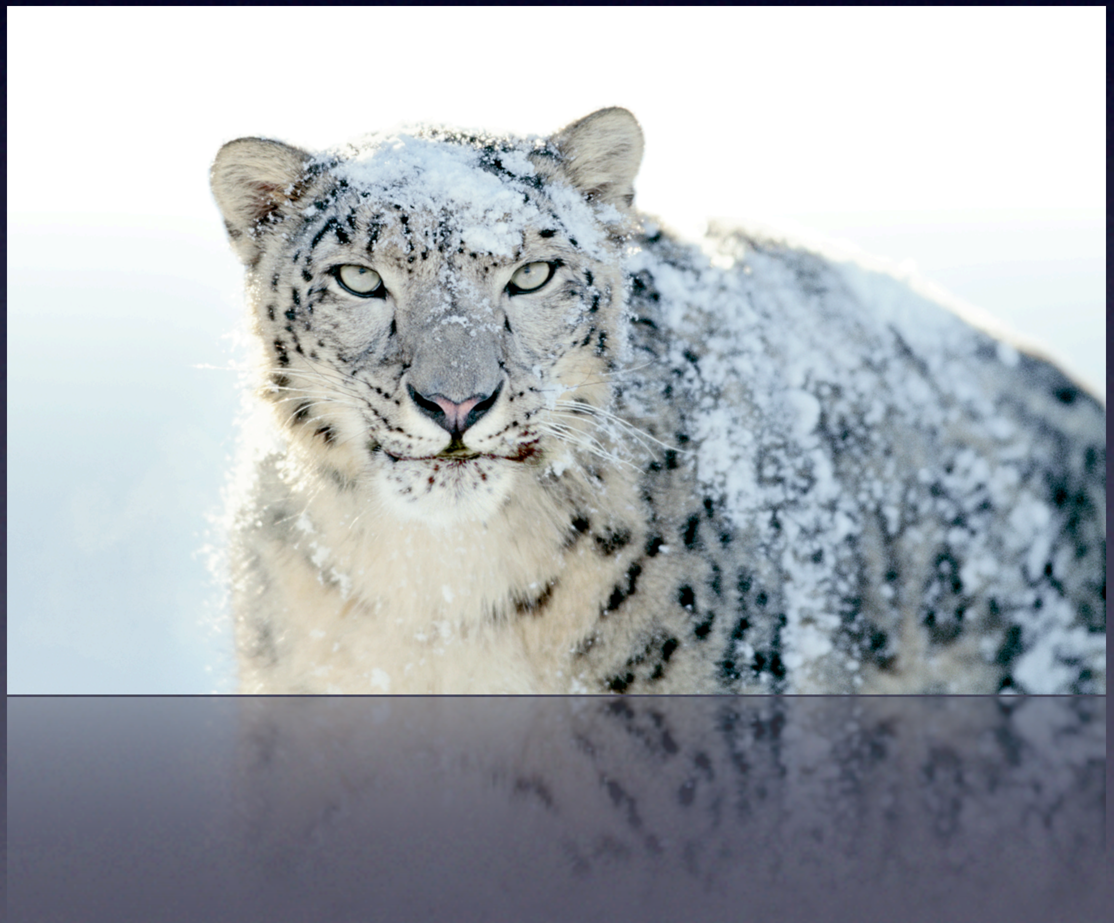
FruityFuzz

A Simple Mutation-Based File Fuzzer for Mac

Jordan Schau
5/2/11

Requirements

- Easy to use
- Versatile
- Fast
- Work with current OS X 10.6.X



Current State

- PeachFuzz - http://peachfuzzer.com/
- Sulley - http://code.google.com/p/sulley/
- Generally Poor Documentation for Mac

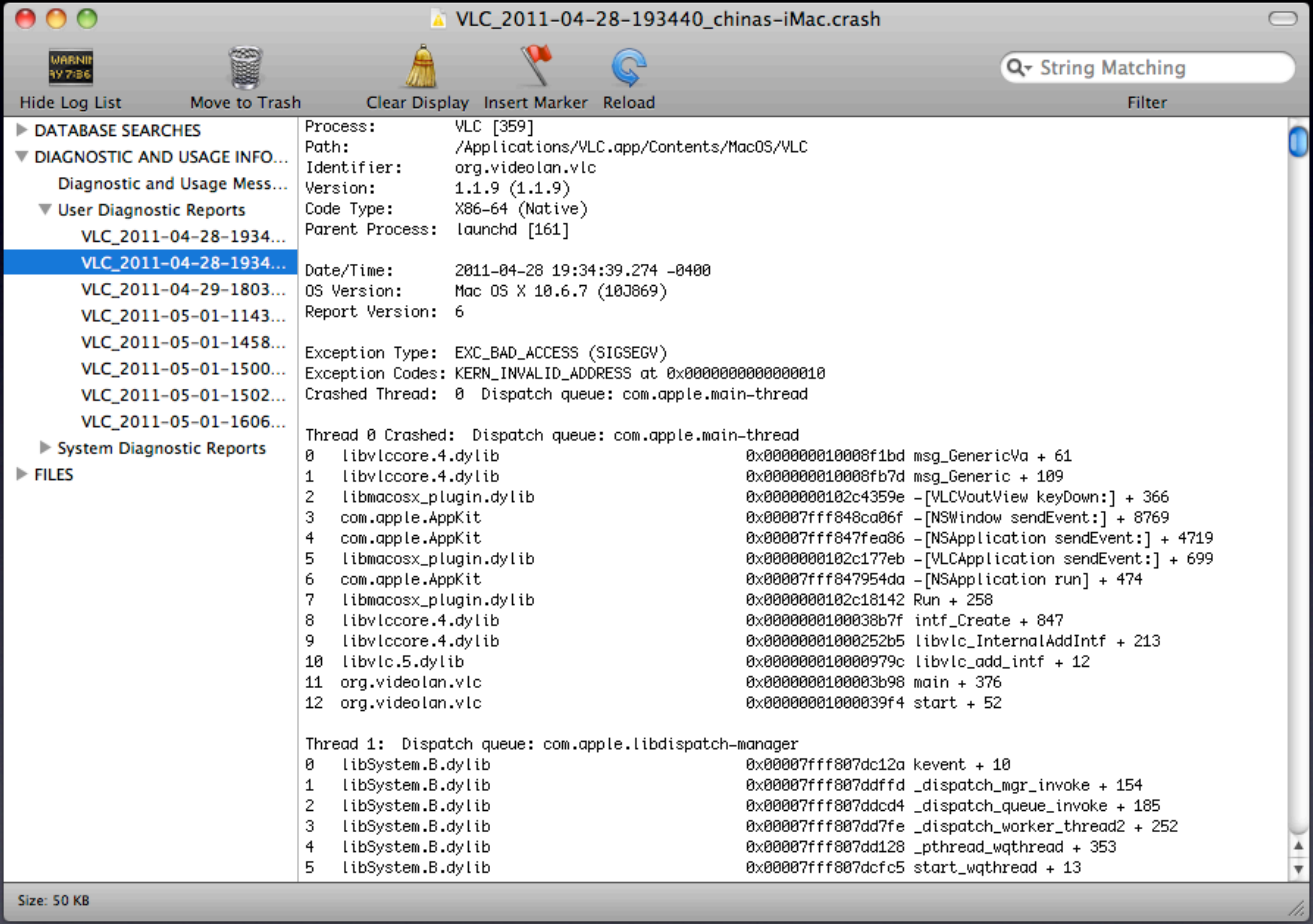
A bit about Mac OS X Snow Leopard

- Most processes are 64 bit
  - Different Register System
    - Moved from 8 registers to 16
- ASLR not fully implemented
  - Only used for certain library offsets

Tools Used

- Python 2.7
  - Good: High Level file I/O
  - Bad: Multithreading and forking child processes
- CrashReporter
  - Good reporting of crash
  - Crash Reports are deleted after 20 are found

Crash Reporter



```
Process:         VLC [359]
Path:            /Applications/VLC.app/Contents/MacOS/VLC
Identifier:      org.videolan.vlc
Version:         1.1.9 (1.1.9)
Code Type:       X86-64 (Native)
Parent Process:  launchd [161]

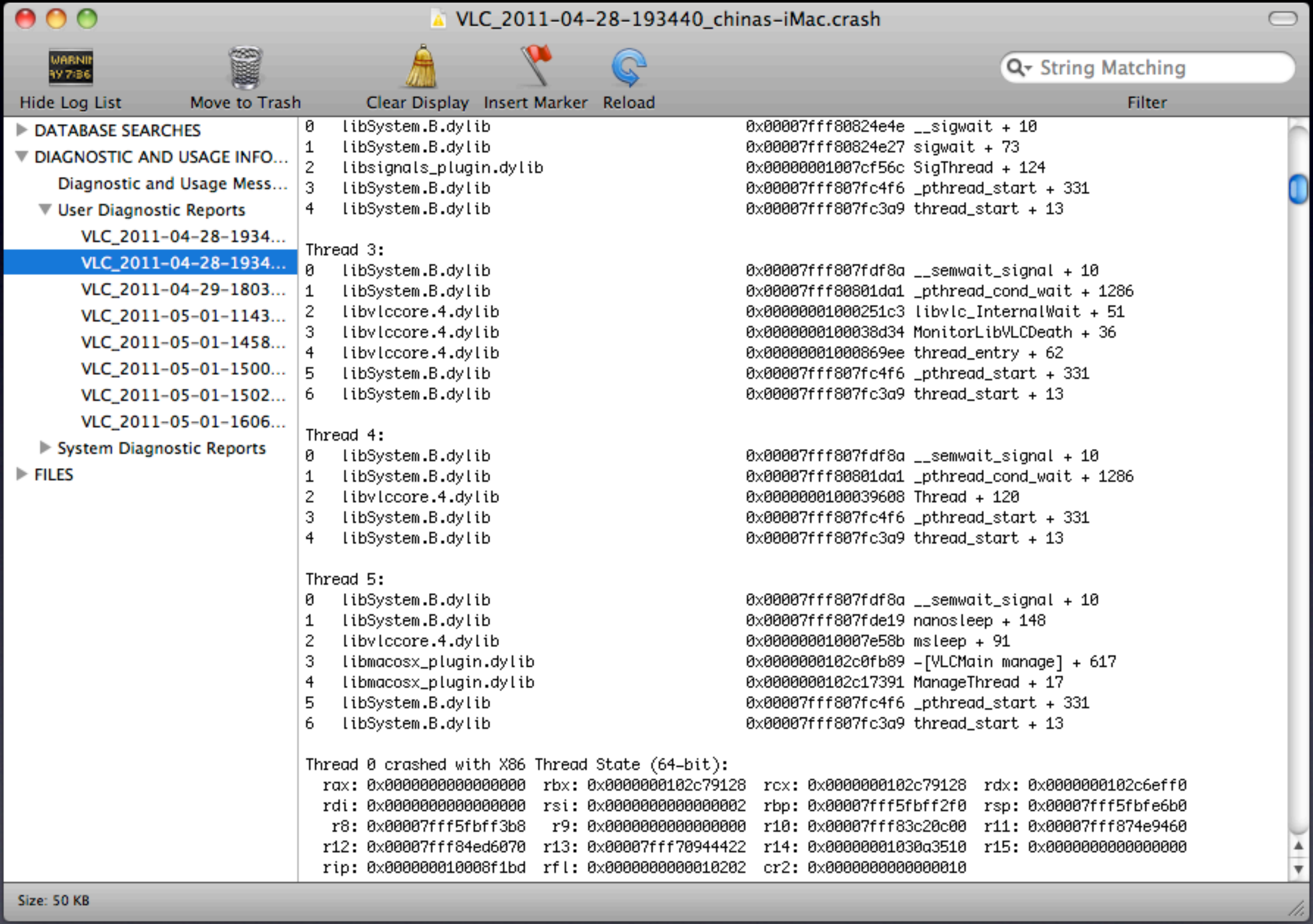
Date/Time:       2011-04-28 19:34:39.274 -0400
OS Version:      Mac OS X 10.6.7 (10J869)
Report Version:  6

Exception Type:  EXC_BAD_ACCESS (SIGSEGV)
Exception Codes: KERN_INVALID_ADDRESS at 0x0000000000000010
Crashed Thread:  0  Dispatch queue: com.apple.main-thread

Thread 0 Crashed:  Dispatch queue: com.apple.main-thread
0   libvlccore.4.dylib              0x000000010008f1bd msg_GenericVa + 61
1   libvlccore.4.dylib              0x000000010008fb7d msg_Generic + 109
2   libmacosx_plugin.dylib          0x0000000102c4359e -[VLCVoutView keyDown:] + 366
3   com.apple.AppKit                0x00007fff848ca06f -[NSWindow sendEvent:] + 8769
4   com.apple.AppKit                0x00007fff847fea86 -[NSApplication sendEvent:] + 4719
5   libmacosx_plugin.dylib          0x0000000102c177eb -[VLCApplication sendEvent:] + 699
6   com.apple.AppKit                0x00007fff847954da -[NSApplication run] + 474
7   libmacosx_plugin.dylib          0x0000000102c18142 Run + 258
8   libvlccore.4.dylib              0x000000010038b7f intf_Create + 847
9   libvlccore.4.dylib              0x00000001000252b5 libvlc_InternalAddIntf + 213
10  libvlc.5.dylib                  0x000000010000979c libvlc_add_intf + 12
11  org.videolan.vlc                0x0000000100003b98 main + 376
12  org.videolan.vlc                0x00000001000039f4 start + 52

Thread 1:  Dispatch queue: com.apple.libdispatch-manager
0   libSystem.B.dylib               0x00007fff807dc12a kevent + 10
1   libSystem.B.dylib               0x00007fff807ddffd _dispatch_mgr_invoke + 154
2   libSystem.B.dylib               0x00007fff807ddcd4 _dispatch_queue_invoke + 185
3   libSystem.B.dylib               0x00007fff807dd7fe _dispatch_worker_thread2 + 252
4   libSystem.B.dylib               0x00007fff807dd128 _pthread_wqthread + 353
5   libSystem.B.dylib               0x00007fff807dcfc5 start_wqthread + 13
```

Crash Reporter



```
0   libSystem.B.dylib                             0x00007fff80824e4e __sigwait + 10
1   libSystem.B.dylib                             0x00007fff80824e27 sigwait + 73
2   libsignals_plugin.dylib                       0x00000001007cf56c SigThread + 124
3   libSystem.B.dylib                             0x00007fff807fc4f6 _pthread_start + 331
4   libSystem.B.dylib                             0x00007fff807fc3a9 thread_start + 13

Thread 3:
0   libSystem.B.dylib                             0x00007fff807fdf8a __semwait_signal + 10
1   libSystem.B.dylib                             0x00007fff80801da1 _pthread_cond_wait + 1286
2   libvlccore.4.dylib                            0x00000001000251c3 libvlc_InternalWait + 51
3   libvlccore.4.dylib                            0x0000000100038d34 MonitorLibVLCDeath + 36
4   libvlccore.4.dylib                            0x00000001000869ee thread_entry + 62
5   libSystem.B.dylib                             0x00007fff807fc4f6 _pthread_start + 331
6   libSystem.B.dylib                             0x00007fff807fc3a9 thread_start + 13

Thread 4:
0   libSystem.B.dylib                             0x00007fff807fdf8a __semwait_signal + 10
1   libSystem.B.dylib                             0x00007fff80801da1 _pthread_cond_wait + 1286
2   libvlccore.4.dylib                            0x0000000100039608 Thread + 120
3   libSystem.B.dylib                             0x00007fff807fc4f6 _pthread_start + 331
4   libSystem.B.dylib                             0x00007fff807fc3a9 thread_start + 13

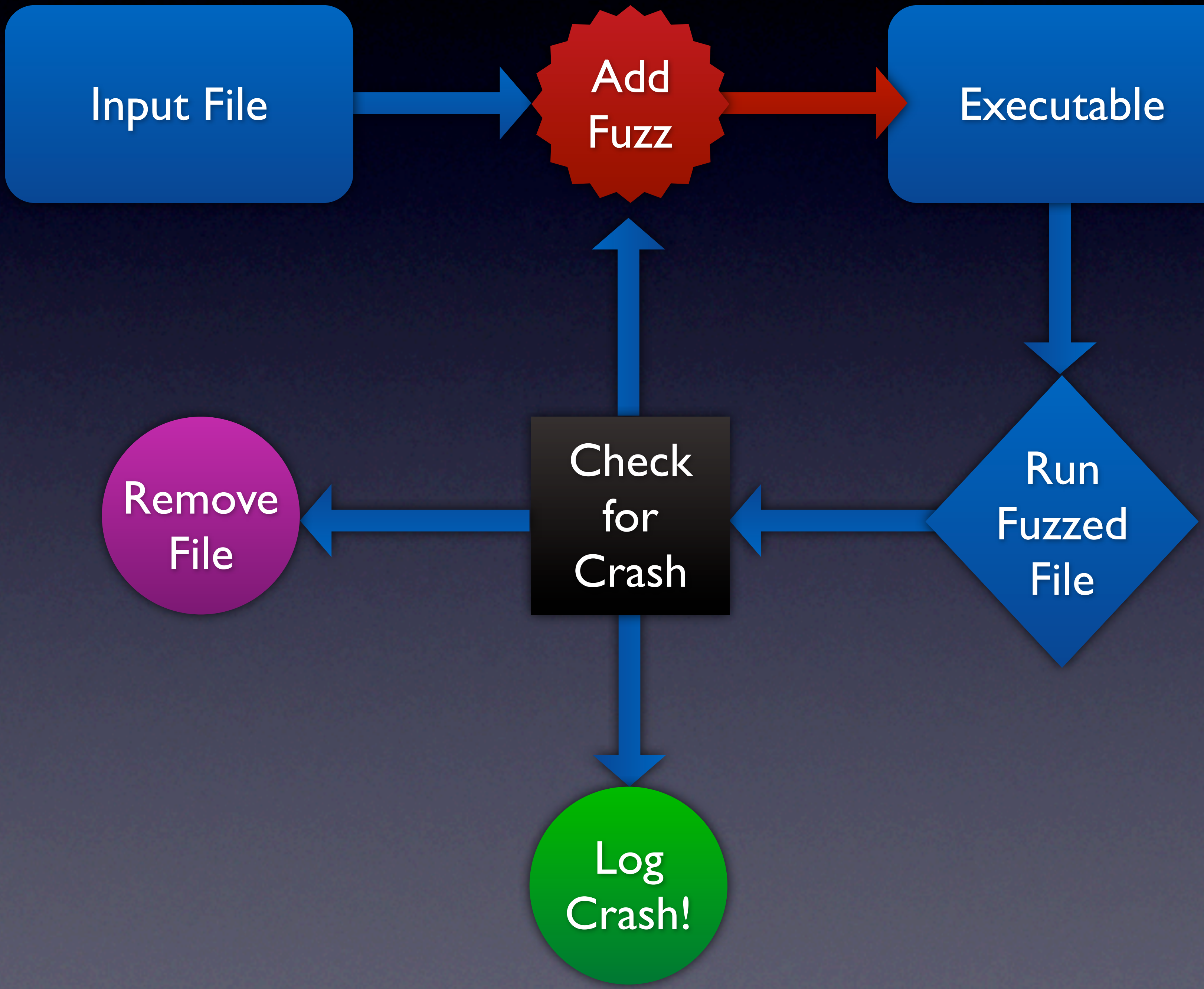
Thread 5:
0   libSystem.B.dylib                             0x00007fff807fdf8a __semwait_signal + 10
1   libSystem.B.dylib                             0x00007fff807fde19 nanosleep + 148
2   libvlccore.4.dylib                            0x000000010007e58b msleep + 91
3   libmacosx_plugin.dylib                        0x0000000102c0fb89 -[VLCMain manage] + 617
4   libmacosx_plugin.dylib                        0x0000000102c17391 ManageThread + 17
5   libSystem.B.dylib                             0x00007fff807fc4f6 _pthread_start + 331
6   libSystem.B.dylib                             0x00007fff807fc3a9 thread_start + 13

Thread 0 crashed with X86 Thread State (64-bit):
  rax: 0x0000000000000000  rbx: 0x0000000102c79128  rcx: 0x0000000102c79128  rdx: 0x0000000102c6eff0
  rdi: 0x0000000000000000  rsi: 0x0000000000000002  rbp: 0x00007fff5fbff2f0  rsp: 0x00007fff5fbfe6b0
   r8: 0x00007fff5fbff3b8   r9: 0x0000000000000000  r10: 0x00007fff83c20c00  r11: 0x00007fff874e9460
  r12: 0x00007fff84ed6070  r13: 0x00007fff70944422  r14: 0x00000001030a3510  r15: 0x0000000000000000
  rip: 0x000000010008f1bd  rfl: 0x0000000000010202  cr2: 0x0000000000000010
```

Approach

- Select a valid input file
- Select a random fuzzy string from a predefined dictionary
- Run File
  - If the application crashes - get the log
  - If not, delete the file and repeat

Fuzz Flow


Input File
Add Fuzz
Executable
Run Fuzzed File
Check for Crash
Remove File
Log Crash!

Interesting Strings

- The obvious overflow: “...AAAAA...”
- Objective-C
  - %@
  - %p
  - @
  - All C special characters apply too!

Targets

*.flv

*.psd, *.pdf

Usage

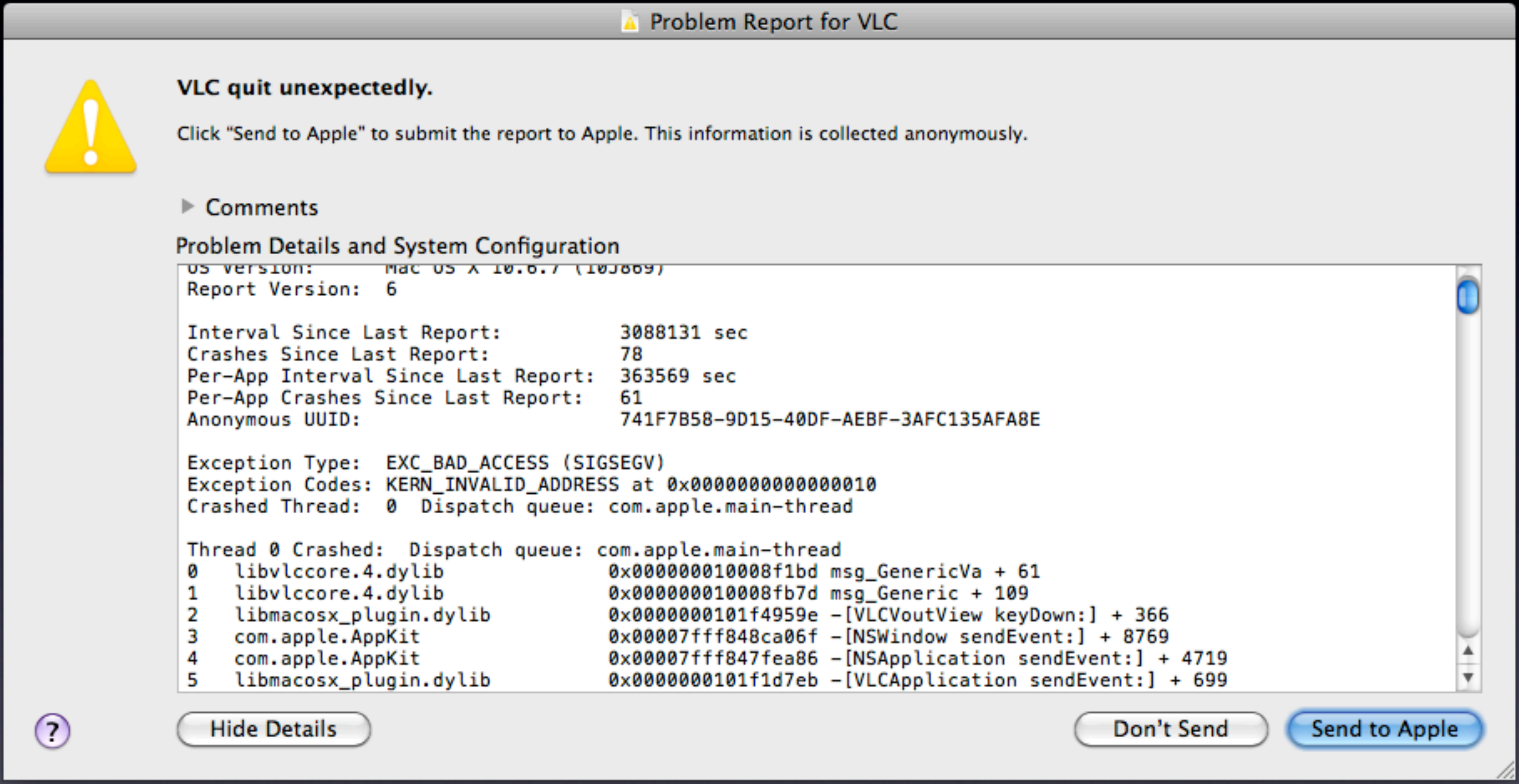
```
Usage:
python fruityfuzzer.py -a <./path/to/executable>
  -f <./path/to/file> -t <./path/to/directory/for/test/files>
  [options]

 [required]
        -a: Path to Application Executable
        -f: File to seed the Fuzzness
 [options]
        -t: Directory to put the test cases (defaults to ./test/)
        -c: Number of test cases to run (defaults to 1000)
        -T: wait time between trials (default is 5 seconds)
        -v: Verbose
        -h: Help page
```

Results

VLC	Preview
8 Interesting Files Found So Far...	No Interesting Files Found Yet...

VLC Crash



VLC quit unexpectedly.

Click "Send to Apple" to submit the report to Apple. This information is collected anonymously.

Problem Details and System Configuration

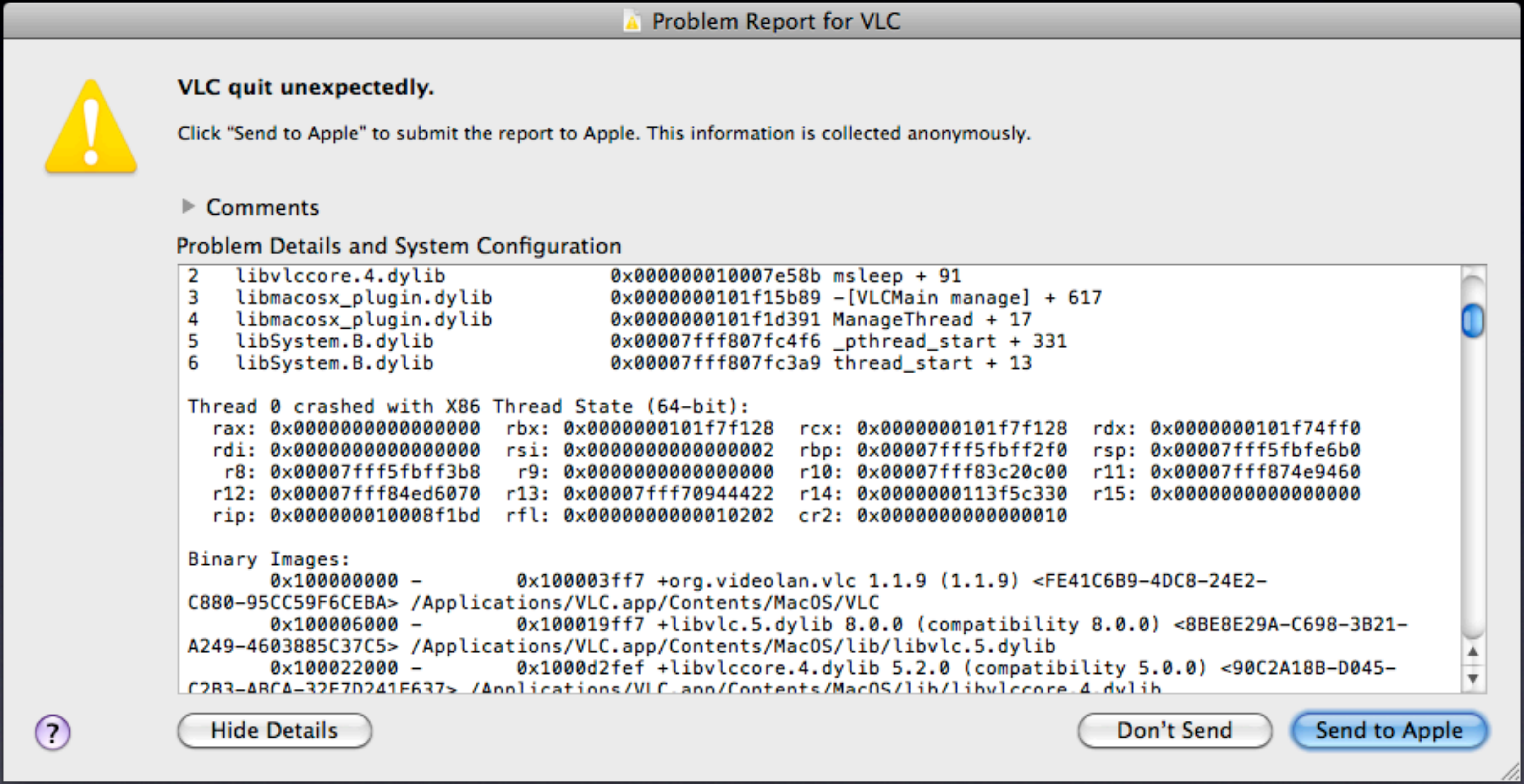
```
OS Version:      Mac OS X 10.6.7 (10J869)
Report Version:  6

Interval Since Last Report:          3088131 sec
Crashes Since Last Report:           78
Per-App Interval Since Last Report:  363569 sec
Per-App Crashes Since Last Report:   61
Anonymous UUID:                      741F7B58-9D15-40DF-AEBF-3AFC135AFA8E

Exception Type:  EXC_BAD_ACCESS (SIGSEGV)
Exception Codes: KERN_INVALID_ADDRESS at 0x0000000000000010
Crashed Thread:  0  Dispatch queue: com.apple.main-thread

Thread 0 Crashed:  Dispatch queue: com.apple.main-thread
0   libvlccore.4.dylib              0x000000010008f1bd msg_GenericVa + 61
1   libvlccore.4.dylib              0x000000010008fb7d msg_Generic + 109
2   libmacosx_plugin.dylib          0x0000000101f4959e -[VLCVoutView keyDown:] + 366
3   com.apple.AppKit                0x00007fff848ca06f -[NSWindow sendEvent:] + 8769
4   com.apple.AppKit                0x00007fff847fea86 -[NSApplication sendEvent:] + 4719
5   libmacosx_plugin.dylib          0x0000000101f1d7eb -[VLCApplication sendEvent:] + 699
```

VLC Crash



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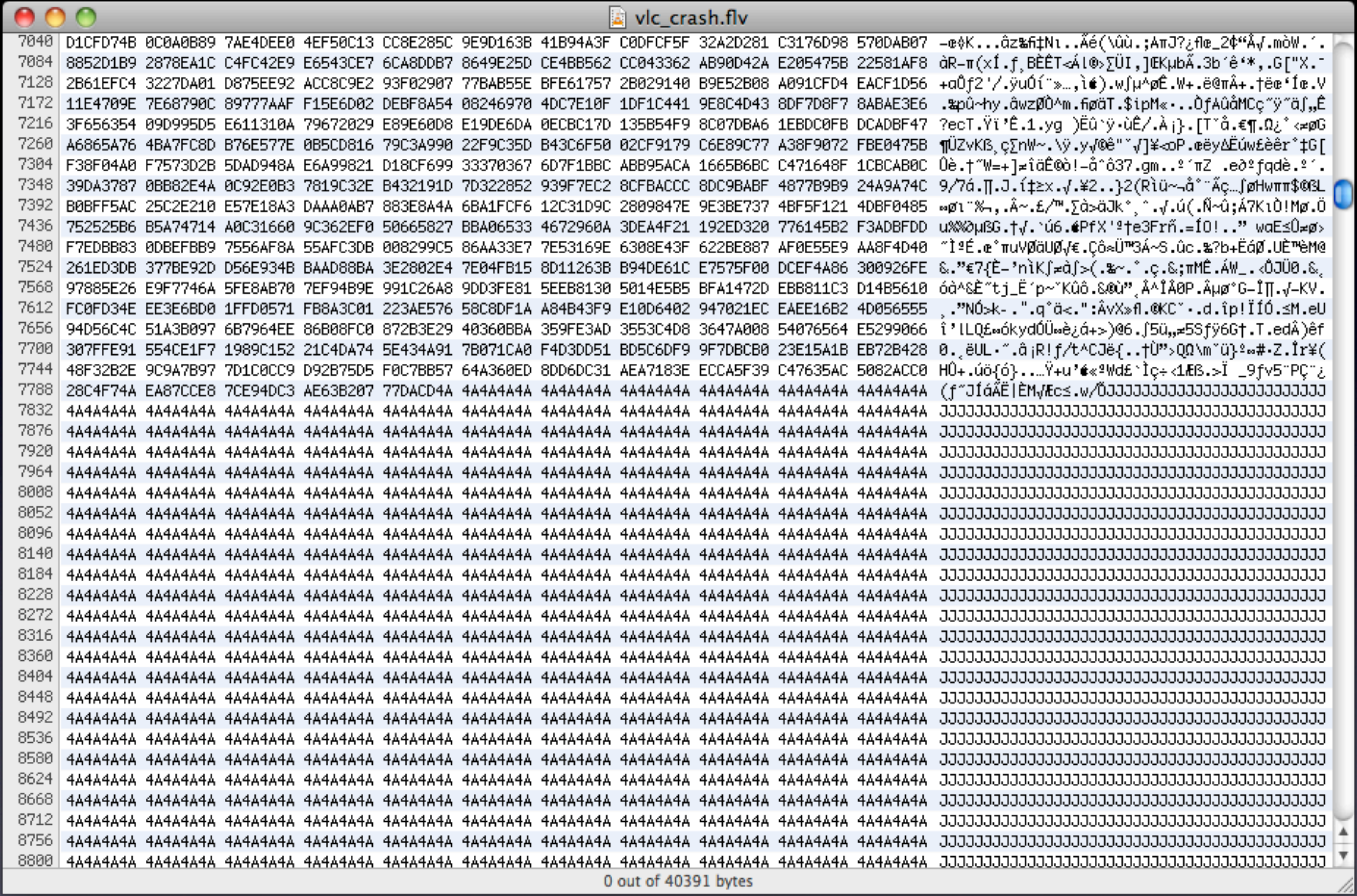
Problem Details and System Configuration

```
2   libvlccore.4.dylib              0x000000010007e58b msleep + 91
3   libmacosx_plugin.dylib          0x0000000101f15b89 -[VLCMain manage] + 617
4   libmacosx_plugin.dylib          0x0000000101f1d391 ManageThread + 17
5   libSystem.B.dylib               0x00007fff807fc4f6 _pthread_start + 331
6   libSystem.B.dylib               0x00007fff807fc3a9 thread_start + 13

Thread 0 crashed with X86 Thread State (64-bit):
  rax: 0x0000000000000000  rbx: 0x0000000101f7f128  rcx: 0x0000000101f7f128  rdx: 0x0000000101f74ff0
  rdi: 0x0000000000000000  rsi: 0x0000000000000002  rbp: 0x00007fff5fbff2f0  rsp: 0x00007fff5fbfe6b0
   r8: 0x00007fff5fbff3b8   r9: 0x0000000000000000  r10: 0x00007fff83c20c00  r11: 0x00007fff874e9460
  r12: 0x00007fff84ed6070  r13: 0x00007fff70944422  r14: 0x0000000113f5c330  r15: 0x0000000000000000
  rip: 0x000000010008f1bd  rfl: 0x0000000000010202  cr2: 0x0000000000000010

Binary Images:
       0x100000000 -        0x100003ff7 +org.videolan.vlc 1.1.9 (1.1.9) <FE41C6B9-4DC8-24E2-
C880-95CC59F6CEBA> /Applications/VLC.app/Contents/MacOS/VLC
       0x100006000 -        0x100019ff7 +libvlc.5.dylib 8.0.0 (compatibility 8.0.0) <8BE8E29A-C698-3B21-
A249-4603885C37C5> /Applications/VLC.app/Contents/MacOS/lib/libvlc.5.dylib
       0x100022000 -        0x1000d2fef +libvlccore.4.dylib 5.2.0 (compatibility 5.0.0) <90C2A18B-D045-
C2B3-ABCA-32E7D241E637> /Applications/VLC.app/Contents/MacOS/lib/libvlccore.4.dylib
```



vlc_crash.flv

```
7040 D1CFD74B 0C0A0B89 7AE4DEE0 4EF50C13 CC8E285C 9E9D163B 41B94A3F C0DFCF5F 32A2D281 C3176D98 570DAB07 –œ◊K...âz‰ﬁ‡Nı..Ãé(\ûù.;AπJ?¿ﬂœ_2¢“Å√.mòW.´.
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7612 FC0FD34E EE3E6BD0 1FFD0571 FB8A3C01 223AE576 58C8DF1A A84B43F9 E10D6402 947021EC EAEE16B2 4D056555 ¸.”NÓ>k-.".q˚ä<.":ÂvX»ﬂ.®KC˘·.d.îp!ÏÍÓ.≤M.eU
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7832 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A JJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJ
7876 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A JJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJ
7920 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A JJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJ
7964 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A JJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJ
8008 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A JJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJ
8052 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A JJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJ
8096 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A JJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJ
8140 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A JJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJ
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8228 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A JJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJ
8272 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A JJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJ
8316 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A JJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJ
8360 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A JJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJ
8404 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A JJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJ
8448 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A JJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJ
8492 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A JJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJ
8536 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A 4A4A4A4A JJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJJ
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Drawbacks

- Fuzzer doesn’t understand code coverage
- Fuzzer isn’t aware of protocols or formats
- Dependent on Platform being up to date
- No Debugging Mode
- Serial flow

Future Work

- Add multithreading support
- Port *pydbg.py* to python 2.7 and OS X 10.6 for full debugging functionality
- More robust reporting
- Smarter Trials
  - Protocol Aware

References

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