The Missing Piece - Sophisticated OS X Backdoor Discovered

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In a nutshell

- Backdoor.OSX.Mokes.a is the most recently discovered OS X variant of a cross-platform backdoor which is able to operate on all major operating systems (Windows,Linux,OS X). Please see also our analysis on the Windows and Linux variants.
- This malware family is able to steal various types of data from the victim's machine (Screenshots, Audio-/Video-Captures, Office-Documents, Keystrokes)
- The backdoor is also able to execute arbitrary commands on the victim's computer
- To communicate it's using strong AES-256-CBC encryption

Background

Back in January this year we found a new family of cross-platform backdoors for desktop environments. After the discovery of the binaries for Linux and Windows systems, we have now finally come across the OS X version of Mokes.A. It is written in C++ using Qt, a cross-platform application framework, and is statically linked to OpenSSL. This leads to a filesize of approx. 14MB. Let's have a look into this very fresh sample.

"Unpacked" Backdoor.OSX.Mokes.a

Its filename was "unpacked" when we got our hands on it, but we're assuming that in-the-wild it comes packed, just like its Linux variant.

```
$ file unpacked
unpacked: Mach-O 64-bit x86_64 executable
```

Startup

When executed for the first time, the malware copies itself to the first available of the following locations, in this order:

- $HOME/Library/App Store/storeuserd
- $HOME/Library/com.apple.spotlight/SpotlightHelper
- $HOME/Library/Dock/com.apple.dock.cache
- $HOME/Library/Skype/SkypeHelper
- $HOME/Library/Dropbox/DropboxCache
- $HOME/Library/Google/Chrome/nacld
- $HOME/Library/Firefox/Profiles/profiled

Corresponding to that location, it creates a plist-file to achieve persistence on the system:

```
[redacted]-Mac-Pro-2:[redacted] root# cat /Users/[redacted]/Library/LaunchAgents/storeuserd.plist
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE plist PUBLIC "-//Apple//DTD PLIST 1.0//EN" "http://www.apple.com/DTDs/PropertyList-1.0.dtd">
<plist version="1.0">
<dict>
        <key>Label</key>
        <string>storeuserd</string>
        <key>ProgramArguments</key>
        <array>
                <string>/Users/[redacted]/Library/App Store/storeuserd</string>
        </array>
        <key>RunAtLoad</key>
        <true/>
        <key>KeepAlive</key>
        <true/>
</dict>
</plist>
```

After that it's time to establish a first connection with its C&C server using HTTP on TCP port 80:

```
GET /v1 HTTP/1.1
Connection: Close
User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10_9_3) AppleWebKit/537.75.14 (KHTML,
 like Gecko) Version/7.0.3 Safari/7046A194A
Accept-Encoding: gzip, deflate
Accept-Language: en-GB,*
Host: 158.69.241.141

HTTP/1.1 200 OK
Server: nginx/1.6.2
Date: [redacted]
Content-Type: text/html; charset=UTF-8
Transfer-Encoding: chunked
Connection: close
Content-Encoding: gzip
```

The User-Agent string is hardcoded in the binary and the server replies to this "heartbeat" request with "text/html" content of 208 bytes in length. Then the binary establishes an encrypted connection on TCP port 443 using the AES-256-CBC algorithm.

```
__text:0000000100016EA1                 mov     rdx, r13
__text:0000000100016EA4                 sub     rdx, 0FFFFFFFFFFFFFF80h ; key
__text:0000000100016EA8                 mov     esi, 256        ; bits
__text:0000000100016EAD                 mov     rdi, rbx        ; userKey
__text:0000000100016EB0                 call    _AES_set_encrypt_key
```

Backdoor functionality

Its next task is to setup the backdoor features:

Function name	Segment	Start
EkomsUserActivity::EkomsUserActivity(void)	__text	000000010000CDB0
EkomsUserActivity::service(void)	__text	000000010000CDD0
EkomsUserActivity::~EkomsUserActivity()	__text	000000010000CEB0
EkomsUserActivity::~EkomsUserActivity()	__text	000000010000CEC0

- **Capturing Audio**

Function name	Segment	Start
AudioCaptureSession::record(void)	__text	00000001000DCB50
AudioCaptureSession::setCaptureDevice(QString const&)	__text	00000001000DE080
AudioCaptureSession::setContainerFormat(QString const&)	__text	00000001000DC8A0
AudioCaptureSession::setFormat(QAudioFormat const&)	__text	00000001000DC890
AudioCaptureSession::setOutputLocation(QUrl const&)	__text	00000001000DC930
AudioCaptureSession::setState(QMediaRecorder::State)	__text	00000001000DC7E0
AudioCaptureSession::state(void)	__text	00000001000DD080
AudioCaptureSession::stateChanged(QMediaRecorder::State)	__text	00000001000DF010
AudioCaptureSession::status(void)	__text	00000001000DD090
AudioCaptureSession::statusChanged(QMediaRecorder::Sta...	__text	00000001000DF060
AudioCaptureSession::stop(void)	__text	00000001000DCA40
AudioCaptureSession::~AudioCaptureSession()	__text	00000001000DC6C0

- **Monitoring Removable Storage**

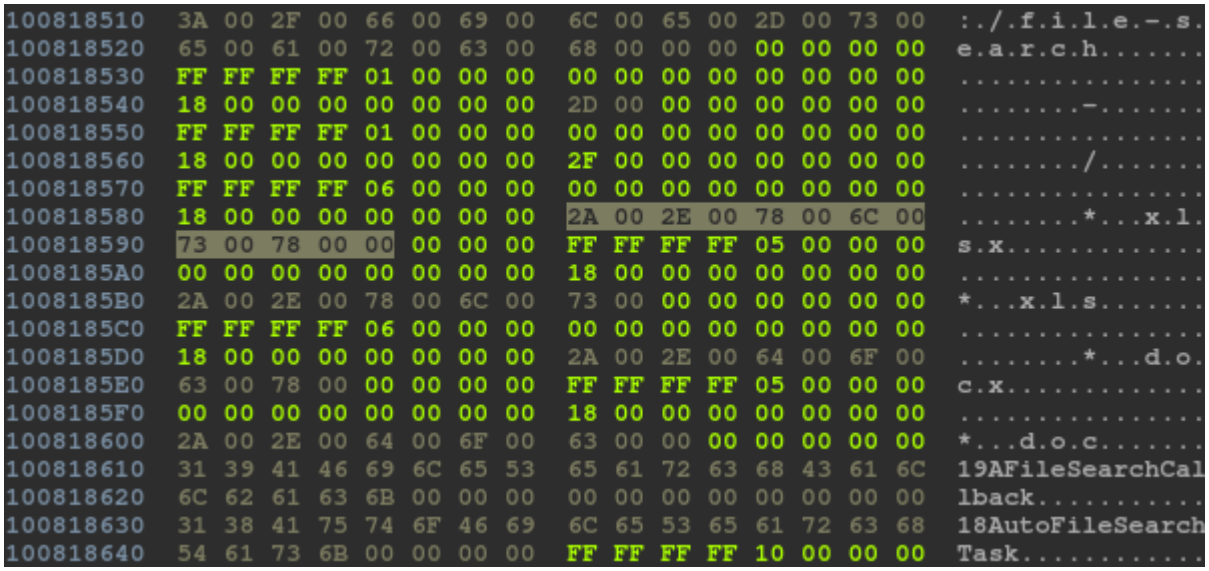
Function name	Segment	Start
AbRemovableStorageMonitorService::AbRemovableStorage...	__text	0000000100014770
AbRemovableStorageMonitorService::onStartService(void)	__text	0000000100014820
AbRemovableStorageMonitorService::onStopService(void)	__text	0000000100014830
AbRemovableStorageMonitorService::~AbRemovableStorag...	__text	0000000100014790
AbRemovableStorageMonitorService::~AbRemovableStorag...	__text	00000001000147D0

- **Capturing Screen (every 30 sec.)**

```
; Attributes: bp-based frame

; __int64 __fastcall AbScreenCapture::start(AbScreenCapture *__hidden this)
                public __ZN15AbScreenCapture5startEv
__ZN15AbScreenCapture5startEv proc near
                push    rbp
                mov     rbp, rsp
                mov     dword ptr [rdi+28h], 0
                and     byte ptr [rdi+24h], 0FEh
                add     rdi, 8 ; this
                mov     esi, 30000 ; int
                pop     rbp
                jmp     __ZN6QTimer5startEi ; QTimer::start(int)
__ZN15AbScreenCapture5startEv endp
```

- **Scanning the file system for Office documents (xls, xlsx, doc, docx)**



The attacker controlling the C&C server is also able to define own file filters to enhance the monitoring of the file system as well as executing arbitrary commands on the system.

Just like on other platforms, the malware creates several temporary files containing the collected data if the C&C server is not available.

- $TMPDIR/ss0-DDMMyy-HHmmss-nnn.sst (Screenshots)
- $TMPDIR/aa0-DDMMyy-HHmmss-nnn.aat (Audiocaptures)
- $TMPDIR/kk0-DDMMyy-HHmmss-nnn.kkt (Keylogs)
- $TMPDIR/dd0-DDMMyy-HHmmss-nnn.ddt (Arbitrary Data)

DDMMyy = date: 070916 = 2016-09-07
HHmmss = time: 154411 = 15:44:11
nnn = milliseconds

If the environment variable $TMPDIR is not defined, “/tmp/” is used as the location (http://doc.qt.io/qt-4.8/qdir.html#tempPath).

Hints from the author

The author of this malware again left some references to the corresponding source files:

```
;org 100B7B100h
dq offset __GLOBAL__sub_I_bot_main_macx_clang_release_plugin_import_cpp
dq offset __GLOBAL__sub_I_qrc_resource_bot_cpp
dq offset _OPENSSL_cpuid_setup
dq offset __GLOBAL__sub_I_avfcamerasession_mm
dq offset __GLOBAL__sub_I_qmediametadata_cpp
dq offset __GLOBAL__sub_I_qaudioformat_cpp
dq offset __GLOBAL__sub_I_qaudiodeviceinfo_cpp
dq offset __GLOBAL__sub_I_qaudiobuffer_cpp
dq offset __GLOBAL__sub_I_qmediacontent_cpp
dq offset __GLOBAL__sub_I_qmediaresource_cpp
dq offset __GLOBAL__sub_I_qmediaencodersettings_cpp
dq offset __GLOBAL__sub_I_qabstractvideobuffer_cpp
dq offset __GLOBAL__sub_I_qabstractvideosurface_cpp
dq offset __GLOBAL__sub_I_qvideoframe_cpp
dq offset __GLOBAL__sub_I_qvideosurfaceformat_cpp
dq offset __GLOBAL__sub_I_qhttpthreaddelegate_cpp
dq offset __GLOBAL__sub_I_qsharednetworksession_cpp
dq offset __GLOBAL__sub_I_qcocoaapplication_mm
dq offset __GLOBAL__sub_I_qcocoamenubar_mm
dq offset __GLOBAL__sub_I_qcocoahelpers_mm
dq offset __GLOBAL__sub_I_qmultitouch_mac_mm
dq offset __GLOBAL__sub_I_qpaintengine_mac_mm
```

Detection

We detect this type of malware as **HEUR:Backdoor.OSX.Mokes.a**

IOCs

Hash:

664e0a048f61a76145b55d1f1a5714606953d69edccec5228017eb546049dc8c

Files:

$HOME/LibraryApp Store/storeuserd

$HOME/Library/com.apple.spotlight/SpotlightHelper

$HOME/Library/Dock/com.apple.dock.cache

$HOME/Library/Skype/SkypeHelper

$HOME/Library/Dropbox/DropboxCache

$HOME/Library/Google/Chrome/nacld

$HOME/Library/Firefox/Profiles/profiled

$HOME/Library/LaunchAgents/$filename.plist

$TMPDIR/ss*-$date-$time-$ms.sst

$TMPDIR/aa*-$date-$time-$ms.aat

$TMPDIR/kk*-$date-$time-$ms.kkt

$TMPDIR/dd*-$date-$time-$ms.ddt

Hosts:

158.69.241[.]141

jikenick12and67[.]com

cameforcameand33212[.]com

User-Agent:
Mozilla/5.0 (Macintosh; Intel Mac OS X 10_9_3) AppleWebKit/537.75.14 (KHTML, like Gecko) Version/7.0.3 Safari/7046A194A
