black hat ASIA 2018
#BHASIA

Mac-A-Mal
An Automated Framework for Mac Malware Hunting

Pham Duy Phuc[†]
Fabio Massacci [†‡]

Sfylabs[†]
University of Trento[‡]

Motivation

- Mac OS market share is increasing 🔥
- Increasing number of new Mac malware
- Increasing complexity of Mac threats
- Common techniques to analyze malware using sandbox technologies on Windows, Linux, Android, ~~macOS.~~

→ Develop a auto malware analysis framework on macOS.

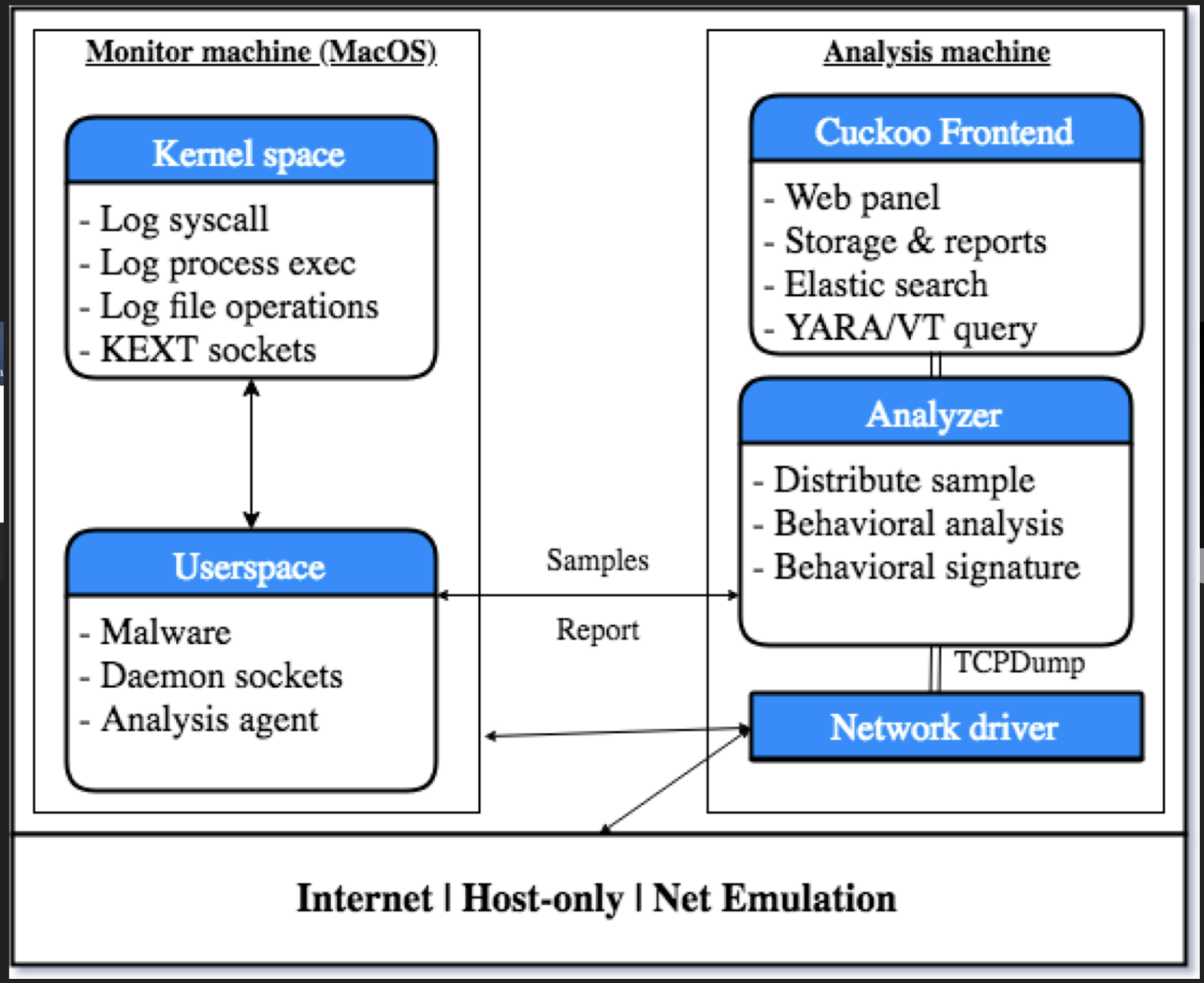
Malware analysis for macOS

- Static analysis
- Dynamic analysis
- Meet Cuckoo!

Mac-A-Mal static analysis

- Binary information: Header; CODE, DATA segments; DYLIB; LOAD commands; Symbol table.
- Entropy
- Signature information
- BoM information for DMG/APP archive
- Plist information

Mac-A-Mal dynamic analysis



Any file types are supported

- /usr/bin/open - mac_syscall interface
- hdiutil – mount Apple disk image
- Java – Perl – Python
- Archive
- URL

Kernel-space monitor

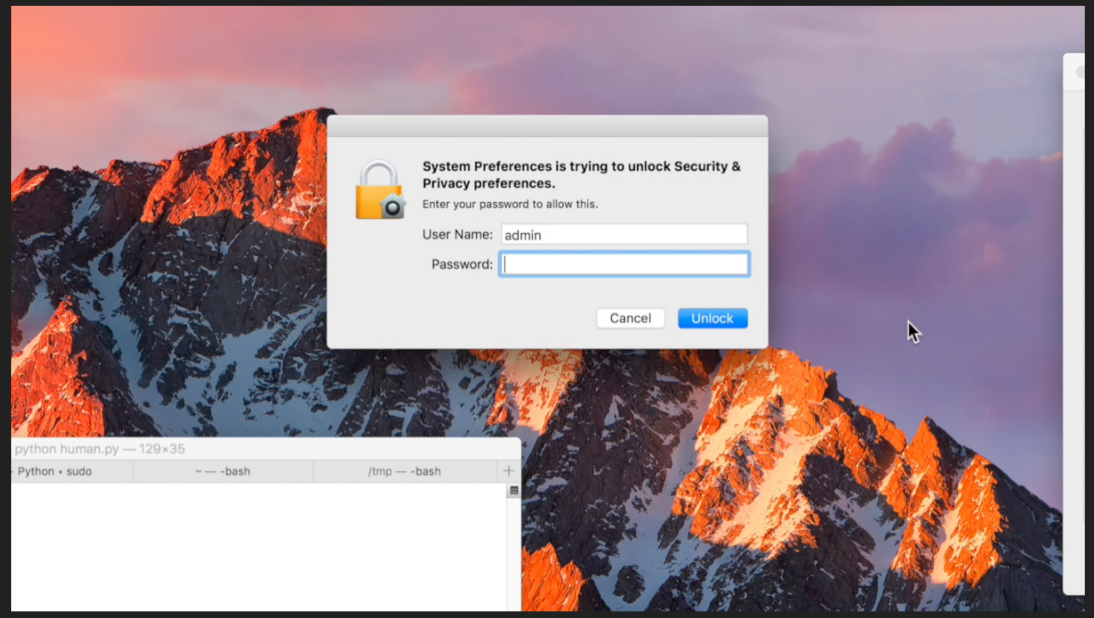
- Resolve macOS kernel protection: Onyx the black cat & Grey-fox
- Syscall interception and arguments collection
- Process tracing, XPC Services tracing
- File accessed behaviors
- Network syscall

Detect evasion techniques & mitigation

- Detect Anti-debug:
  - By intercept → ptrace(), sysctl()
- Mitigate Anti-sandbox:
  - SIP status manipulation → csrctl ()
  - Hardening process names, virtual devices information (display resolution, processor cores, etc.) → sysctl(), ioctl()
  - Harden VM configuration (e.g: CPUID, VM Plist)

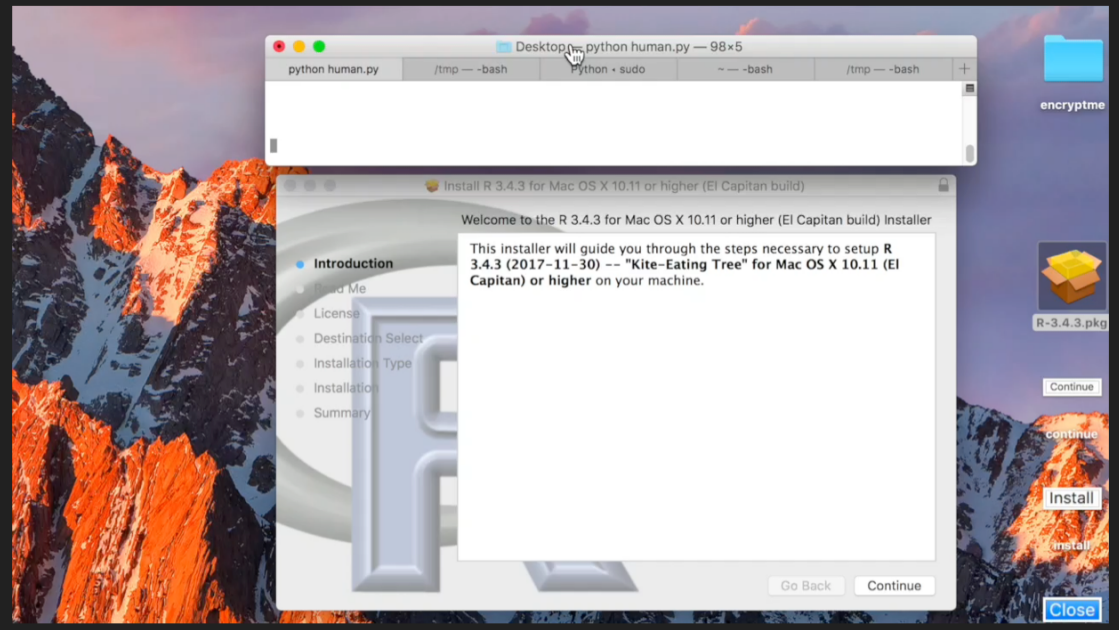
March 12, 1970, 1:16 p.m. **posix_spawn**	arg0: 5441 arg1: /usr/sbin/sysctl arg2: -n hw.model
March 12, 1970, 1:16 p.m. **posix_spawn**	arg0: 5442 arg1: /usr/sbin/sysctl arg2: -n hw.physicalcpu

(no) Human Interaction



Authorization Solver

- Quartz: CGEventCreateKeyboardEvent



Screenshots & Interact MessageBox:

- Quartz: CGWindowListCreateImage, CGEventCreateMouseEvent

OSX/Mughthesec

Static analysis
Developer code signer

Quoc Thinh 9G2J3967H9
Pham Huong 2BS26F3ZCP
Phan Anh C7J9SJ95GX
Nhien Nguyen
Thanh Thuy WAA98JBA59
Tran Phong GMFY4TULB3
Minh Duc 7CXE5FM69W
Mai Linh M3XXTCHY66

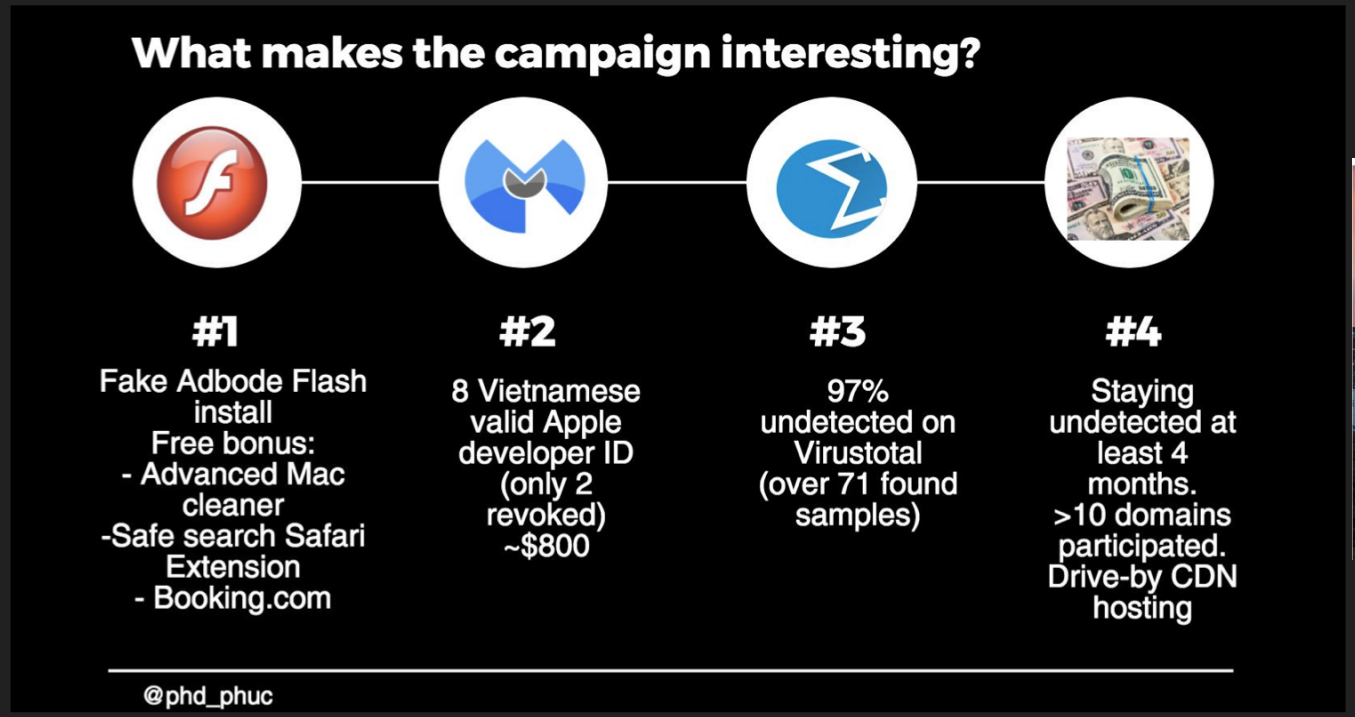
Dynamic analysis

Evasion by detecting network driver MAC address

Persistence indicator: *mughthesec.plist*

Network
Suspicious domains

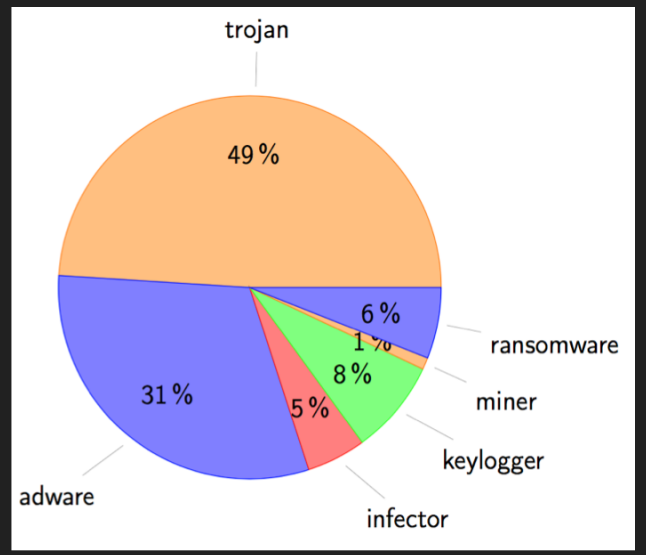
appfastplay.com
mughthesec.com
SimplyEApps.com
dynacubeapps.
cloudmacfront.com
api.airautoupdates.com
osxessentials.com
api.vertizoom.com
macgabspan.com
install.searchwebsvc.com
trustedsafefinder.com



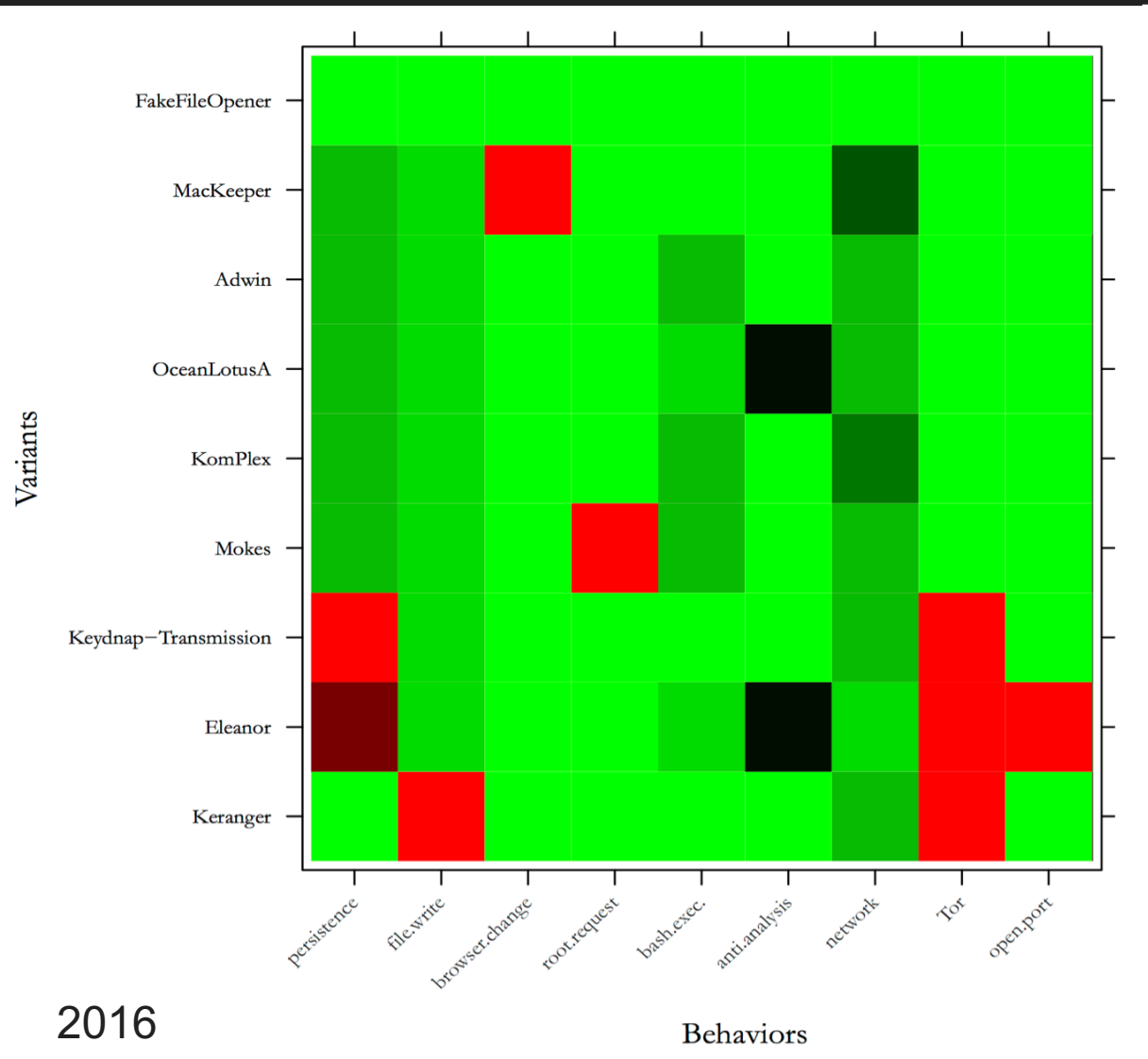
Screenshot(s)

On large scale

- N=2149
- 85% of the collected samples are adware, which dominated by OSX/Pirrit and OSX/MacKeeper
- 86 different Mac malware families, and 49% of them belongs to backdoor/trojan.



macOS malware evolution



2016

2017

Summary

- It is possible to automatically analyze network traffic, malware evasion techniques, persistence methods, file operations etc. from samples in virtualized Mac environment.
- We succeeded in clarifying malware variants and its evolution on macOS
- Found undiscovered Mac adware including legitimate Apple developer certificates, other undetected backdoor (APT32) → possibility of outperforming existing solutions currently available on the market.
- Opensource: https://github.com/phdphuc/mac-a-mal

Q&A