Electron Security

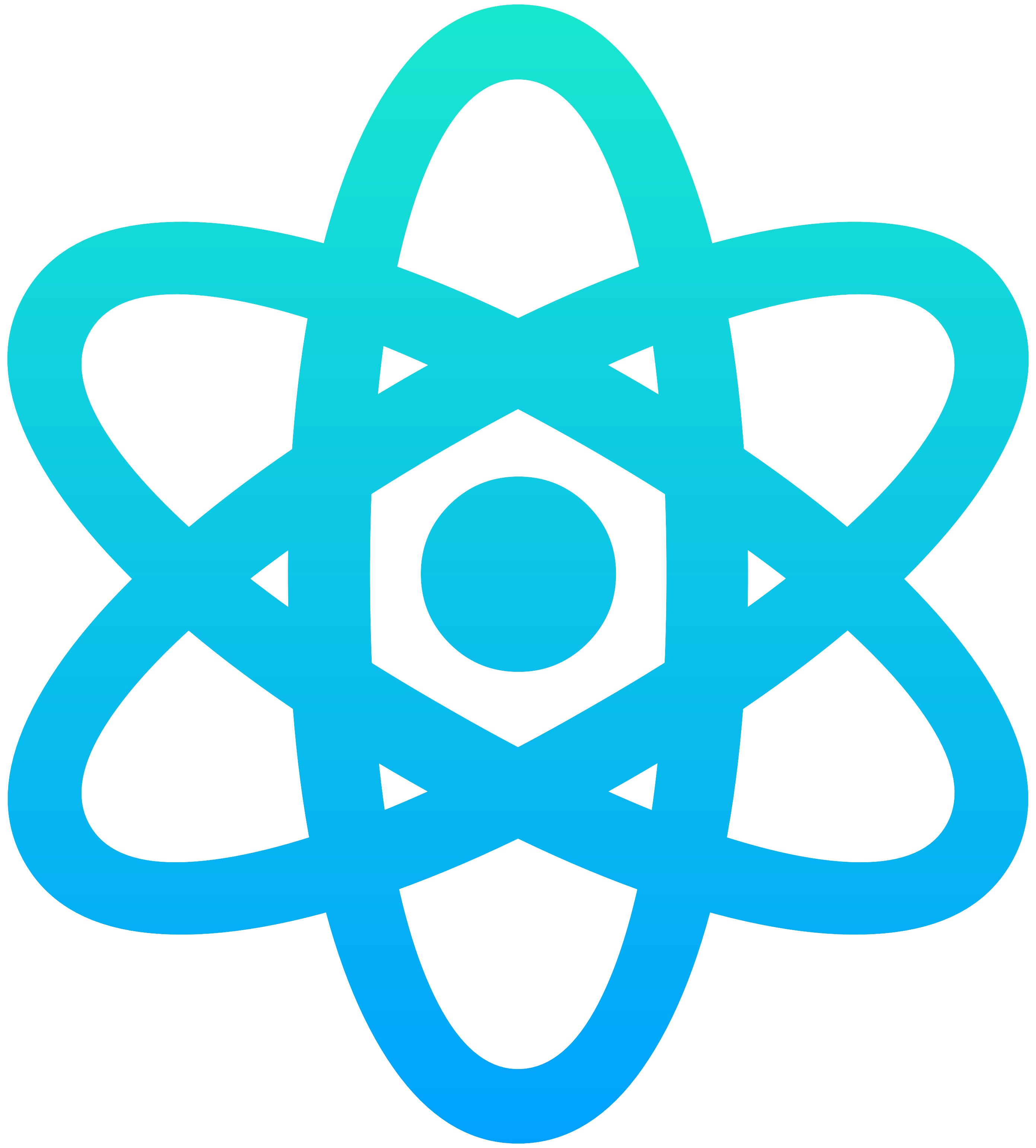
Making your Mac (and PC) a worse place?

Mykola Grymalyuk - February 19th, 2025

University of Utah - MacAdmins Meeting

Bill of Materials

- What is Electron?
- Overview of Electron’s Structure
- Introduction to Electron Fuses
- Dangers of Arbitrary Code Execution
- Demos galore with Lectricus!
- Using Endpoint Security
- Electron’s response
- Next steps



$ '/usr/bin/whoami'

```
> "Mykola Grymalyuk"
```

- Lead Security and Software Engineer at RIPEDA Consulting 🇨🇦.
- Project lead of OpenCore Legacy Patcher.
- Breaks macOS internals on my blog, khronokernel.com.

What is Electron?

What is Electron?

What is Electron?

1. Chromium

What is Electron?

1. Chromium

2. Node.JS

What is Electron?

1. Chromium

2. Node.JS

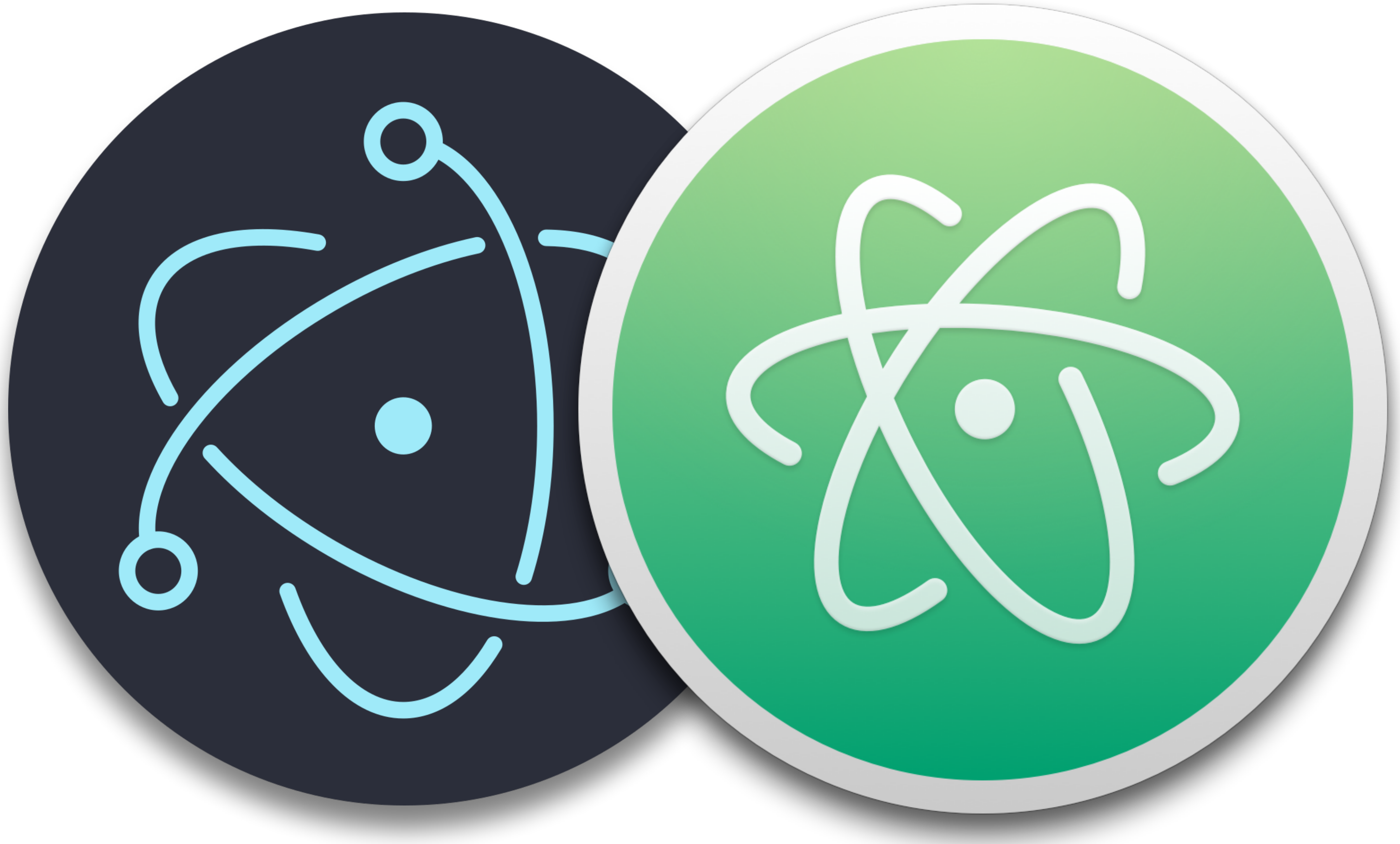
3. Multi-Platform

x86_64

ARM64

Electron

- Initial release in 2013.
- Designed originally for Atom.
- Other frameworks also exist, like nwjs (formerly node-webkit)
- Many applications use Electron:
  - Slack
  - Discord
  - Visual Studio Code
  - 1Password
  - OpenVPN



Electron Structure

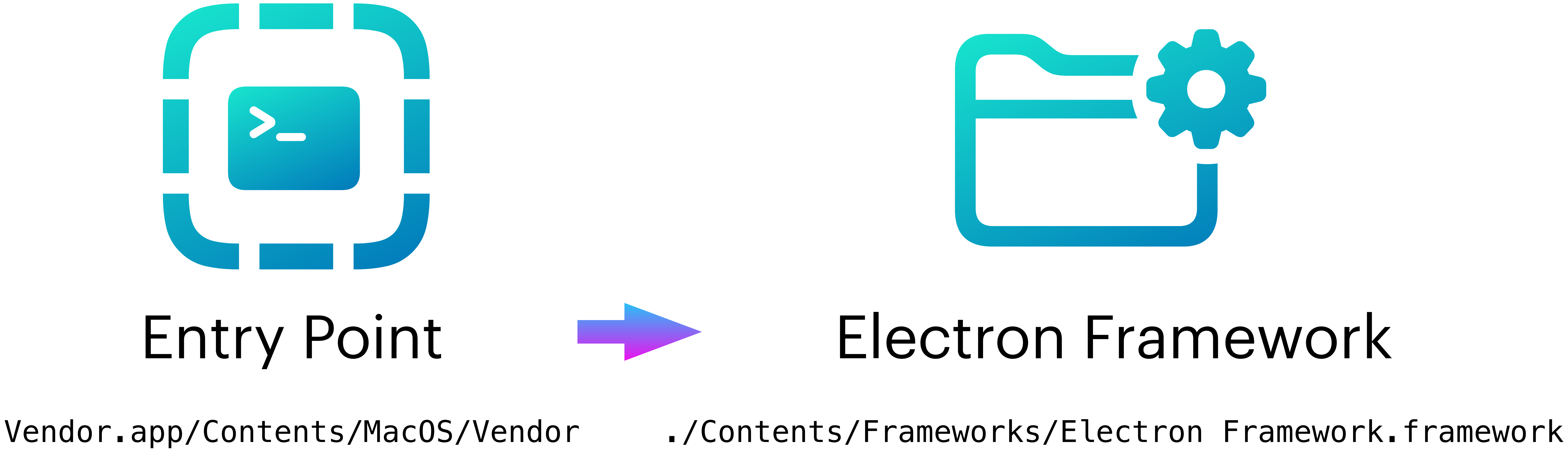
Electron Structure

Electron Structure

Entry Point

`Vendor.app/Contents/MacOS/Vendor`

Electron Structure

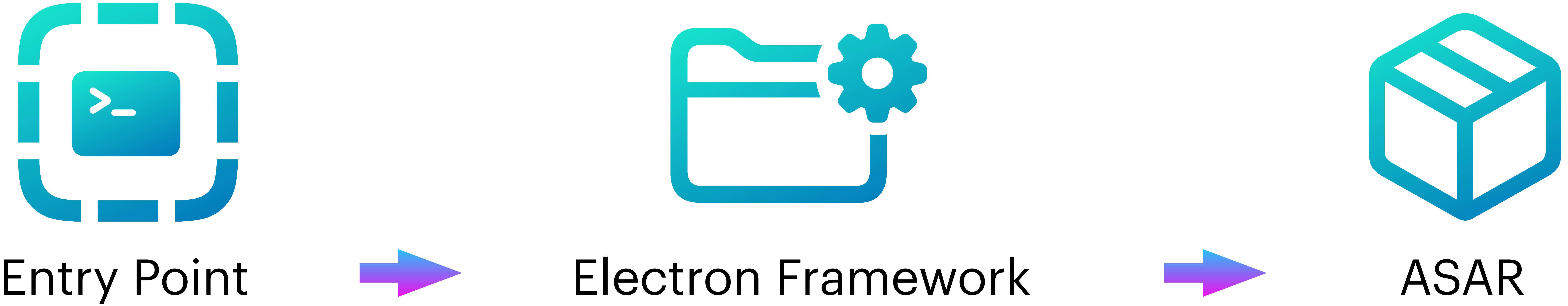


Entry Point → Electron Framework

`Vendor.app/Contents/MacOS/Vendor`

`./Contents/Frameworks/Electron Framework.framework`

Electron Structure



Entry Point

`Vendor.app/Contents/MacOS/Vendor`

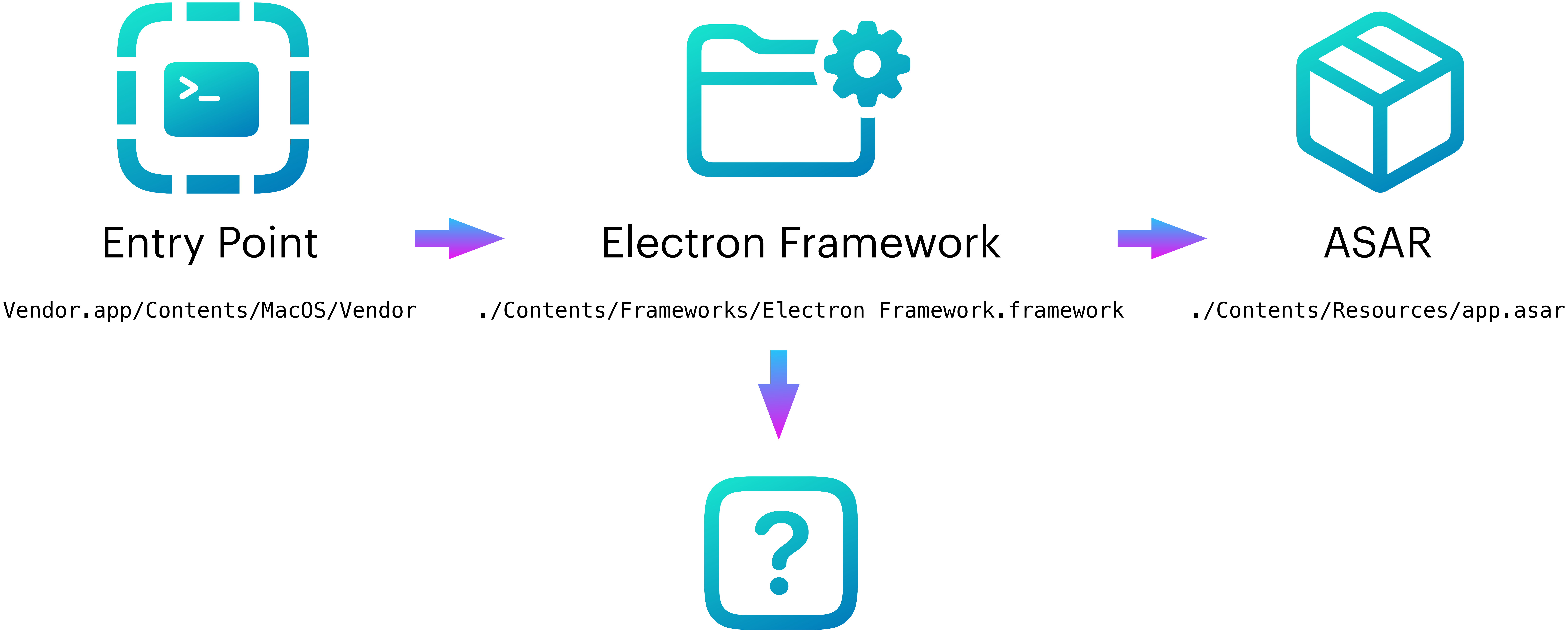
Electron Framework

`./Contents/Frameworks/Electron Framework.framework`

ASAR

`./Contents/Resources/app.asar`

Electron Structure



Entry Point

`Vendor.app/Contents/MacOS/Vendor`

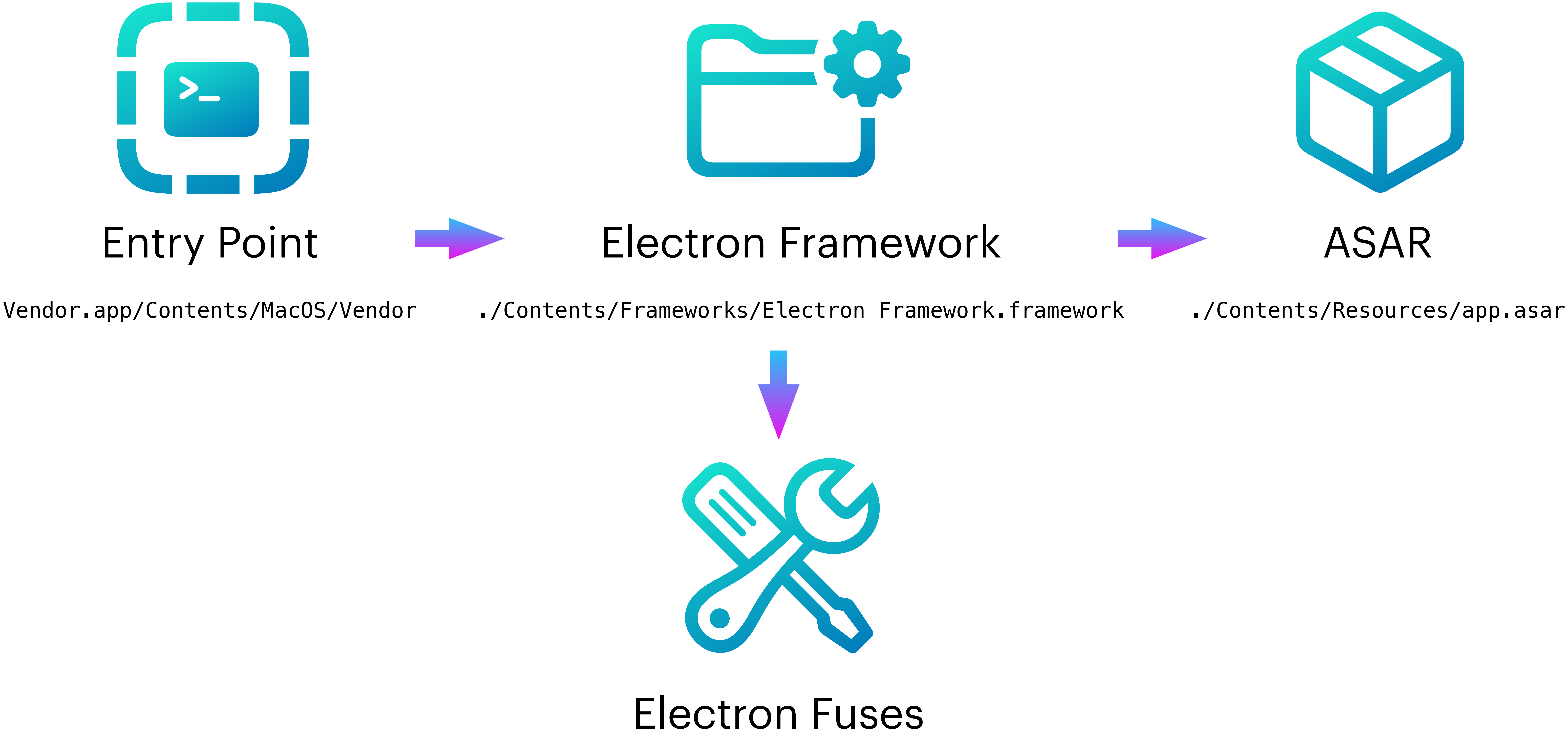
Electron Framework

`./Contents/Frameworks/Electron Framework.framework`

ASAR

`./Contents/Resources/app.asar`

Electron Structure



Entry Point

Vendor.app/Contents/MacOS/Vendor

Electron Framework

./Contents/Frameworks/Electron Framework.framework

ASAR

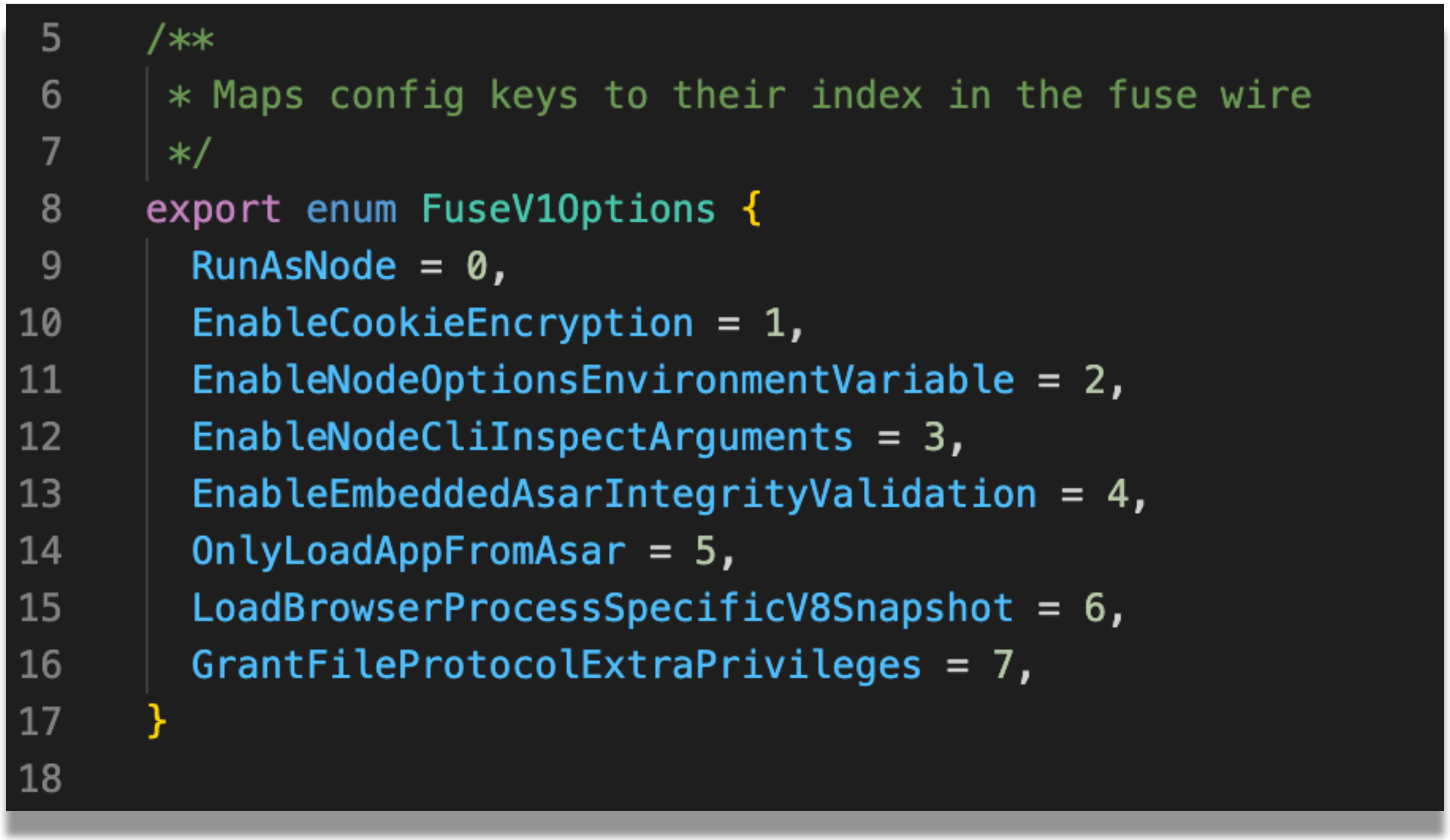
./Contents/Resources/app.asar

Electron Fuses

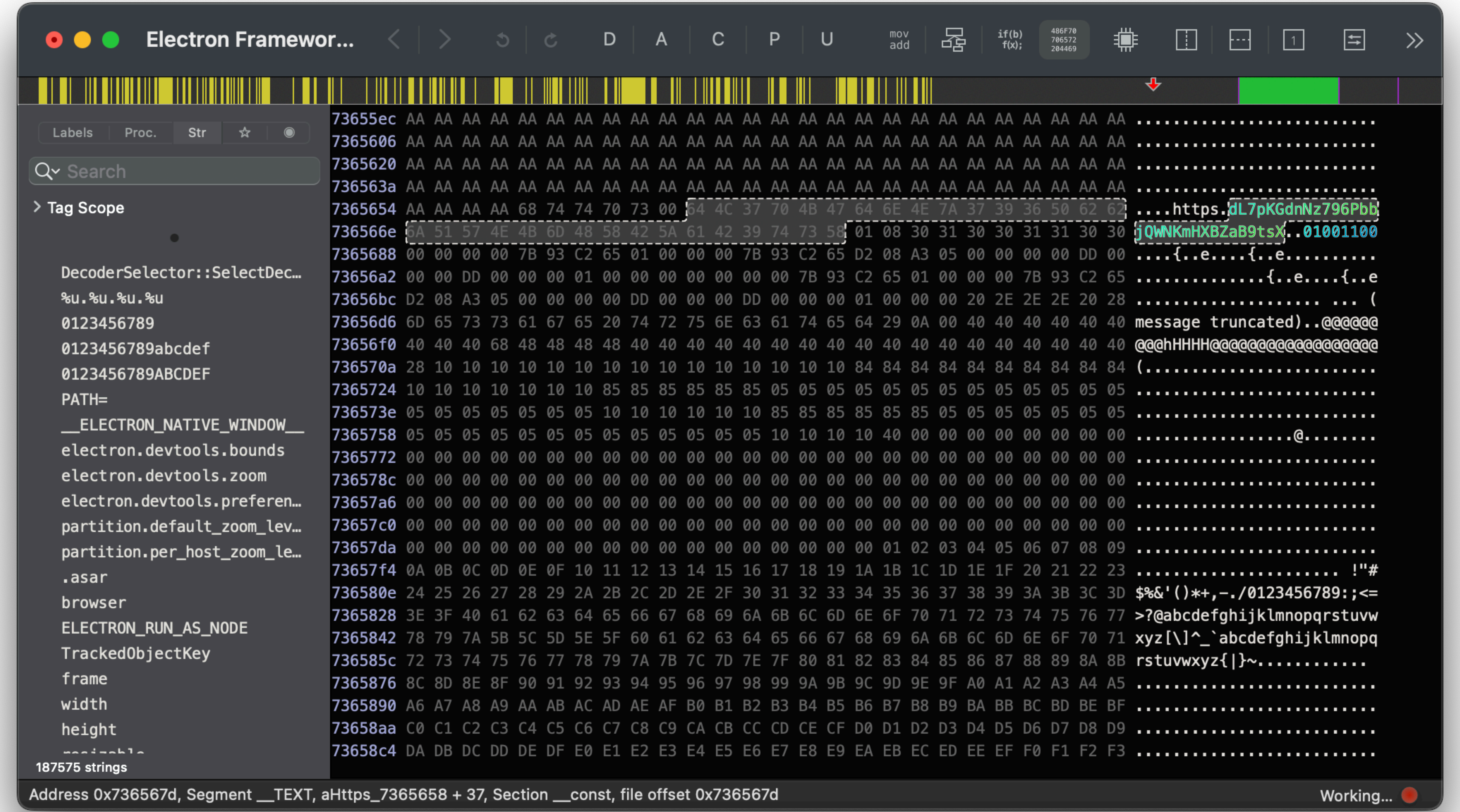
Electron Fuses

Debug options!

- Embedded inside Electron.framework.
- Introduced with Electron v12.0.0 in 2021.
- Found after a “`sentinel`”:
    - `dL7pKGdnNz796PbbjQWNKmHXBZaB9tsX`
- 8 fuses currently implemented as of fuses v1.8.0.
- On/Off switches.
    - Similar to macOS’ System Integrity Protection (SIP)



```
/**
 * Maps config keys to their index in the fuse wire
 */
export enum FuseV1Options {
  RunAsNode = 0,
  EnableCookieEncryption = 1,
  EnableNodeOptionsEnvironmentVariable = 2,
  EnableNodeCliInspectArguments = 3,
  EnableEmbeddedAsarIntegrityValidation = 4,
  OnlyLoadAppFromAsar = 5,
  LoadBrowserProcessSpecificV8Snapshot = 6,
  GrantFileProtocolExtraPrivileges = 7,
}
```



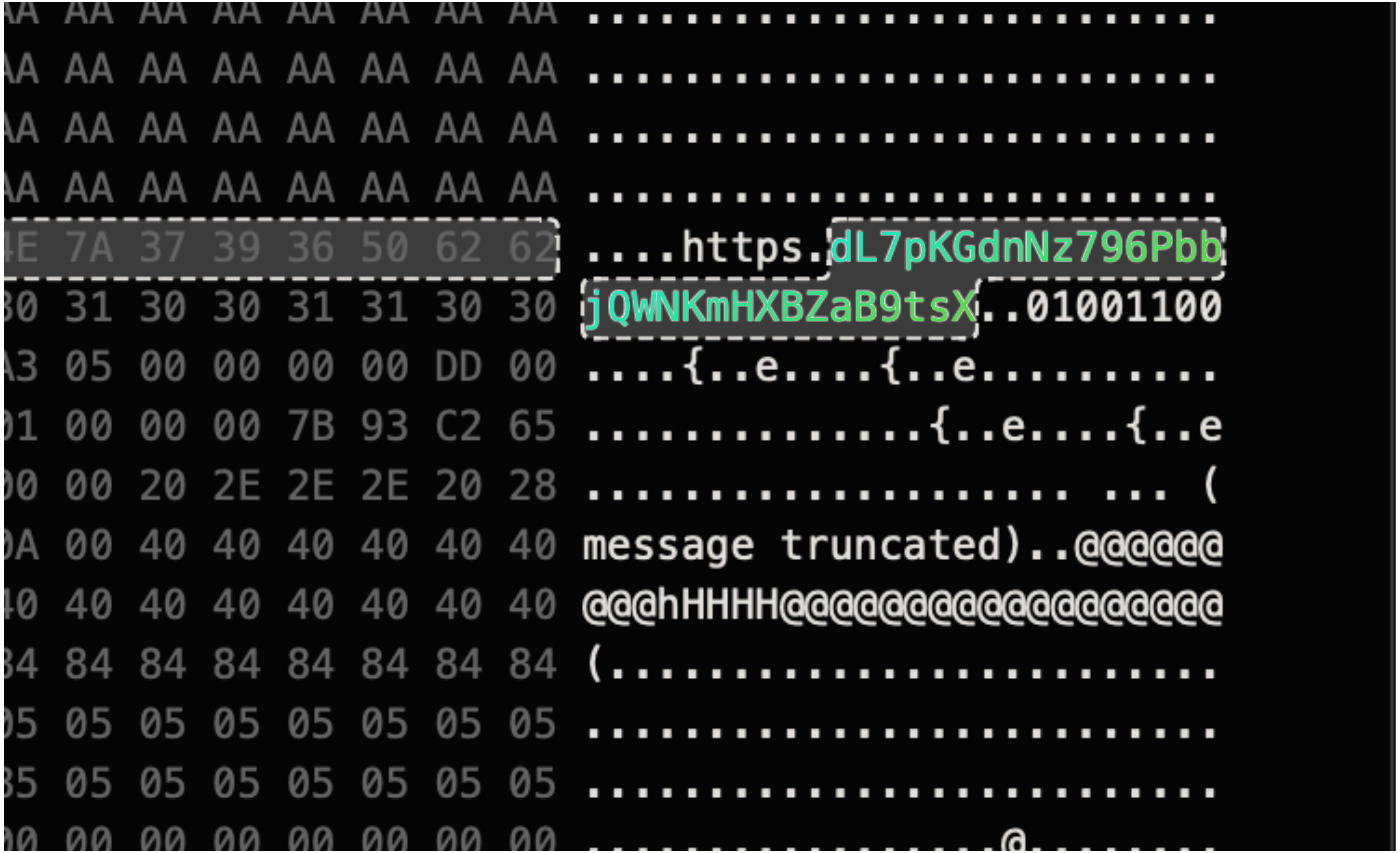
```
DecoderSelector::SelectDec…
%u.%u.%u.%u
0123456789
0123456789abcdef
0123456789ABCDEF
PATH=
__ELECTRON_NATIVE_WINDOW__
electron.devtools.bounds
electron.devtools.zoom
electron.devtools.preferen…
partition.default_zoom_lev…
partition.per_host_zoom_le…
.asar
browser
ELECTRON_RUN_AS_NODE
TrackedObjectKey
frame
width
height
```

187575 strings

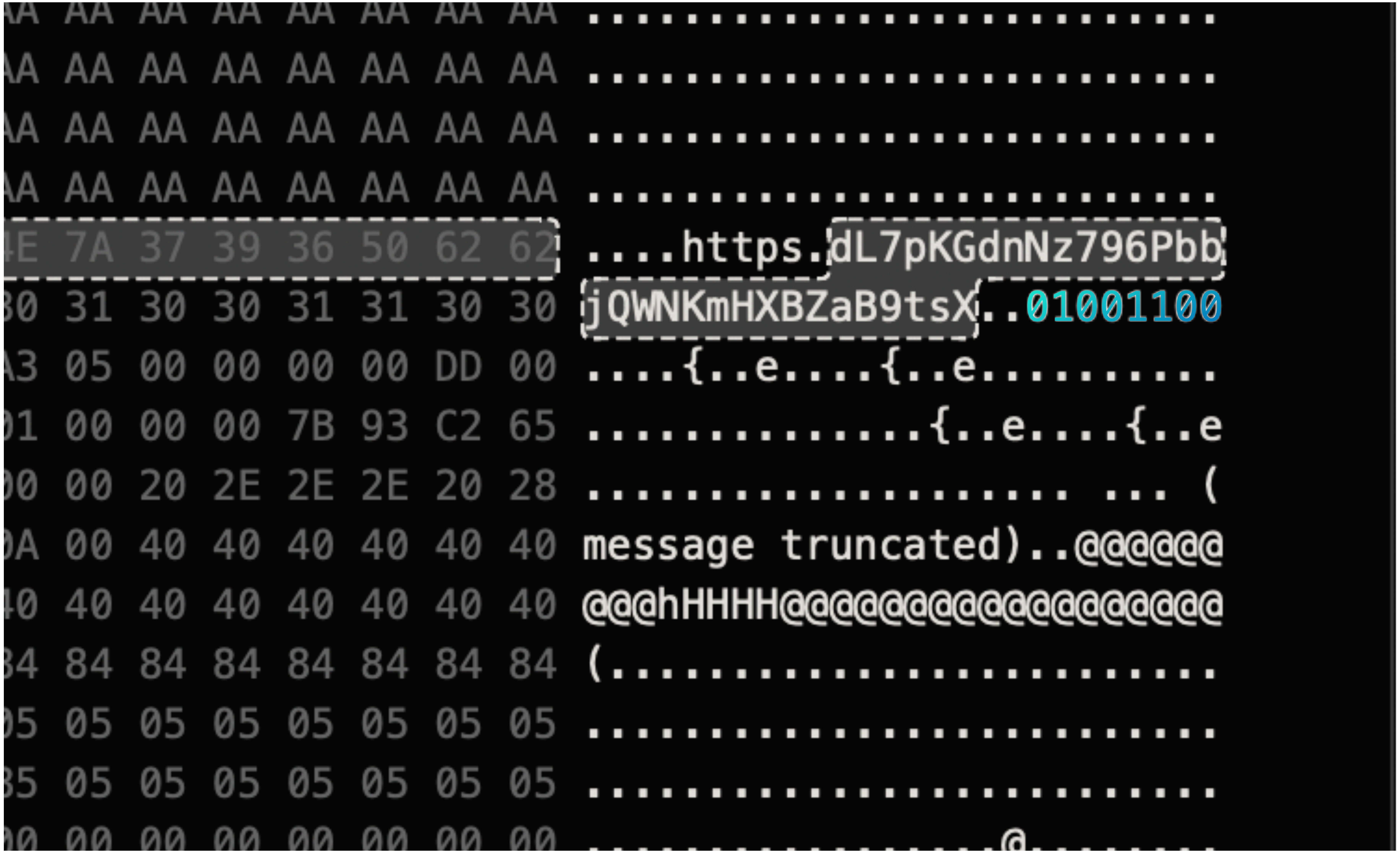
```
73655ec AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA ..........................
7365606 AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA ..........................
7365620 AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA ..........................
736563a AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA ..........................
7365654 AA AA AA AA 68 74 74 70 73 00 64 4C 37 70 4B 47 64 6E 4E 7A 37 39 36 50 62 62 ....https.dL7pKGdnNz796Pbb
736566e 6A 51 57 4E 4B 6D 48 58 42 5A 61 42 39 74 73 58 01 08 30 31 30 30 31 31 30 30 jQWNKmHXBZaB9tsX..01001100
7365688 00 00 00 00 7B 93 C2 65 01 00 00 00 7B 93 C2 65 D2 08 A3 05 00 00 00 00 DD 00 ....{..e....{..e..........
73656a2 00 00 DD 00 00 00 01 00 00 00 00 00 00 00 7B 93 C2 65 01 00 00 00 7B 93 C2 65 ..............{..e....{..e
73656bc D2 08 A3 05 00 00 00 00 DD 00 00 00 DD 00 00 00 01 00 00 00 20 2E 2E 2E 20 28 .................... ... (
73656d6 6D 65 73 73 61 67 65 20 74 72 75 6E 63 61 74 65 64 29 0A 00 40 40 40 40 40 40 message truncated)..@@@@@@
73656f0 40 40 40 68 48 48 48 48 40 40 40 40 40 40 40 40 40 40 40 40 40 40 40 40 40 40 @@@hHHHH@@@@@@@@@@@@@@@@@@
736570a 28 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 84 84 84 84 84 84 84 84 84 84 (.........................
7365724 10 10 10 10 10 10 10 85 85 85 85 85 85 05 05 05 05 05 05 05 05 05 05 05 05 05 ..........................
736573e 05 05 05 05 05 05 05 10 10 10 10 10 10 85 85 85 85 85 85 05 05 05 05 05 05 05 ..........................
7365758 05 05 05 05 05 05 05 05 05 05 05 05 05 10 10 10 10 40 00 00 00 00 00 00 00 00 .................@........
7365772 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ..........................
736578c 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ..........................
73657a6 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ..........................
73657c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ..........................
73657da 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 01 02 03 04 05 06 07 08 09 ..........................
73657f4 0A 0B 0C 0D 0E 0F 10 11 12 13 14 15 16 17 18 19 1A 1B 1C 1D 1E 1F 20 21 22 23 ...................... !"#
736580e 24 25 26 27 28 29 2A 2B 2C 2D 2E 2F 30 31 32 33 34 35 36 37 38 39 3A 3B 3C 3D $%&'()*+,-./0123456789:;<=
7365828 3E 3F 40 61 62 63 64 65 66 67 68 69 6A 6B 6C 6D 6E 6F 70 71 72 73 74 75 76 77 >?@abcdefghijklmnopqrstuvw
7365842 78 79 7A 5B 5C 5D 5E 5F 60 61 62 63 64 65 66 67 68 69 6A 6B 6C 6D 6E 6F 70 71 xyz[\]^_`abcdefghijklmnopq
736585c 72 73 74 75 76 77 78 79 7A 7B 7C 7D 7E 7F 80 81 82 83 84 85 86 87 88 89 8A 8B rstuvwxyz{|}~.............
7365876 8C 8D 8E 8F 90 91 92 93 94 95 96 97 98 99 9A 9B 9C 9D 9E 9F A0 A1 A2 A3 A4 A5 ..........................
7365890 A6 A7 A8 A9 AA AB AC AD AE AF B0 B1 B2 B3 B4 B5 B6 B7 B8 B9 BA BB BC BD BE BF ..........................
73658aa C0 C1 C2 C3 C4 C5 C6 C7 C8 C9 CA CB CC CD CE CF D0 D1 D2 D3 D4 D5 D6 D7 D8 D9 ..........................
73658c4 DA DB DC DD DE DF E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 EA EB EC ED EE EF F0 F1 F2 F3 ..........................
```

Address 0x736567d, Segment __TEXT, aHttps_7365658 + 37, Section __const, file offset 0x736567d

Working...



```
AA AA AA AA AA AA AA AA ..........................
AA AA AA AA AA AA AA AA ..........................
AA AA AA AA AA AA AA AA ..........................
AA AA AA AA AA AA AA AA ..........................
4E 7A 37 39 36 50 62 62 ....https.dL7pKGdnNz796Pbb
30 31 30 30 31 31 30 30 jQWNKmHXBZaB9tsX..01001100
A3 05 00 00 00 00 DD 00 ....{..e....{..e..........
01 00 00 00 7B 93 C2 65 ..............{..e....{..e
00 00 20 2E 2E 2E 20 28 .................... ... (
0A 00 40 40 40 40 40 40 message truncated)..@@@@@@
40 40 40 40 40 40 40 40 @@@hHHHH@@@@@@@@@@@@@@@@@@
84 84 84 84 84 84 84 84 (.........................
05 05 05 05 05 05 05 05 ..........................
85 05 05 05 05 05 05 05 ..........................
00 00 00 00 00 00 00 00 .................@........
```



```
AA AA AA AA AA AA AA AA ..........................
AA AA AA AA AA AA AA AA ..........................
AA AA AA AA AA AA AA AA ..........................
AA AA AA AA AA AA AA AA ..........................
4E 7A 37 39 36 50 62 62 ....https.dL7pKGdnNz796Pbb
30 31 30 30 31 31 30 30 jQWNKmHXBZaB9tsX..01001100
A3 05 00 00 00 00 DD 00 ....{..e....{..e..........
01 00 00 00 7B 93 C2 65 ..............{..e....{..e
00 00 20 2E 2E 2E 20 28 .................... ... (
0A 00 40 40 40 40 40 40 message truncated)..@@@@@@
40 40 40 40 40 40 40 40 @@@hHHHH@@@@@@@@@@@@@@@@@@
84 84 84 84 84 84 84 84 (.........................
05 05 05 05 05 05 05 05 ..........................
85 05 05 05 05 05 05 05 ..........................
00 00 00 00 00 00 00 00 ..................@.......
```

Slack's Electron Fuses

0	→	0x0 RunAsNode
1	→	0x1 EnableCookieEncryption
0	→	0x2 EnableNodeOptionsEnvironmentVariable
0	→	0x3 EnableNodeCliInspectArguments
1	→	0x4 EnableEmbeddedAsarIntegrityValidation
1	→	0x5 OnlyLoadAppFromAsar
0	→	0x6 LoadBrowserProcessSpecificV8Snapshot
0	→	0x7 GrantFileProtocolExtraPrivileges

Apple’s System Integrity Protection

```
0x803 -> 1000 0000 0011 -> 1100 0000 0001
```

1	→	0x1	CSR_ALLOW_UNTRUSTED_KEXTS
1	→	0x2	CSR_ALLOW_UNRESTRICTED_FS
0	→	0x4	CSR_ALLOW_TASK_FOR_PID
0	→	0x8	CSR_ALLOW_KERNEL_DEBUGGER
0	→	0x10	CSR_ALLOW_APPLE_INTERNAL
0	→	0x20	CSR_ALLOW_UNRESTRICTED_DTRACE
0	→	0x40	CSR_ALLOW_UNRESTRICTED_NVRAM
0	→	0x80	CSR_ALLOW_DEVICE_CONFIGURATION
0	→	0x100	CSR_ALLOW_ANY_RECOVERY_OS
0	→	0x200	CSR_ALLOW_UNAPPROVED_KEXTS
0	→	0x400	CSR_ALLOW_EXECUTABLE_POLICY_OVERRIDE
1	→	0x800	CSR_ALLOW_UNAUTHENTICATED_ROOT

The fun electron fuses

RunAsNode

EnableNodeCliInspectArguments

RunAsNode

- Introduced in Electron v0.35.2
- Environment Variable:
    - `ELECTRON_RUN_AS_NODE`
- Free node.js shell.

EnableNodeCliInspectArguments

- Introduced with Electron v2.0.0
- Argument:
    - `--inspect={port}`
- WebSocket for communication.

RunAsNode

```
$ ELECTRON_RUN_AS_NODE=1 Vendor.app/Contents/MacOS/Vendor hello.js
```

EnableNodeCliInspectArguments

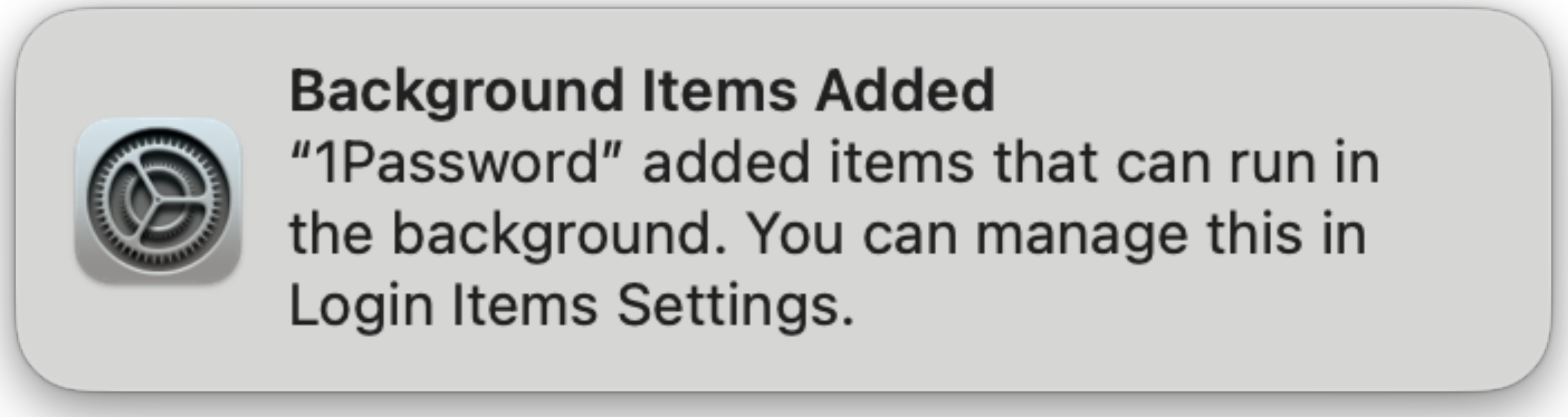
```
$ Vendor.app/Contents/MacOS/Vendor --inspect=4096

> http://127.0.0.1:4096/json/ -> webSocketDebuggerUrl

> ws://127.0.0.1:26711/e580f9b3-0905-4c49-8a37-e3d17ea04410:
{“params”: {
  “expression”: “eval(‘hello world’)”
  }}
```

What does this mean for us?

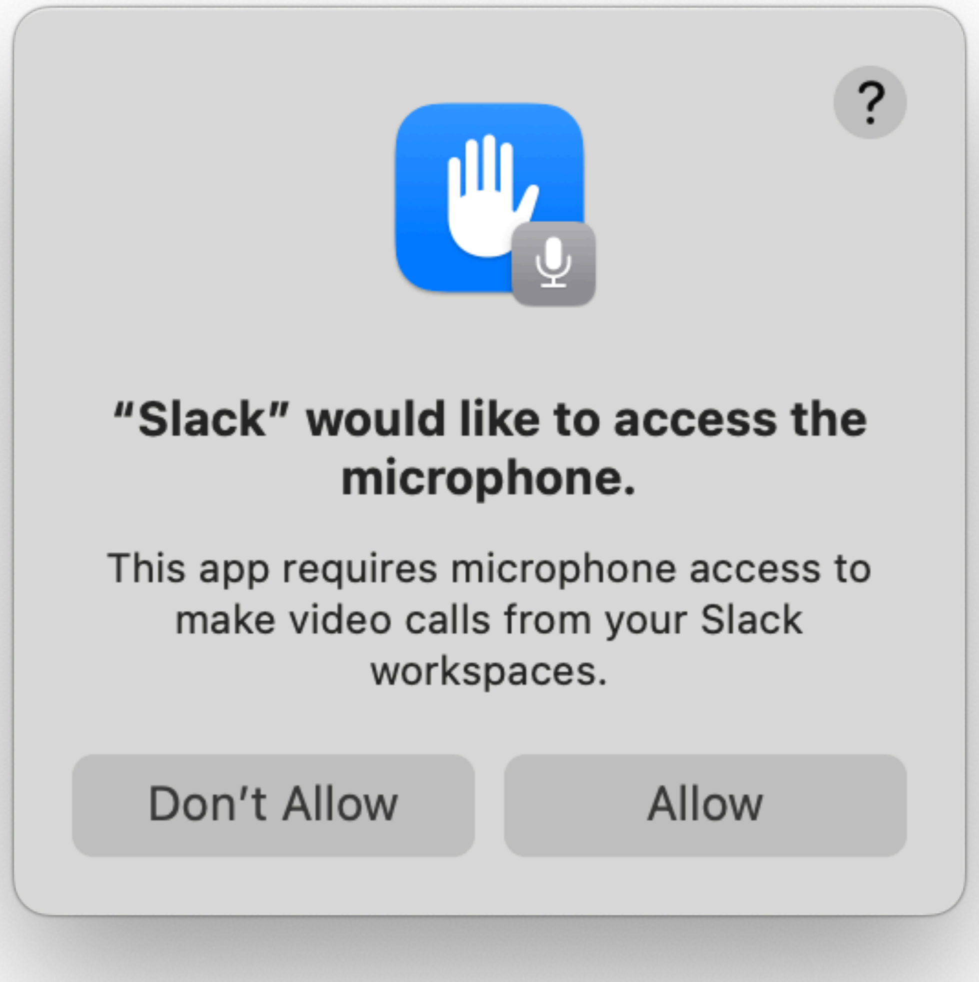
Arbitrary code execution 🎉

Arbitrary Code Execution

- Ability to run random code of your choosing.
- Code Signature Inheritance.
  - Launch Service Prompts.
  - TCC Inheritance.
- Windows: TCC-like permissions opt-in
- Linux: N/A



Background Items Added
"1Password" added items that can run in the background. You can manage this in Login Items Settings.

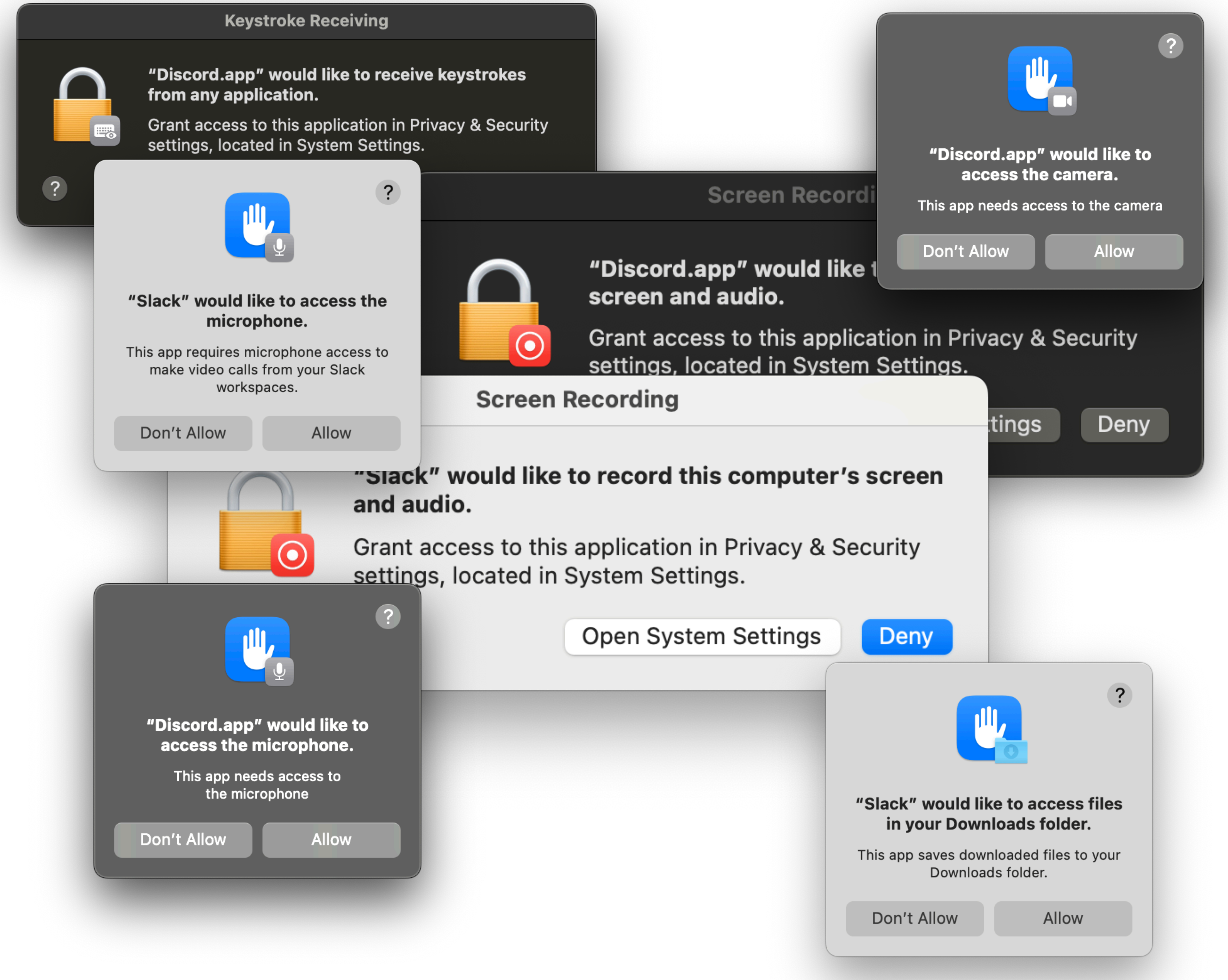


"Slack" would like to access the microphone.

This app requires microphone access to make video calls from your Slack workspaces.

TCC

- Transparency, Consent, and Control.
- Yeah those annoying prompts.
- Inheritance for child processes.
- Important to Apple.
- All applications must respect it (SIP protected).



Keystroke Receiving

“Discord.app” would like to receive keystrokes from any application.

Grant access to this application in Privacy & Security settings, located in System Settings.

“Discord.app” would like to access the camera.

This app needs access to the camera

Screen Recordi

“Discord.app” would like t screen and audio.

Grant access to this application in Privacy & Security settings, located in System Settings.

“Slack” would like to access the microphone.

This app requires microphone access to make video calls from your Slack workspaces.

Screen Recording

“Slack” would like to record this computer’s screen and audio.

Grant access to this application in Privacy & Security settings, located in System Settings.

“Discord.app” would like to access the microphone.

This app needs access to the microphone

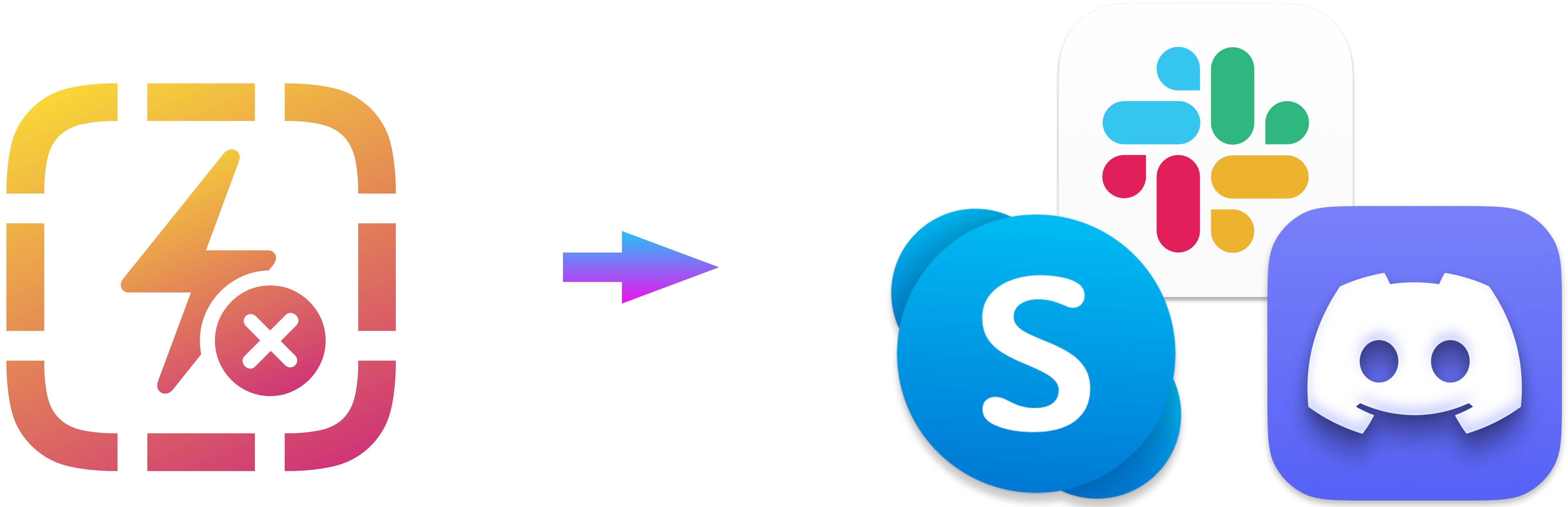
“Slack” would like to access files in your Downloads folder.

This app saves downloaded files to your Downloads folder.

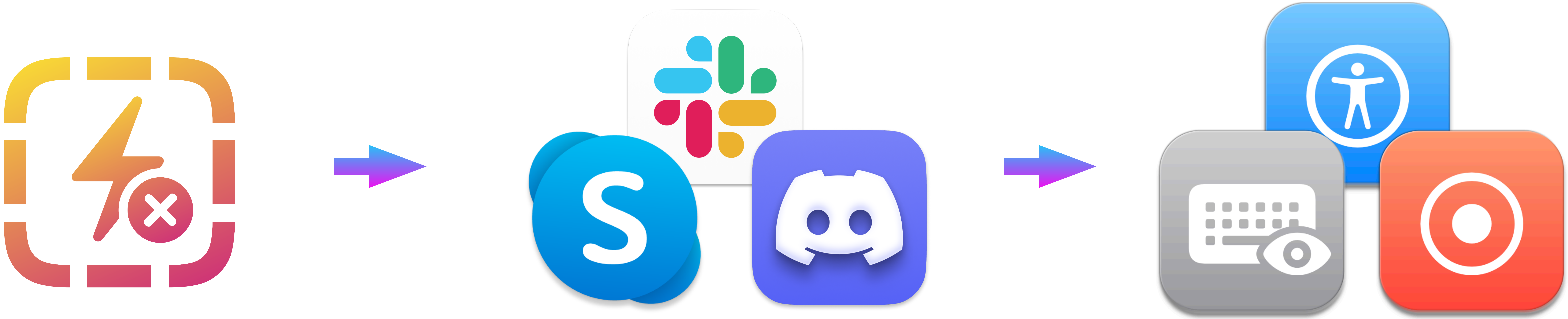
Attack Scenario #1 in Enterprise

Malicious software in Enterprise

Malicious software in Enterprise



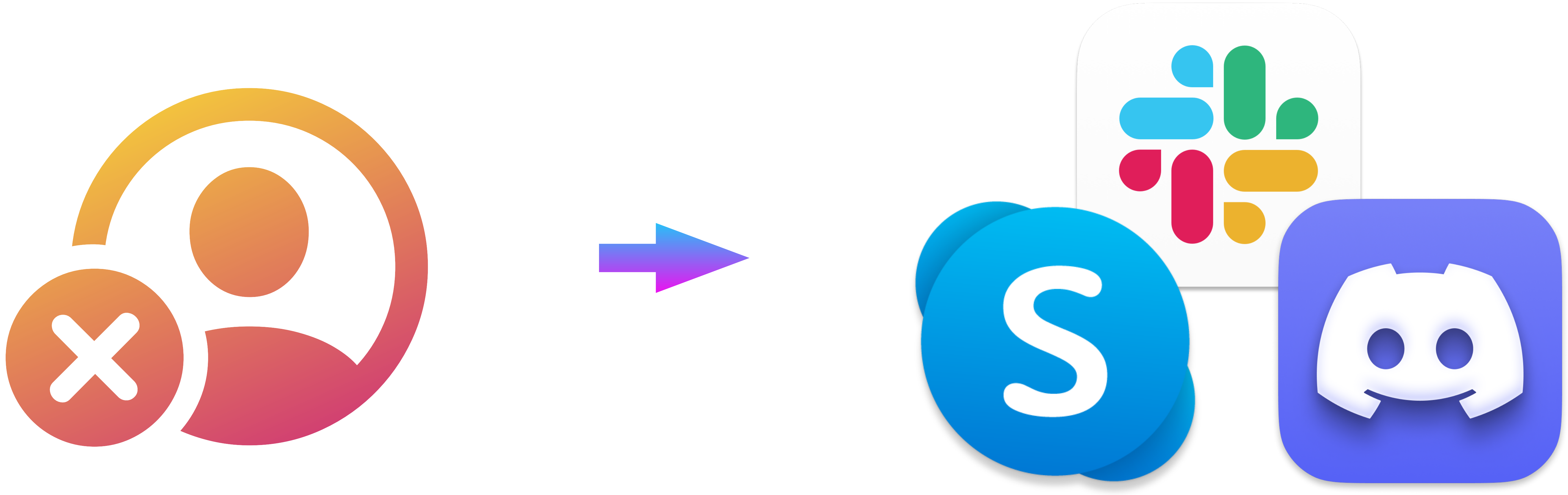
Malicious software in Enterprise



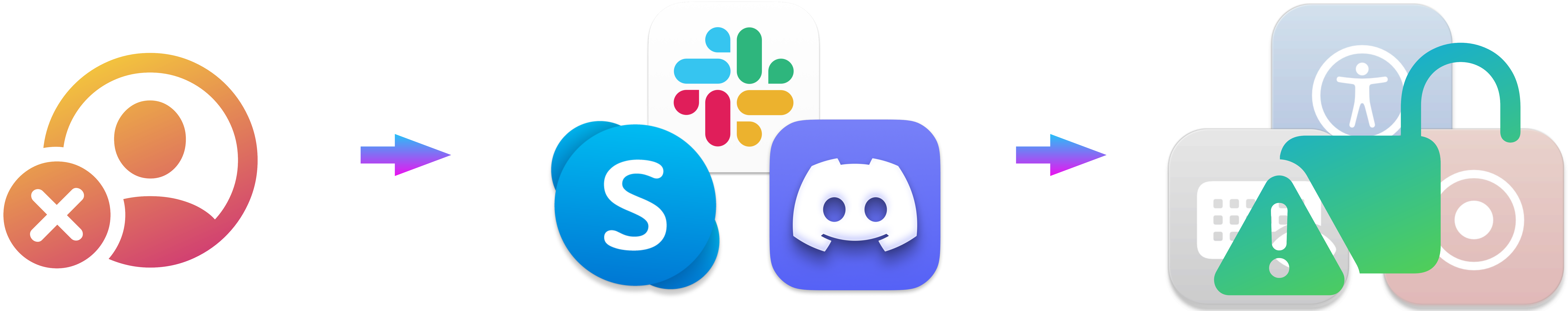
Attack Scenario #2 in Enterprise

Malicious user in Enterprise

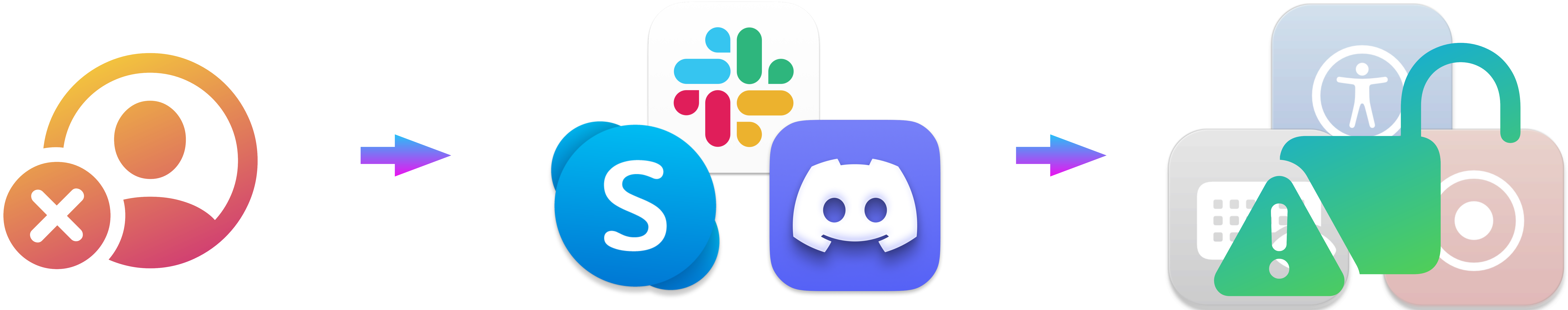
Malicious user in Enterprise



Malicious user in Enterprise



Malicious user in Enterprise



com.apple.TCC.configuration-profile-policy

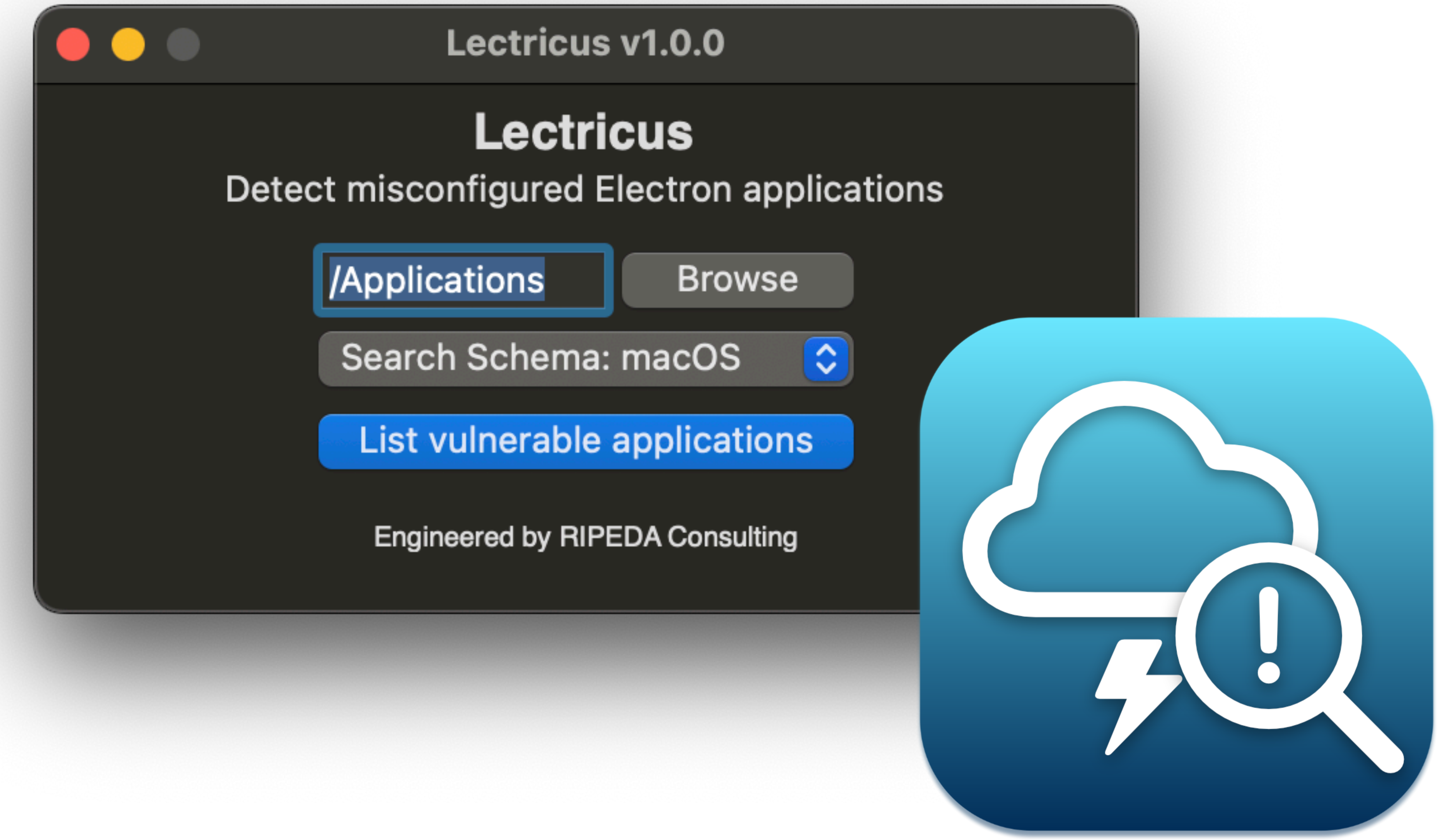
Services

ScreenCapture

AllowStandardUserToSetSystemService

So how do you find misconfigured apps?

Python to the rescue 🐍



Lectricus v1.0.0

Lectricus

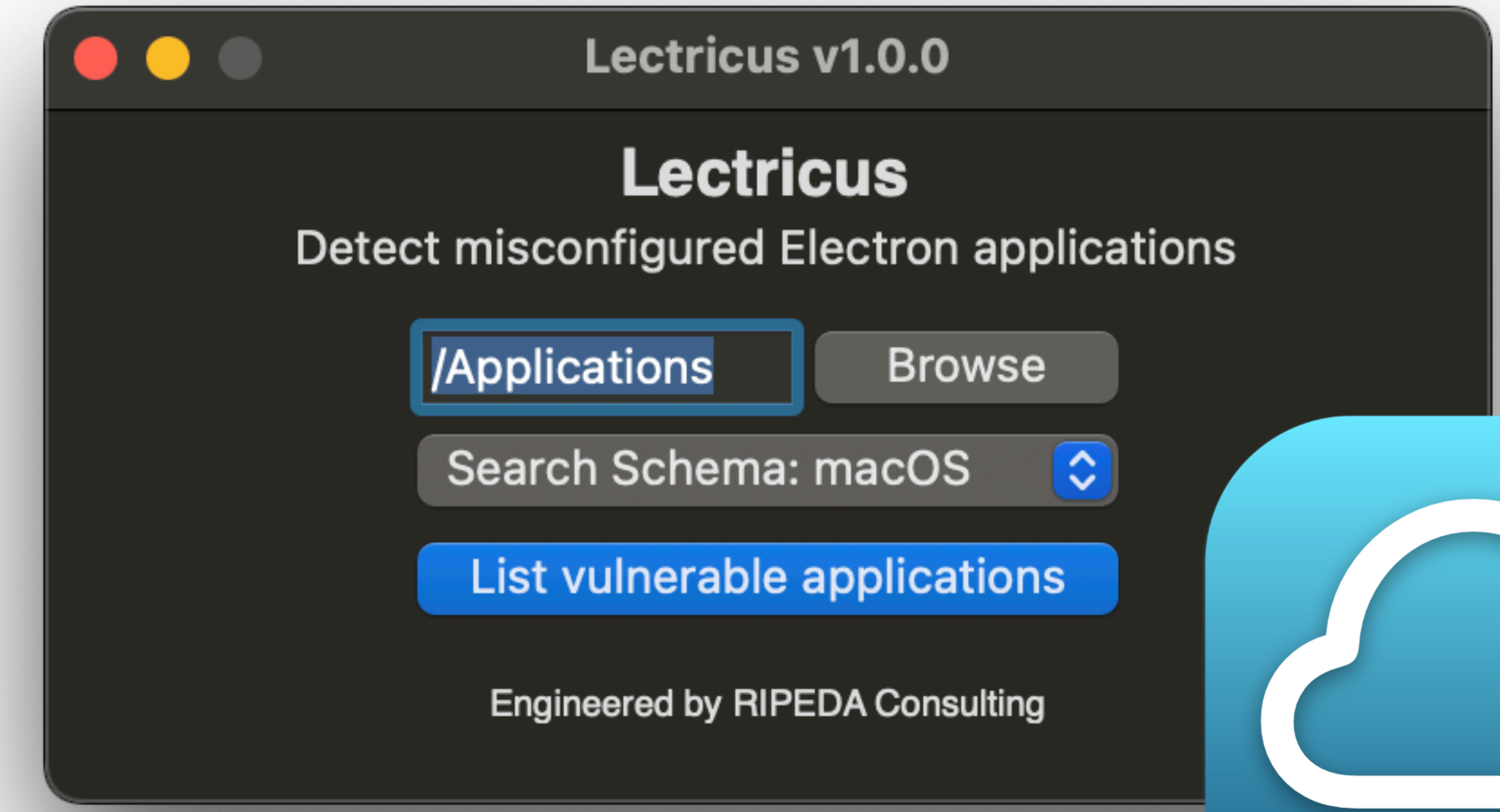
Detect misconfigured Electron applications

/Applications

Search Schema: macOS

Engineered by RIPEDA Consulting

Lectricus



Lectricus v1.0.0

Lectricus

Detect misconfigured Electron applications

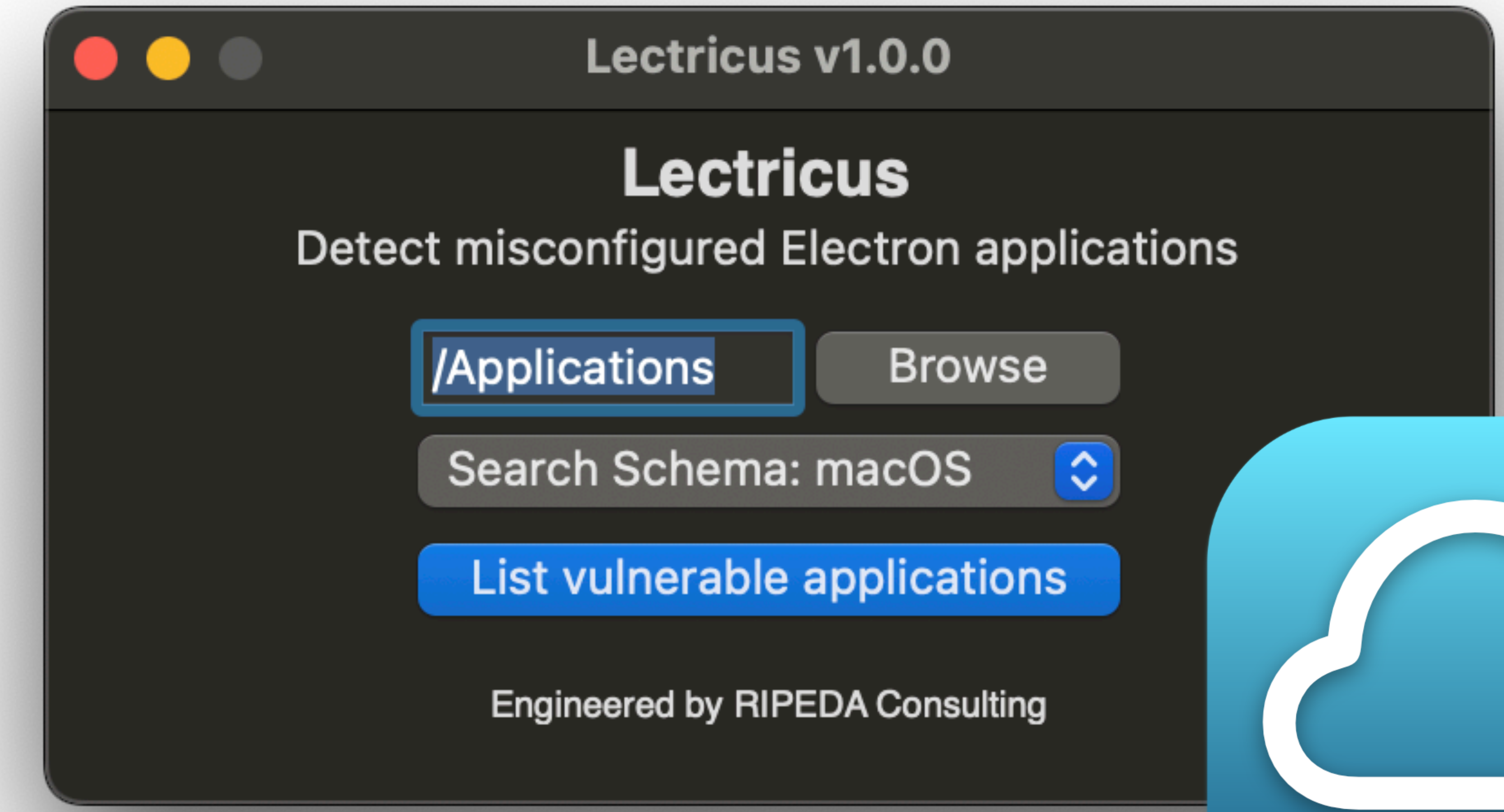
/Applications

Search Schema: macOS

Engineered by RIPEDA Consulting

Lectricus

Python-based library for finding
vulnerable electron apps.



Lectricus v1.0.0

Lectricus

Detect misconfigured Electron applications

/Applications

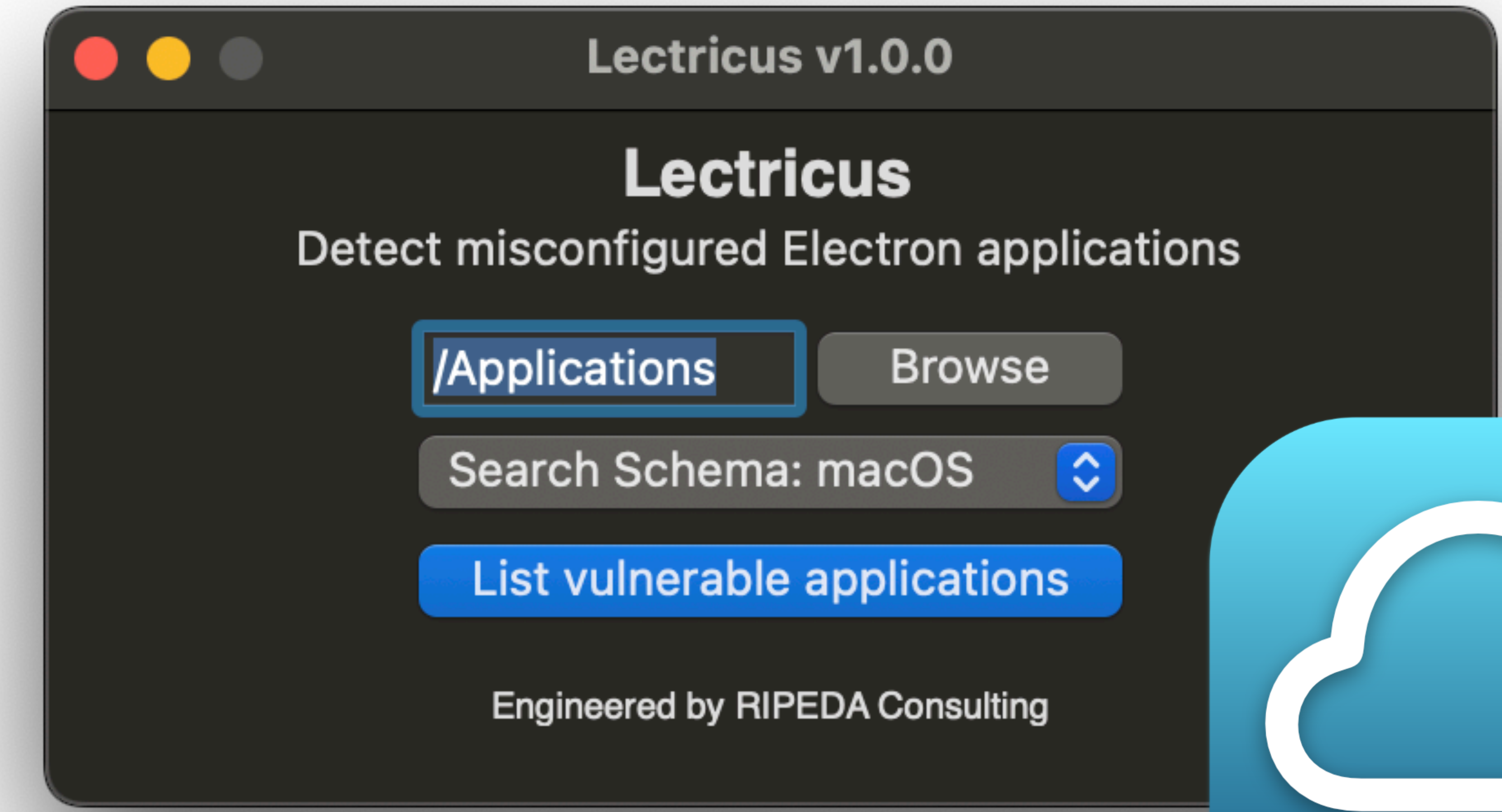
Search Schema: macOS

Engineered by RIPEDA Consulting

CLI or GUI.

Lectricus

Python-based library for finding vulnerable electron apps.



Lectricus v1.0.0

Lectricus

Detect misconfigured Electron applications

/Applications

Search Schema: macOS

Engineered by RIPEDA Consulting

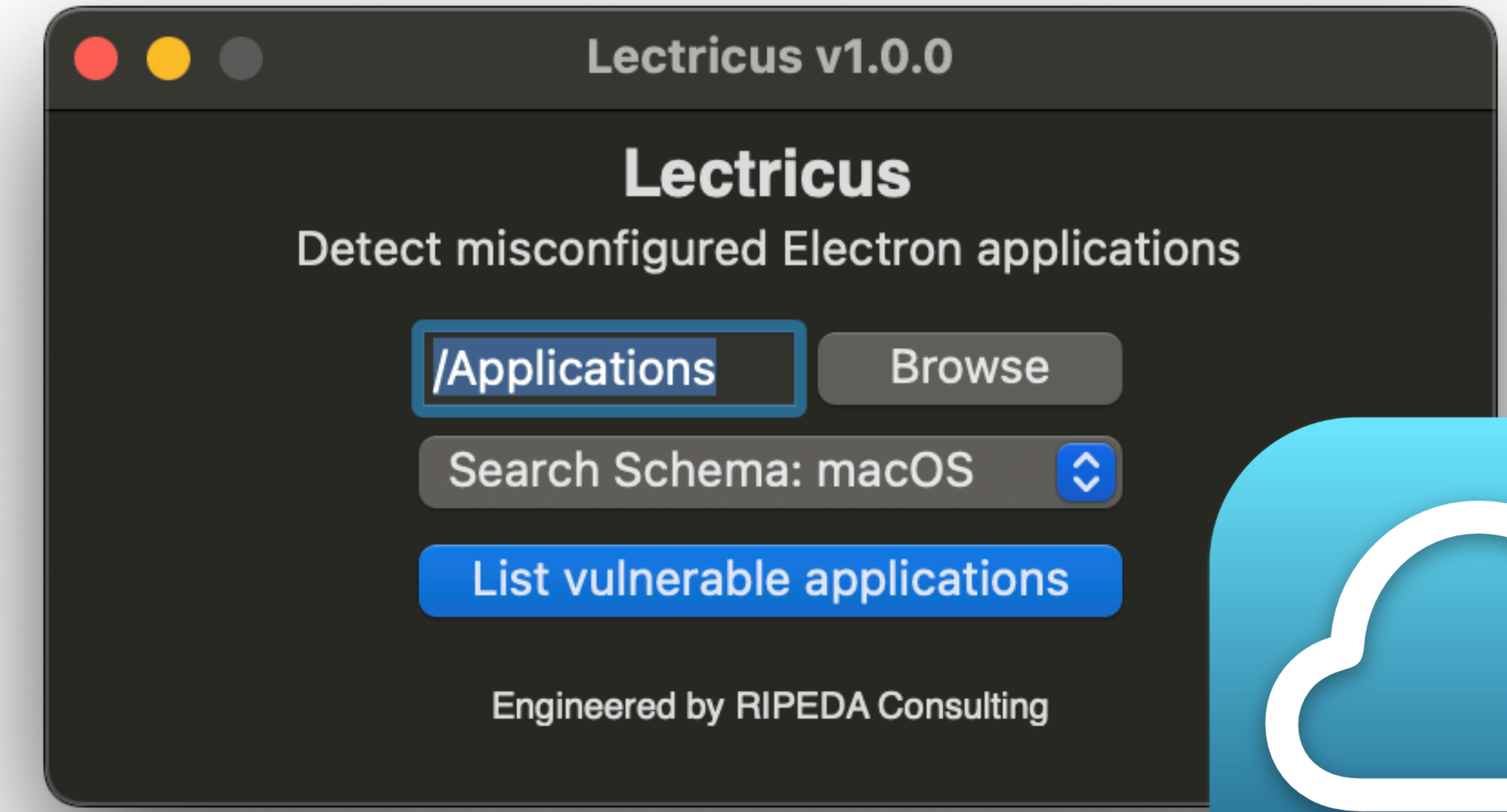
Lectricus

Multi-platform: Windows, Linux and macOS.

CLI or GUI.

Python-based library for finding vulnerable electron apps.

Multi-platform: Windows, Linux and macOS.



Lectricus

Detect misconfigured Electron applications

/Applications

Search Schema: macOS

Engineered by RIPEDA Consulting

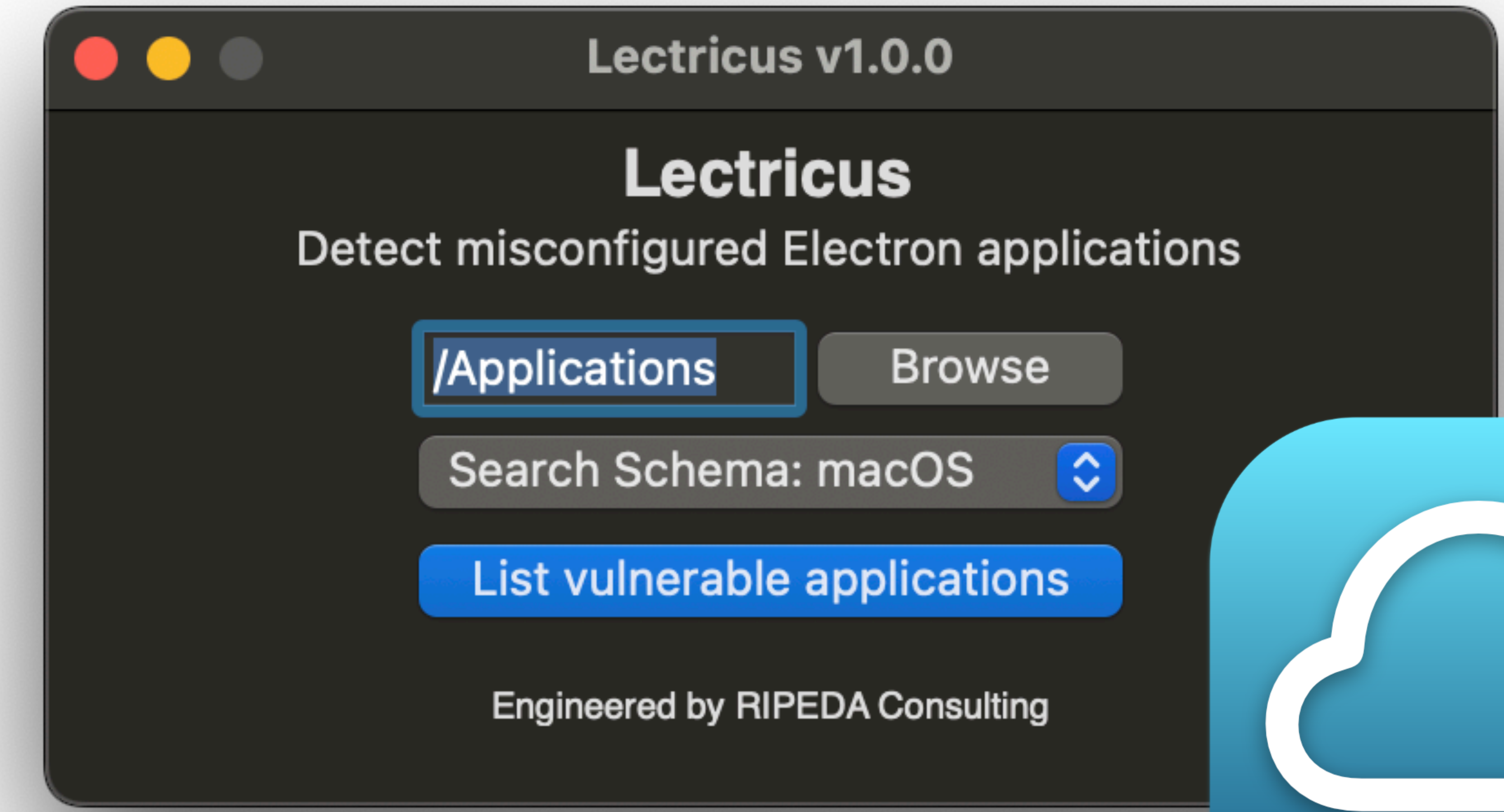
CLI or GUI.

Lectricus

Python-based library for finding vulnerable electron apps.

PLIST, XML, JSON and CSV exports.

Multi-platform: Windows, Linux and macOS.



Lectricus

Detect misconfigured Electron applications

/Applications

Search Schema: macOS

Engineered by RIPEDA Consulting

CLI or GUI.

Lectricus

Python-based library for finding vulnerable electron apps.

Open source on GitHub.

PLIST, XML, JSON and CSV exports.

macOS Demo - Detection

Windows Demo - Detection

Linux Demo - Detection

macOS Demo - Exploitation

So how do we prevent these attacks?

So how do we prevent these attacks?

Endpoint Security Framework

So how do we prevent these attacks?

Endpoint Security Framework

*on macOS

What is Endpoint Security?

What is Endpoint Security?

Hook into the OS that sees all

What is Endpoint Security?

Hook into the OS that sees all

- Networking

What is Endpoint Security?

Hook into the OS that sees all

- Networking
- File Operations

What is Endpoint Security?

Hook into the OS that sees all

- Networking
- File Operations
- Code Execution

What is Endpoint Security?

Hook into the OS that sees all

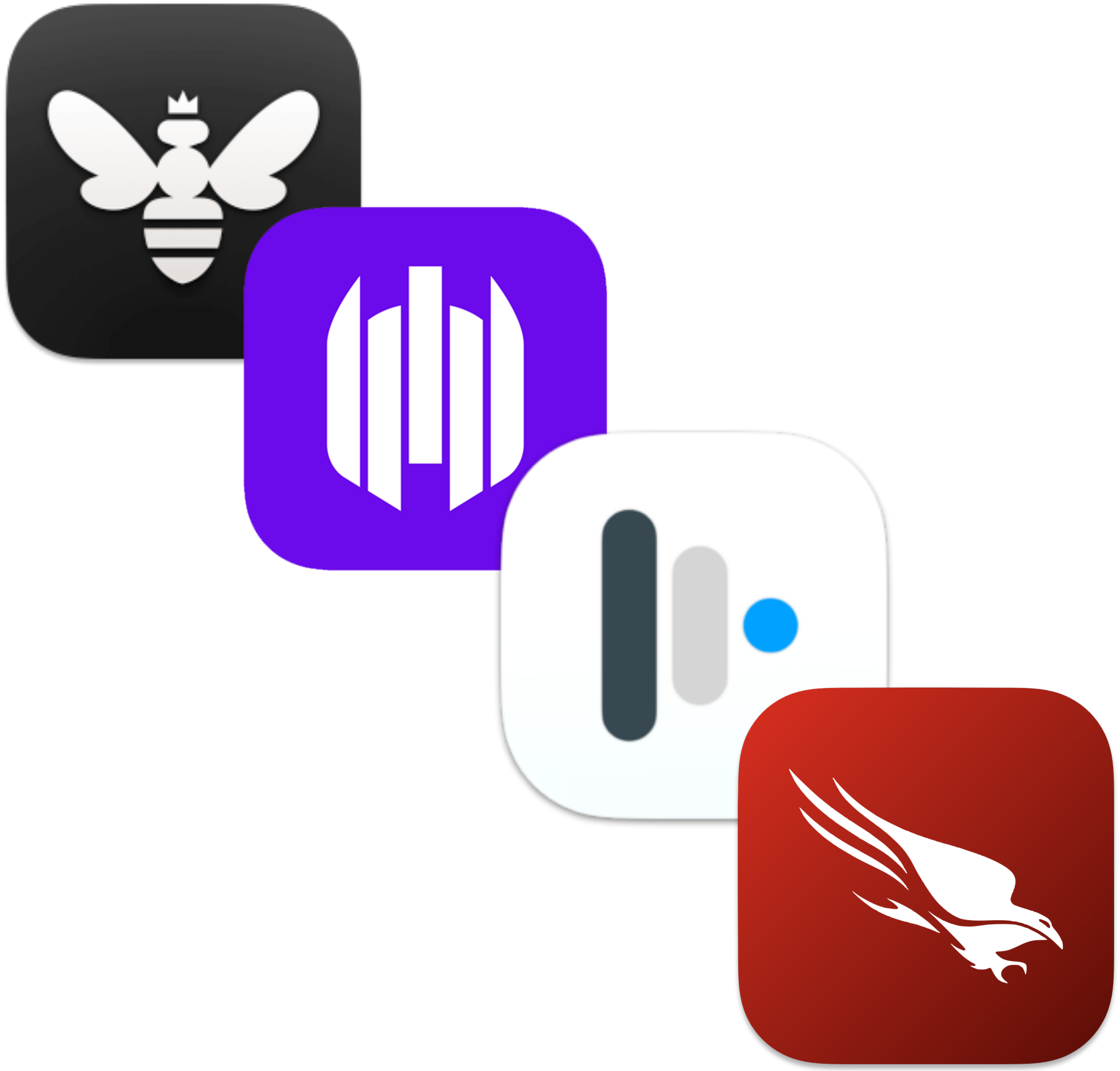
- Networking
- File Operations
- Code Execution

Not just watch,
take action

macOS Demo - Endpoint Security

Reach out to your vendors!

XProtect only handles extreme threats

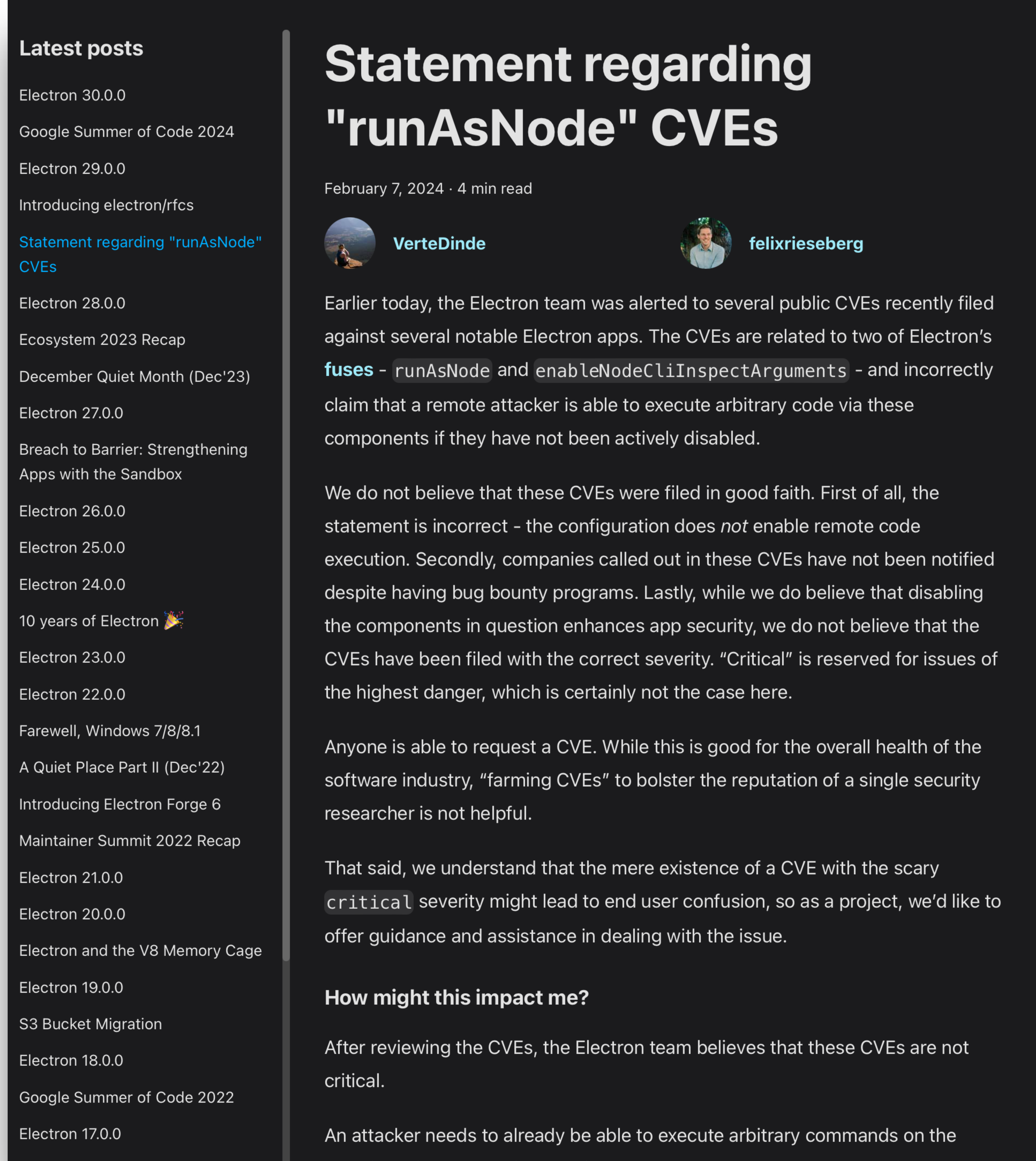


What’s Electron’s response to all this?

Statement regarding "runAsNode" CVEs

Posted February 7th, 2024

- In response to CVEs filed in bad faith.
- Is a valid vulnerability.
- Chrome Security Model.
- No TCC bypasses mentioned.



Latest posts

- Electron 30.0.0
- Google Summer of Code 2024
- Electron 29.0.0
- Introducing electron/rfcs
- Statement regarding "runAsNode" CVEs
- Electron 28.0.0
- Ecosystem 2023 Recap
- December Quiet Month (Dec'23)
- Electron 27.0.0
- Breach to Barrier: Strengthening Apps with the Sandbox
- Electron 26.0.0
- Electron 25.0.0
- Electron 24.0.0
- 10 years of Electron 🎉
- Electron 23.0.0
- Electron 22.0.0
- Farewell, Windows 7/8/8.1
- A Quiet Place Part II (Dec'22)
- Introducing Electron Forge 6
- Maintainer Summit 2022 Recap
- Electron 21.0.0
- Electron 20.0.0
- Electron and the V8 Memory Cage
- Electron 19.0.0
- S3 Bucket Migration
- Electron 18.0.0
- Google Summer of Code 2022
- Electron 17.0.0

Statement regarding "runAsNode" CVEs

February 7, 2024 · 4 min read

VerteDinde felixrieseberg

Earlier today, the Electron team was alerted to several public CVEs recently filed against several notable Electron apps. The CVEs are related to two of Electron's **fuses** - `runAsNode` and `enableNodeCliInspectArguments` - and incorrectly claim that a remote attacker is able to execute arbitrary code via these components if they have not been actively disabled.

We do not believe that these CVEs were filed in good faith. First of all, the statement is incorrect - the configuration does *not* enable remote code execution. Secondly, companies called out in these CVEs have not been notified despite having bug bounty programs. Lastly, while we do believe that disabling the components in question enhances app security, we do not believe that the CVEs have been filed with the correct severity. “Critical” is reserved for issues of the highest danger, which is certainly not the case here.

Anyone is able to request a CVE. While this is good for the overall health of the software industry, “farming CVEs” to bolster the reputation of a single security researcher is not helpful.

That said, we understand that the mere existence of a CVE with the scary `critical` severity might lead to end user confusion, so as a project, we'd like to offer guidance and assistance in dealing with the issue.

How might this impact me?

After reviewing the CVEs, the Electron team believes that these CVEs are not critical.

An attacker needs to already be able to execute arbitrary commands on the

What’s the end goal with Lectricus?

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Educate

Take action

Ways to take action

- Developers:
  - Review fuses in your electron Apps.
  - Not just the two talked about, many more dangerous fuses.
- Users:
  - Find and report misconfigured fuses in app you use.
- Admins:
  - Same as users.
  - Remove TCC permissions from apps that are vulnerable.
  - `$ sudo tccutil reset All com.bad.app`
  - Don’t solely rely on XProtect!

Thanks for listening to my rambles!

Mirrored on khronokernel.com

Links and shoutouts!

- Lectricus:
  - https://github.com/ripeda/lectricus
- Endpoint Security Sample:
  - https://github.com/khronokernel/Electron-Blocker
- Tsunek0h's CVE-2023-32546:
  - What kicked off this idea for Electron querying!
  - Chatwork Desktop Application.
  - Part of their SIP bypass talk at CODE BLUE 2023.
- Wojciech Reguła's electroniz3r:
  - Didn't know it existed when I started Lectricus…
  - But made me go further with Lectricus!
  - https://github.com/r3ggi/electroniz3r
- Electron:
  - https://www.electronjs.org/docs/latest/tutorial/fuses
  - https://www.electronjs.org/blog/statement-run-as-node-cves