Hunting Windows U-boats with Cyber Depth Charges

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WHOAMI

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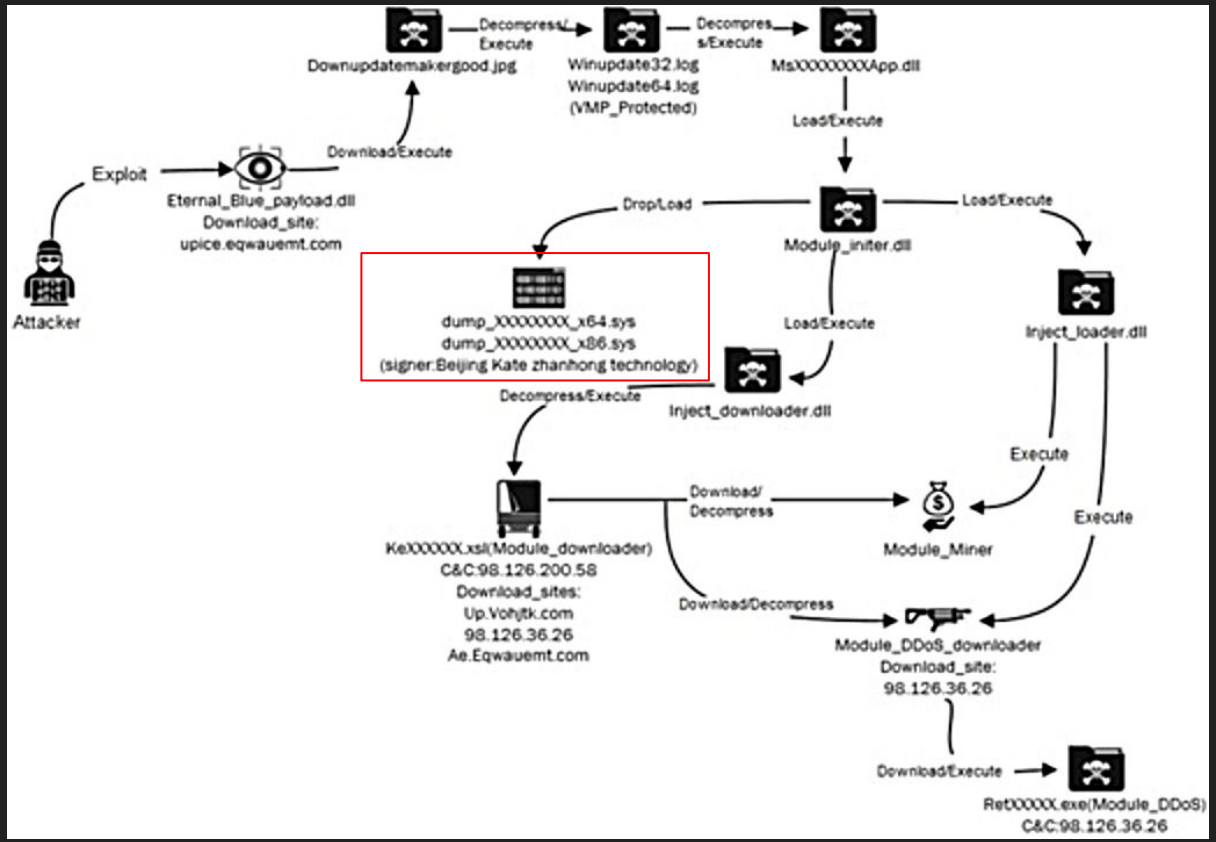
- Splunk
  - Simulate/Emulate TAs
  - Research techniques
  - Generate content
- Red Canary
  - Co-Founded Atomic Red Team
  - Threat Research

NuggetPhantom

- Slashing through a binary store, came across an sys filename + digsig_status
- Turned out, we shipped a detection months ago, but some artifacts were missing

https://redcanary.com/blog/tracking-driver-inventory-to-expose-rootkits/

NuggetPhantom



https://nsfocusglobal.com/nuggetphantom-analysis-report/

Problem: Hunting drivers as Windows Rootkits is hard.

- High volume
- Low reward
- May take years
- A special level of Threat Hunting
- A real challenge

Agenda

- What do drivers buy an adversary?
- Driver Signing
- Hunting
- LOLDrivers
- Prevent

What do drivers buy an adversary?

- Windows will load signed/unsigned, old and new
- Kernel level persistence
- Hard to prevent (AV)
- Hard to detect

Drivers and Signatures

32-Bit drivers typically unsigned

Windows Vista and up - new enforcement

- But require backwards compatibility

Which introduced -

LOLDrivers / ScrewedDrivers

- Vulnerable signed drivers

Certificate theft

- Steal cert, sign malware.

What to Hunt

Where to Hunt

How to Hunt

Driver Signing - Subvert Trust Controls: Code Signing


POSTED: 28 FEB, 2022 | 9 MIN READ | THREAT INTELLIGENCE

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Daxin: Stealthy Backdoor Designed for Attacks Against Hardened Networks

Espionage tool is the most advanced piece of malware Symantec researchers have seen from China-linked actors.

https://docs.microsoft.com/en-us/sysinternals/downloads/sigcheck

https://gist.github.com/MHaggis/9ab3bb795a6018d70fb11fa7c31f8f48

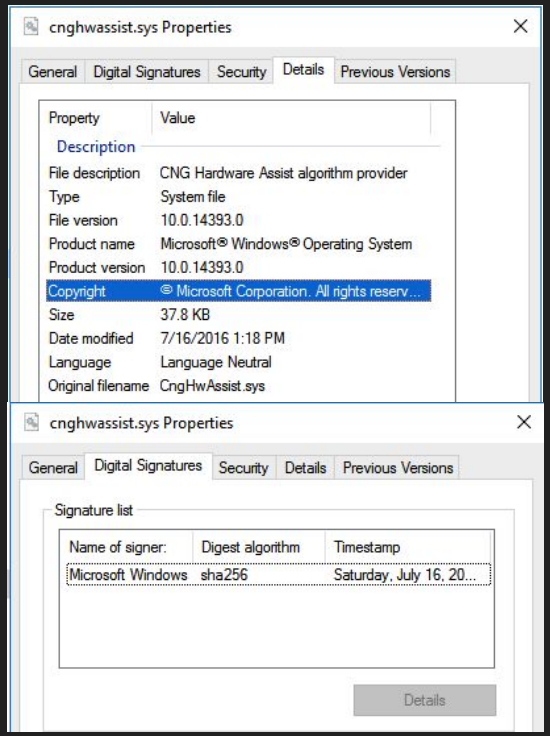
Driver Signing - Subvert Trust Controls: Code Signing

B	C	D	E	F	G	H	I	J
Verified	Date	Publisher	Company	Description	Product	Product Version	File Version	Machine Type
A required certificate is not within its validity peric	11:59 PM 11/27/2013	Anhua Xinda (Beijing) Technology Co., Ltd.	Microsoft Corporation	WAN Transport Driver	Microsoft Windows Operating System	6.1.7600.1172	6.1.7600.1172	64-bit
A required certificate is not within its validity peric	1:03 AM 9/3/2019	Anhua Xinda (Beijing) Technology Co., Ltd.	Microsoft Corporation	MS LAN Driver	Microsoft« Windows« Operating System	6.1.7600.16385	6.1.7600.16385	64-bit
The digital signature of the object did not verify.	8:23 PM 2/28/2022	Anhua Xinda (Beijing) Technology Co., Ltd.	Microsoft Corporation	MS LAN Driver	Microsoft« Windows« Operating System	6.1.7600.16385	6.1.7600.16385	64-bit
Signed	7:07 AM 1/23/2013	Anhua Xinda (Beijing) Technology Co., Ltd.	n/a	n/a	n/a	n/a	n/a	64-bit
A certificate was explicitly revoked by its issuer.	4:05 AM 2/6/2021	Fuqing Yuntan Network Tech Co.,Ltd.	n/a	n/a	n/a	n/a	n/a	64-bit
A certificate was explicitly revoked by its issuer.	4:05 AM 2/6/2021	Fuqing Yuntan Network Tech Co.,Ltd.	n/a	n/a	n/a	n/a	n/a	64-bit
Signed	7:52 AM 4/30/2014	Anhua Xinda (Beijing) Technology Co., Ltd.	Microsoft Corporation	WAN Transport Driver	Microsoft Windows Operating System	6.1.7600.938	6.1.7600.938	64-bit
Unsigned	12:54 AM 11/18/2009	n/a	n/a	n/a	n/a	n/a	n/a	32-bit
Unsigned	7:52 AM 4/30/2014	n/a	Microsoft Corporation	WAN Transport Driver	Microsoft Windows Operating System	5.2.3790.938	5.2.3790.938	32-bit
The digital signature of the object did not verify.	8:23 PM 2/28/2022	Anhua Xinda (Beijing) Technology Co., Ltd.	Microsoft Corporation	WAN Transport Driver	Microsoft Windows Operating System	6.1.7600.1172	6.1.7600.1172	64-bit
Unsigned	8:42 AM 4/20/2010	n/a	n/a	n/a	n/a	n/a	n/a	32-bit
Unsigned	10:26 AM 11/19/2009	n/a	Microsoft Corporation	ntbios driver	Microsoft(R) Windows (R) NT Operating System	5, 0, 2, 1	5, 0, 2, 1	32-bit
Unsigned	1:29 AM 7/18/2008	n/a	n/a	n/a	n/a	n/a	n/a	32-bit
A required certificate is not within its validity peric	4:49 PM 10/12/2012	Anhua Xinda (Beijing) Technology Co., Ltd.	Microsoft Corporation	MS LAN Driver	Microsoft« Windows« Operating System	6.1.7600.1421	6.1.7600.1421	64-bit
The digital signature of the object did not verify.	8:23 PM 2/28/2022	Anhua Xinda (Beijing) Technology Co., Ltd.	Microsoft Corporation	WAN Transport Driver	Microsoft Windows Operating System	6.1.7600.1172	6.1.7600.1172	64-bit
Unsigned	3:04 AM 5/18/2009	n/a	Microsoft Corporation	ntbios driver	Microsoft(R) Windows (R) NT Operating System	5, 0, 2, 1	5, 0, 2, 1	32-bit
Unsigned	2:44 AM 3/26/2009	n/a	n/a	n/a	n/a	n/a	n/a	32-bit
The digital signature of the object did not verify.	8:23 PM 2/28/2022	Anhua Xinda (Beijing) Technology Co., Ltd.	Microsoft Corporation	WAN Transport Driver	Microsoft Windows Operating System	6.1.7600.1172	6.1.7600.1172	64-bit

https://docs.microsoft.com/en-us/sysinternals/downloads/sigcheck

https://gist.github.com/MHaggis/9ab3bb795a6018d70fb11fa7c31f8f48

Driver Signing - Subvert Trust Controls: Code Signing



- `signed` : Digital signature status: One of `Signed`, `Unsigned`, `Expired`, `Bad Signature`, `Invalid Signature`, `Invalid Chain`, `Untrusted Root`, `Explicit Distrust`
- `digsig_result` : Digital signature status: One of `Signed`, `Unsigned`, `Expired`, `Bad Signature`, `Invalid Signature`, `Invalid Chain`, `Untrusted Root`, `Explicit Distrust`
- `digsig_result_code` : HRESULT_FROM_WIN32 for the result of the digital signature operation via WinVerifyTrust
- `digsig_sign_time` : If signed, the timestamp of the signature in GMT
- `digsig_publisher` : If signed and present, the publisher name
- `digsig_prog_name` : If signed and present, the program name
- `digsig_issuer` : If signed and present, the issuer name
- `digsig_subject` : If signed and present, the subject

https://github.com/MHaggis/CBR-Queries/blob/master/binary.md

Driver Signing - Subvert Trust Controls: Code Signing

```
VersionInfo : File:             \96bf3ee7c6673b69c6aa173bb44e21fa636b1c2c73f4356a7599c121284a51cc
              InternalName:     ntbio.sys
              OriginalFilename: ntbios.sys
              FileVersion:      5, 0, 2, 1
              FileDescription:  ntbios driver
              Product:          Microsoft(R) Windows (R) NT Operating System
              ProductVersion:   5, 0, 2, 1
              Debug:            False
              Patched:          False
              PreRelease:       False
              PrivateBuild:     False
              SpecialBuild:     False
              Language:         English (United States)
```

```
File:             \8d9a2363b757d3f127b9c6ed8f7b8b018e65
InternalName:     wantd.sys
OriginalFilename: wantd.sys
FileVersion:      6.1.7600.1172
FileDescription:  WAN Transport Driver
Product:          Microsoft Windows Operating System
ProductVersion:   6.1.7600.1172
Debug:            False
```

Get-ItemProperty -Path <path>| Format-list -Property VersionInfo

https://gist.github.com/MHaggis/9ab3bb795a6018d70fb11fa7c31f8f48

Digital Signature Results

- Digsig_result
  - Signed, Unsigned, Expired, Bad Signature, Invalid Signature, Invalid Chain, Untrusted Root, Explicit Distrust
- Digsig_publisher
- Digsig_issuer
  - Signers gone bad
- Digsig_subject
- Digsig_sign_time
  - First time seen, old sign time
- company_name

Verified	Date	Publisher	Company	Description	Product	Product Version	File Version	Machine Type
Signed	7:52 AM 4/30/2014	Anhua Xinda (Beijing) Technology Co., Ltd.	Microsoft Corporation	WAN Transport Driver	Microsoft Windows Operating System	6.1.7600.938	6.1.7600.938	64-bit

What path to take

Drivers may be loaded from anywhere

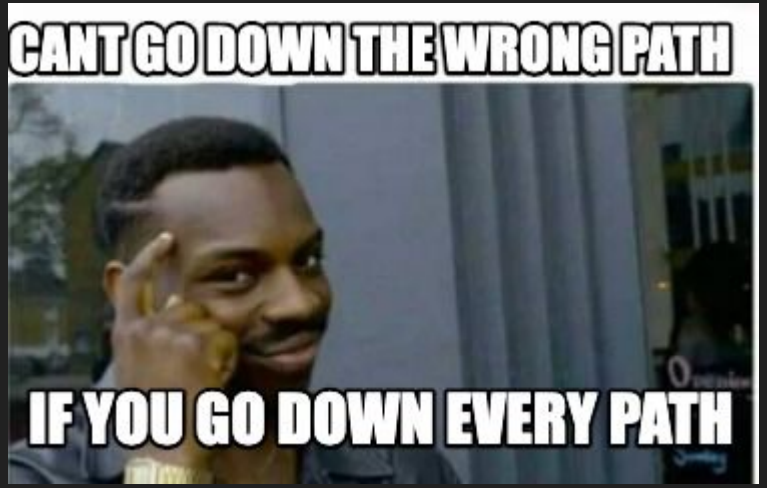
Most likely always find in

- \system32\drivers\
- \spool\drivers\
- \programdata\

Combine paths with digsig_result

Note the name -

Will not be “evildriver.sys”

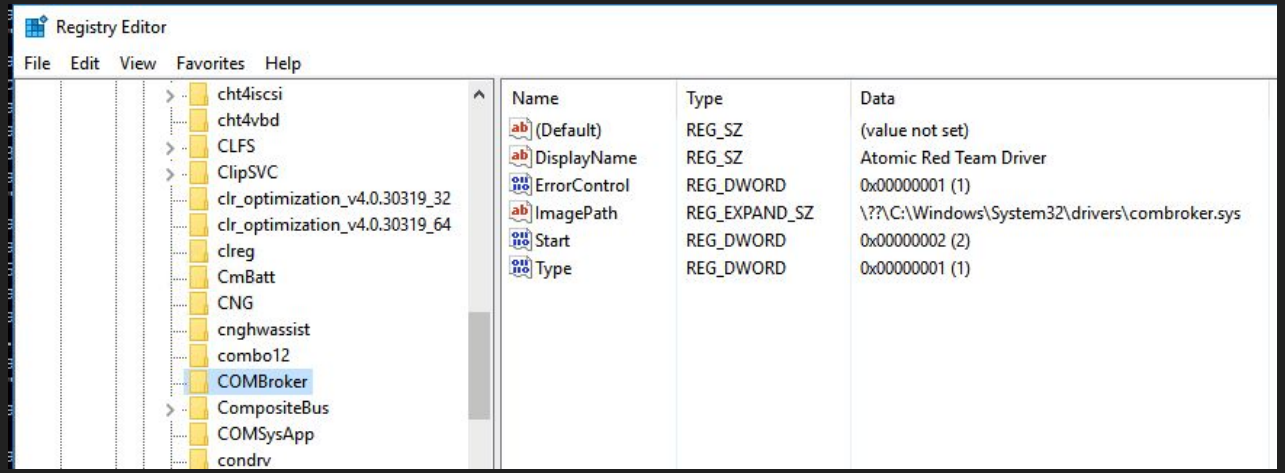


observed_filename:c:\windows\system32\drivers\ digsig_result:"Explicit Distrust"

Check the registry

New driver - who dis?

\Machine\\System\\CurrentControlSet\\Services



HKLM\\SYSTEM\\CurrentControlSet\\Control\\SafeBoot\\Minimal\\MySafeModeService, Default = Service

HKLM\\SYSTEM\\CurrentControlSet\\Control\\SafeBoot\\Network\\MySafeModeService, Default = Service

7045

`wineventlog_system` EventCode=7045 Service_Type="kernel mode driver"

ComputerName	EventCode	Service_File_Name	Service_Name	Service_Start_Type	Service_Type
win-dc-mhaag-attack-range-270.attackrange.local	7045	C:\Users\Administrator\Desktop\artifact_DriverInstallationPackage\builder\package2\combo.sys	Atomi322	auto start	kernel mode driver
win-dc-mhaag-attack-range-270.attackrange.local	7045	C:\Users\Administrator\Desktop\artifact_DriverInstallationPackage\builder\package2\combo2.sys	Atomi3222	auto start	kernel mode driver
win-dc-mhaag-attack-range-270.attackrange.local	7045	C:\Windows\System32\drivers\combroker.sys	Atomic Red Team Driver	auto start	kernel mode driver
win-dc-mhaag-attack-range-270	7045	system32\drivers\dfs.sys	DFS Namespace Server Filter Driver	system start	kernel mode driver
win-dc-mhaag-attack-range-270	7045	system32\drivers\dfsrro.sys	DFS Replication ReadOnly Driver	boot start	kernel mode driver
win-dc-mhaag-attack-range-270.attackrange.local	7045	\SystemRoot\system32\DRIVERS\npcap.sys	Npcap Packet Driver (NPCAP)	demand start	kernel mode driver

Known Vulnerable Drivers

LOLDrivers / ScrewedDrivers

- CapCom Driver
- Dell Drivers
- Asrock Drivers

https://github.com/eclypsium/Screwed-Drivers/blob/master/DRIVERS.md

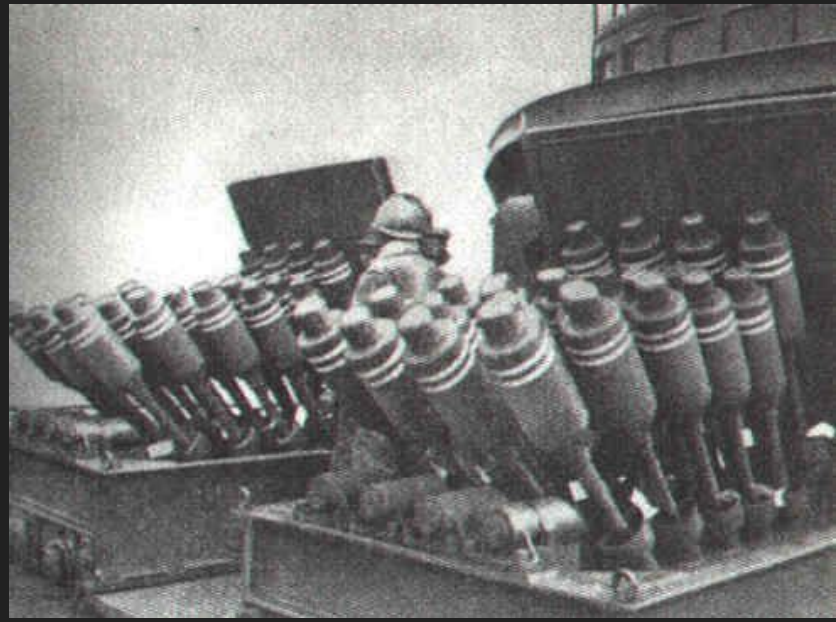
https://www.rapid7.com/blog/post/2021/12/13/driver-based-attacks-past-and-present/

https://attackerkb.com/topics/zAHZGAFaQX/cve-2021-21551

MSFT Block list - https://bit.ly/3laHK73

Windows will load them all.

Stack and rank



Source and Prevalence

`sysmon` EventCode=6 | stats min(_time) as firstTime max(_time) as lastTime count by ImageLoaded Computer Signed Signature service_signature_verified service_signature_exists Hashes

ImageLoaded	Computer	Signed	Signature	service_signature_verified	service_signature_exists
C:\Temp\dell.sys	win-dc-mhaag-attack-range-270.attackrange.local	true	Dell Inc.	true	true
C:\Windows\System32\drivers\mmcss.sys	win-dc-mhaag-attack-range-270.attackrange.local	true	Microsoft Windows	true	true
C:\Windows\System32\drivers\mmcss.sys	win-host-mhaag-attack-range-803	true	Microsoft Windows	true	true
C:\ProgramData\combo12.sys	win-dc-mhaag-attack-range-270.attackrange.local	true	CAPCOM Co.,Ltd.	true	true
C:\Users\Administrator\Desktop\artifact_DriverInstallationPackage\builder\package 2\combo2.sys	win-dc-mhaag-attack-range-270.attackrange.local	true	CAPCOM Co.,Ltd.	true	true
C:\Windows\System32\DriverStore\FileRepository\compositebus.inf_amd64_a140581a8f8b58b7\CompositeBus.sys	win-dc-mhaag-attack-range-270.attackrange.local	true	Microsoft Windows	true	true

New Sys Files

dest	file_create_time	file_name	file_path	count	firstTime	lastTime
win-dc-mhaag-attack-range-270.attackrange.local	2022-05-12T19:55:12-06:00	combroker.sys	C:\Users\Administrator\Desktop\U-Program\seewolf\combroker.sys	1	2022-05-12T19:55:12-06:00	2022-0 12T19:5
win-dc-mhaag-attack-range-270.attackrange.local	2022-05-12T19:55:46-06:00	$IOVYWD9.sys	C:\$Recycle.Bin\S-1-5-21-2059343465-2300599999-2417073716-500\$IOVYWD9.sys	1	2022-05-12T19:55:46-06:00	2022-0 12T19:5 06:00
win-dc-mhaag-attack-range-270.attackrange.local	2022-05-12T19:56:42-06:00	Capcom.sys	C:\Users\Administrator\Desktop\U-Program\seewolf\Capcom.sys	1	2022-05-12T19:56:42-	2022-0 12T19:5

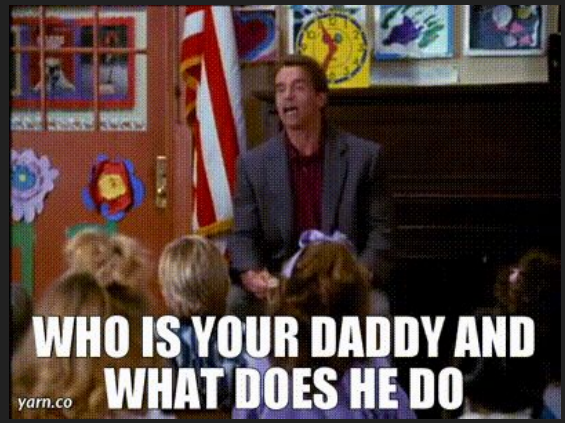
Sc Create New Kernel Driver

dest	user	parent_process_name	process_name	process
win-dc-mhaag-attack-range-270.attackrange.local	Administrator	cmd.exe	sc.exe	sc.exe create Atomi322 binpath= "C:\Users\Administrator\Desktop\artifact_DriverInstallationPackage\builder\package2\combo.sys" type= kernel start= auto displayname= "Atomi322"
win-dc-mhaag-attack-range-270.attackrange.local	Administrator	cmd.exe	sc.exe	sc.exe create Atomi3222 binpath= "C:\Users\Administrator\Desktop\artifact_DriverInstallationPackage\builder\package2\combo2.sys" type= kernel start= auto displayname= "Atomi3222"

Simple dashboard

Sys Loads

ntoskrnl.exe will load sys



process_name:ntoskrnl.exe
(digsig_result_modload:"Unsigned" OR digsig_result_modload:"Explicit\ Distrust")

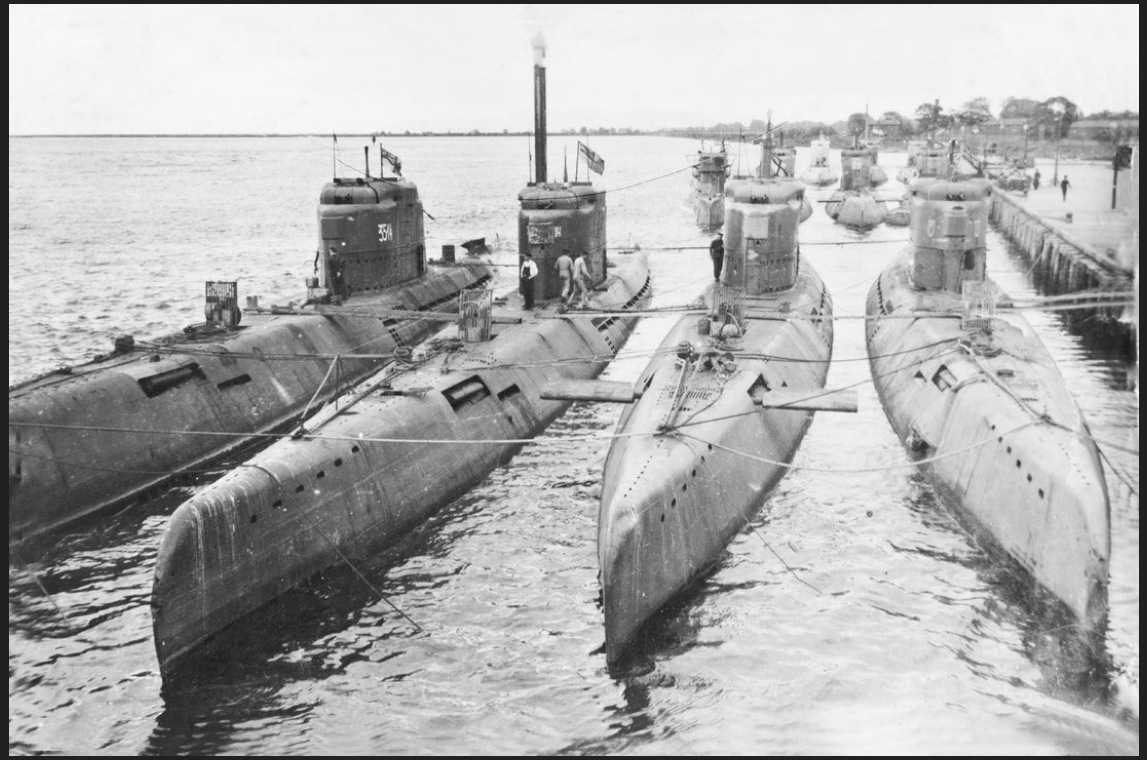
Audit and Prevent

#RedTeamTips

- Inventory Drivers
- Enable Windows Attack Surface Reduction rules (can’t prevent? Audit!)
- Use SecureBoot
- Driver Signing Enforcement
- Implement Application Control
- Windows Defender Application Control or AppLocker

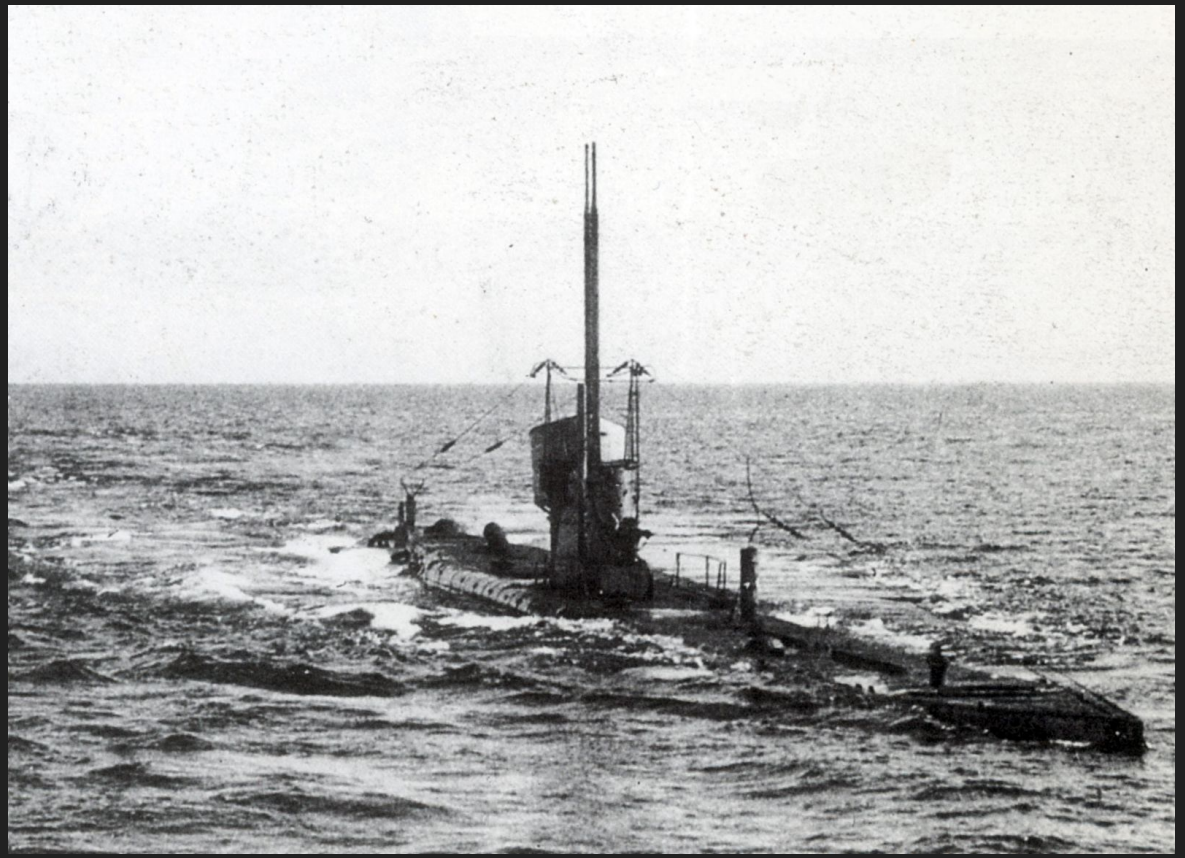
	Target(s)	Rating	Description	Rec	Reference	Notes
1	[IP Address 1]	Critical	MS14-066 Vulnerability	Apply Patch	https://support.microsoft.com/en-us/kb/2992611	Exploited – DOS Achieved
2	[IP Address 2]	Critical	MS15-034 Vulnerability	Apply Patch	https://support.microsoft.com/en-us/kb/3042553	Exploited – DOS Achieved
3	[IP Address 3] [IP Address 4]	Medium	XSS (Reflected)	Fix Apache Server / Code	https://www.owasp.org/index.php/XSS_(Cross_Site_Scripting)_Prevention_Cheat_Sheet	Instances in numerous URIs
4	[IP Address 5]	Medium	SSL Certificate Not Valid for Hostname	Register SSL Certificates for Hostname	https://wiki.mozilla.org/Security/Server_Side_TLS	None
5	[IP Address 6]	Medium	Sensitive Data Leakage (POODLE)	Disable SSL 3.0	https://technet.microsoft.com/en-us/library/security/3009008.aspx	None

Conclusion: Hard. However, obtainable.



Summary

- Investigate preventative measures today
- Inventory drivers and check prevalence (compare with the knowns)
- Monitor for new registered kernel mode drivers
- Test with Atomic Red Team



https://github.com/MHaggis/notes

Thank you for listening 🙏