NanoCoreRAT Behind an Increase in Tax-Themed Phishing E-mails

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It seems every mainstream news event or holiday has an accompanying phishing campaign. Opportunistic actors hoping to capitalize on the public's attention are often seen sending phishing e-mails with themes related to the news or the season..

It happened this last holiday season and will likely continue to occur as long as email is around.

Unsurprisingly, as we near the U.S. deadline for filing our income taxes, Palo Alto Networks researchers have seen an increase in phishing emails specifically related to taxes. This blog details some recent trends we have been able to identify. Palo Alto Networks noticed both executable attachments and Microsoft Word documents with macros designed to download and execute files.

Tax-Themed Phishing

Looking through recent email attachments determined to be malicious by WildFire, we noticed a trend in subject lines involving tax forms using the keywords ‘report’, ‘tax’, ‘secure’ and ‘pin’. Pivoting from subject lines to the hash values and filenames of attachments included in the emails allowed us to expand our initial sample set. Finally, using the AutoFocus API and a bit of Python we were able to collect data about the samples included in the tax-themed phishing and build a data frame for further analysis.

Within the final sample set, we were able to identify 70 unique malware samples distributed through 2,062 email sessions between September 2, 2015 and January 28, 2016. As expected, email sender addresses were often spoofed to provide a sense of legitimacy.

Some examples of email sender addresses:

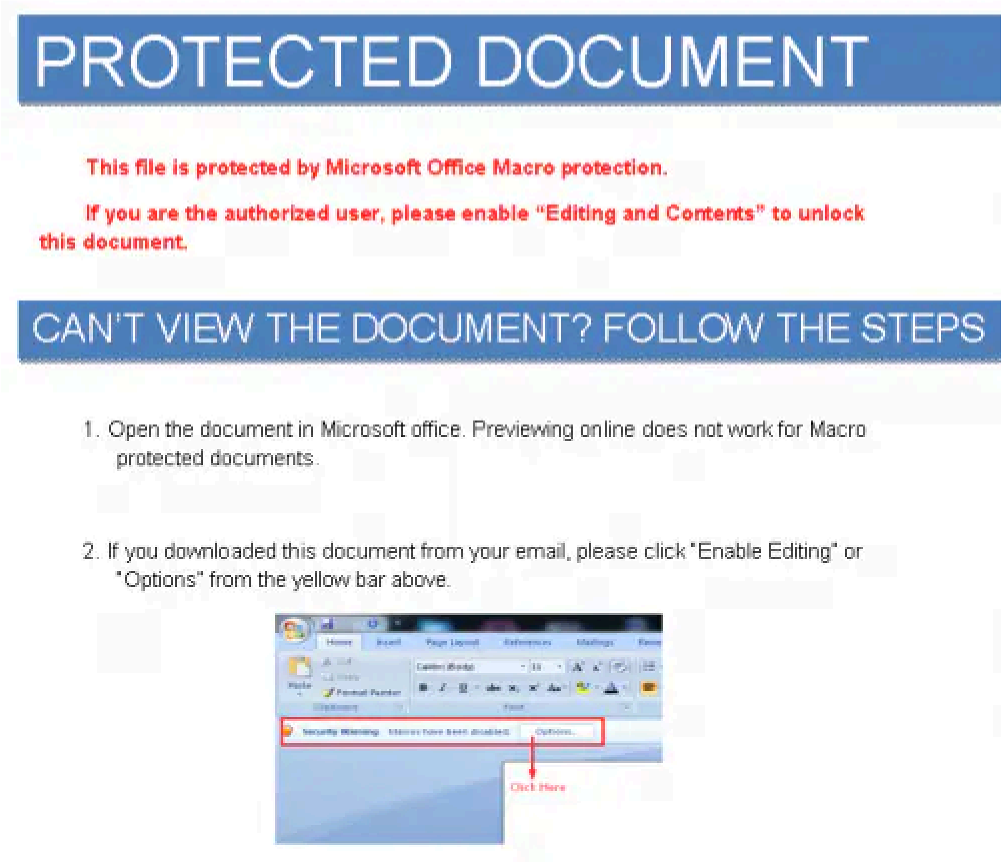
- 2015-autax-return@ato.gov.au
- 2015Refund@cra-arc.gc.ca
- 2015autaxreturn@ato.gov.au
- 2015tax-return@irs.gov
- 2015taxreturn-noreply@irs.gov
- 2015taxreturn@iras.gov.sg

We also noticed the source IP address of the emails primarily came from a free mail service called mail2world. The top 5 source IP addresses by session count were:

- 209.67.128.221 934 sessions
- 117.120.5.194 214 sessions

- 209.67.128.182 213 sessions
- 23.235.221.158 63 sessions
- 130.194.13.86 53 sessions

While some of the phishing email attachments were PE files, others were MS Word documents with malicious macros. One sample (119f3dd48e316f77974a7ec84c0fdecd943ceed77c30db9a6df0c1b0615b0ac0) included instructions on how to enable macros.

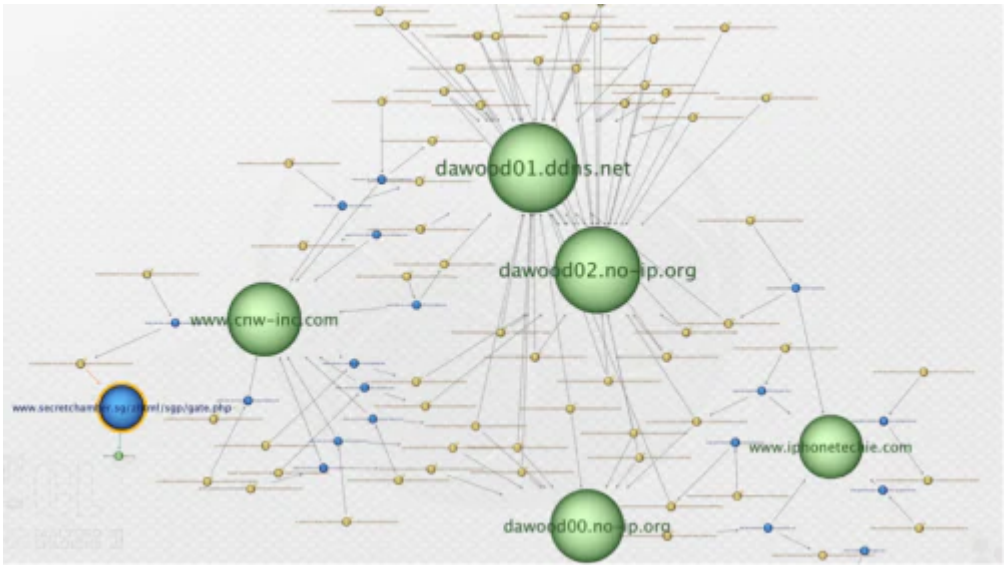


Using open source tools, the obfuscated file download functionality is easily located in the Word macro.

Looking at the malware contained in each email attachment, the payloads consisted predominantly of NanoCoreRAT or a generic macro downloader that would then download and execute NanoCoreRAT. The countries receiving these phishing messages align with what are believed to be country code indicators in malicious URLs and email attachment names.

Recipients of Tax-Based Phishing E-mails

Analyzing the malicious macro documents we observed for these tax-themed phishing attacks revealed that although there were a large number of unique samples, their behavior and infrastructure contained significant overlap.



In the above figure, we can easily see that six domains were in heavy use by most samples.

Second-stage download:

- www.cnw-inc[.]com

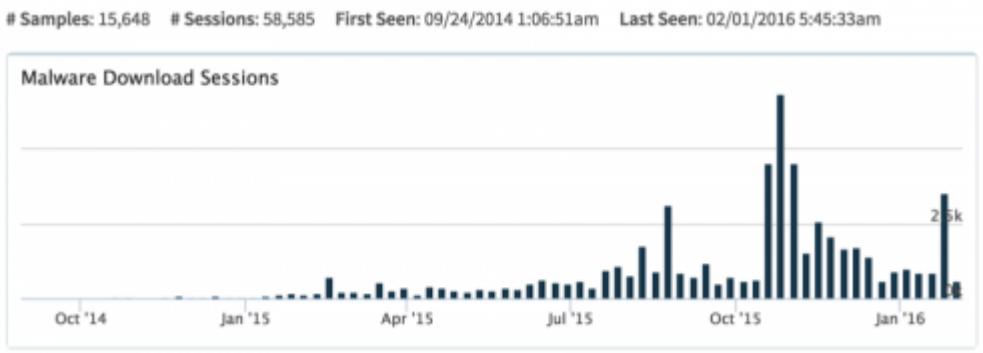
- www.iphonetechie[.]com

NanoCoreRAT Command and Control:

- dawood01.ddns[.]net
- dawood02.no-ip[.]org
- dawood00.no-ip[.]org

NanoCore

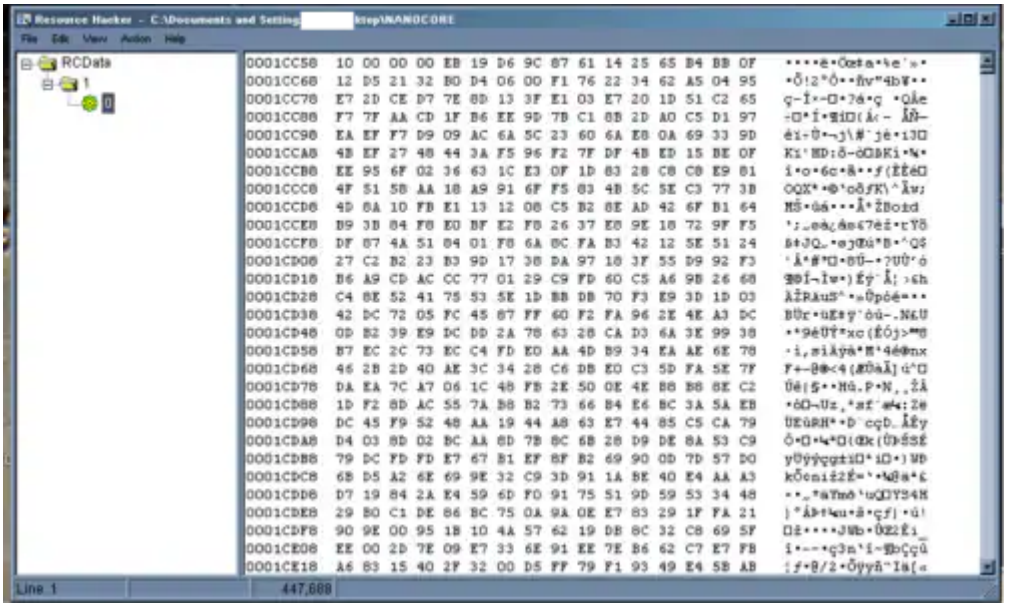
NanoCore is a commodity trojan developed in the .NET framework. According to Symantec, a fully cracked version of NanoCore 1.2.2.0 with premium plugins was released around March 2015 and has been seen targeting the energy sector. This release caused NanoCore to become increasingly popular with adversaries, especially the more frugal ones. Around April 2015 we observed a rise in activity involving NanoCore. We have observed its incorporation into tax-themed phishing since June 2015 and are continuing to see a general increase in activity since then. Below shows the upward trend Palo Alto Networks has seen in NanoCoreRAT being distributed since September 2014.



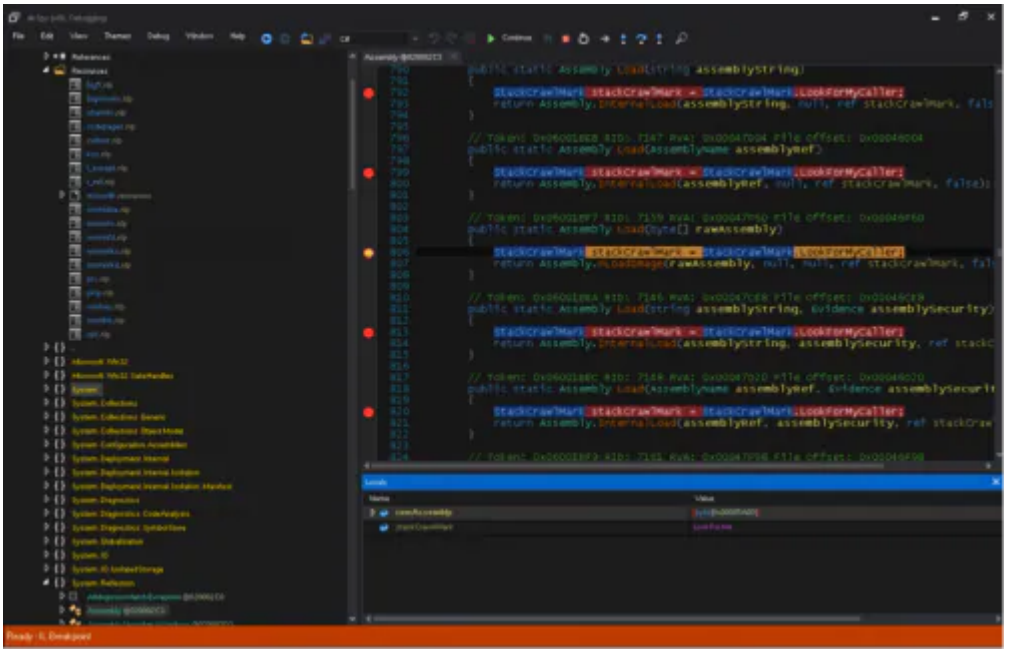
NanoCore is a modular RAT with many of its capabilities provided through plugins. Capabilities provided by the premium plugins we could identify include:

- keylogging and password "recovery"
- "stress testing" or DoS
- download, execute, or install other software
- remote CLI and UI
- registry editing
- socks proxy
- firewall modification
- webcam and audio controls

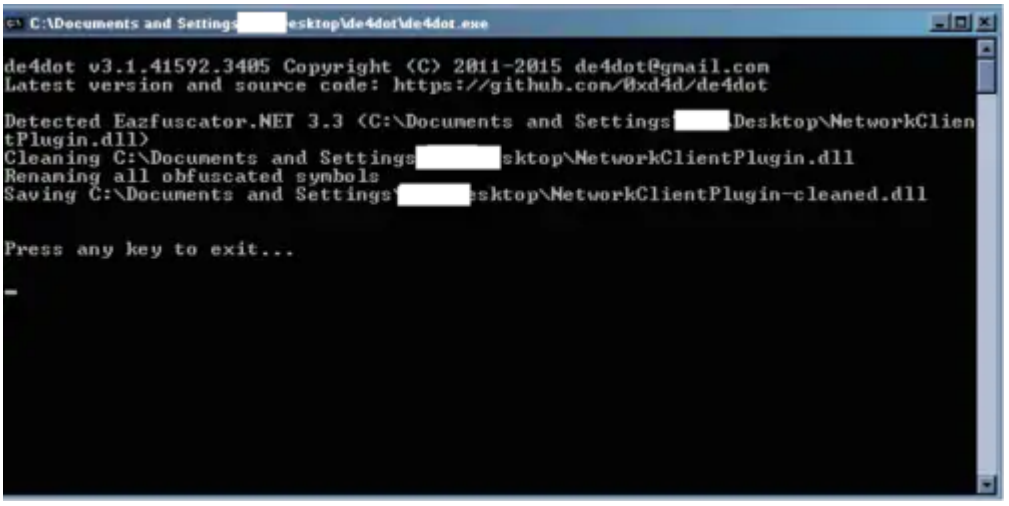
The plugins available to a NanoCoreRAT sample are encrypted and stored in the resource section of the PE file.



Using dnSpy as a debugger, we extracted the plugins included in sample 758f255abc102d53b7a4e8a8902da57076db9889cb80e81e8f1a344056f00c59 by setting breakpoints on all Assembly.Load calls, running the sample, and manually dumping the raw assembly bytes passed to those functions to disk as DLLs.



Most of the plugins included in this sample were obfuscated with Eazfuscater.NET 3.3 and easily deobfuscated using de4dot.



NanoCoreRAT uses a custom TCP protocol to connect to a server specified by the attacker on the port of their choosing. Below is the encrypted traffic sent by one sample to 54.152.254.8 on TCP port 4782:

```
00000000 40 00 00 00 52 5a 31 be 44 a9 01 f5 65 18 54 8e @...RZ1. D...e.T.
00000010 75 be e4 66 6a a4 0f e1 d0 4b 4e 6d 27 b6 19 a1 u..fj... .KNm'...
00000020 0b 21 07 b8 1a 57 60 42 0d 54 d8 4e 1b 04 54 6b .!...W`B .T.N..Tk
00000030 d5 8c 94 a0 76 88 6f 8a 05 88 dc ca 65 62 54 2b ....v.o. ....ebT+
00000040 fe d4 ab 7c
```

This sample uses DES to encrypt the traffic. It creates DESCryptoServiceProvider with a key from the Assembly Resource Guide Attribute and bytes from the resource section.

```
1  private static bool smethod_13()
2  {
3  byte[] array = Class8.smethod_16();
4  if (array != null)
5  {
6  ...
7  Guid guid_ = Class8.smethod_18(Assembly.GetExecutingAssembly());
8  Class8.byte_2 = Class8.smethod_19(byte_, guid_);
9  Class13.smethod_0(Class8.byte_2);
```

```
10  ...
11  }
12  private static Guid smethod_18(Assembly assembly_1)
13  {
14  Guid result = new Guid(((GuidAttribute)assembly_1.GetCustomAttributes(typeof(GuidAttribute), false)
    [0]).Value);
15
    return result;
16
    }
17
    private static byte[] smethod_19(byte[] byte_3, Guid guid_0)
18
    {
19
    Rfc2898DeriveBytes rfc2898DeriveBytes = new Rfc2898DeriveBytes(guid_0.ToByteArray(),
20  guid_0.ToByteArray(), 8);
21  return new RijndaelManaged
22  {
23  IV = rfc2898DeriveBytes.GetBytes(16),
24  Key = rfc2898DeriveBytes.GetBytes(16)
25  }.CreateDecryptor().TransformFinalBlock(byte_3, 0, byte_3.Length);
    }
```

```
48      public static void smethod_0(byte[] byte_0)
49      {
50          DESCryptoServiceProvider dESCryptoServiceProvider = new DESCryptoServiceProvider();
51          dESCryptoServiceProvider.BlockSize = 64;
52          dESCryptoServiceProvider.Key = byte_0;
53          dESCryptoServiceProvider.IV = byte_0;
54          Class13.icryptoTransform_0 = dESCryptoServiceProvider.CreateEncryptor();
55          Class13.icryptoTransform_1 = dESCryptoServiceProvider.CreateDecryptor();
56      }
57
58      // Token: 0x06000101 RID: 257 RVA: 0x00007144 File Offset: 0x00005344
59      public static byte[] smethod_1(object[] object_1)
60      {
61          Guid guid_;
62          return Class13.smethod_3(true, 0, 0, guid_, object_1);
63      }
64
65      // Token: 0x06000102 RID: 258 RVA: 0x0000715C File Offset: 0x0000535C
66      public static object[] smethod_2(byte[] byte_0)
67      {
68          return Class13.smethod_4(byte_0).object_0;
69      }
70
```

Locals

Name	Value
byte_0	{byte[0x00000008]}
[0]	0x72
[1]	0x20
[2]	0x18
[3]	0x78
[4]	0x8C
[5]	0x29
[6]	0x48
[7]	0x97
dESCryptoServiceProvider	{System.Security.Cryptography.DESCryptoServiceProvider}
BlockSize	0x00000040
BlockSizeValue	0x00000040
FeedbackSize	0x00000008
FeedbackSizeValue	0x00000008
IV	{byte[0x00000008]}
IVValue	{byte[0x00000008]}
Key	{byte[0x00000008]}
KeySize	0x00000040
KeySizeValue	0x00000040
KeyValue	{byte[0x00000008]}
LegalBlockSizes	{System.Security.Cryptography.KeySizes[0x00000001]}
LegalBlockSizesValue	{System.Security.Cryptography.KeySizes[0x00000001]}
LegalKeySizes	{System.Security.Cryptography.KeySizes[0x00000001]}
LegalKeySizesValue	{System.Security.Cryptography.KeySizes[0x00000001]}
Mode	CBC
ModeValue	CBC
Padding	PKCS7
PaddingValue	PKCS7
s_legalBlockSizes	{System.Security.Cryptography.KeySizes[0x00000001]}
s_legalKeySizes	{System.Security.Cryptography.KeySizes[0x00000001]}

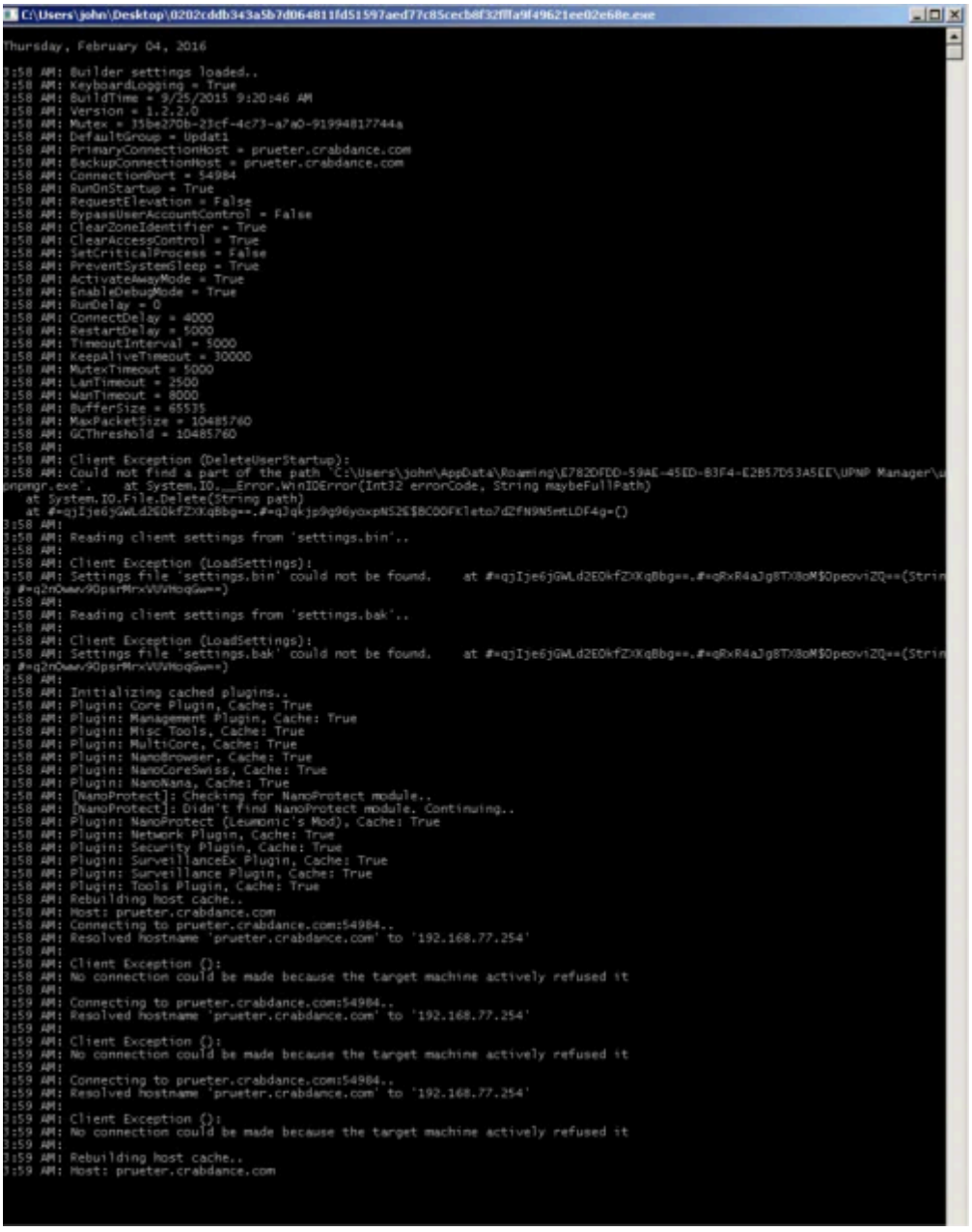
The DES key for this sample is 72 20 18 78 8C 29 48 97, we can use it to decrypt the traffic into the following:

00 00 00 00 12 DD DF 82 E7 AE 59 ED 45 B3 F4 E2 B5 7D 53 A5 EE 0C 14 57 49 4E 2D 48 55 46 44 39 33 41 52 36 32 32 5C 6A 6F 68 6E 0C 07 44 65 66 61 75 6C 74 0C 07 31 2E 32 2E 32 2E 30
.....Ýß,ç®YíE³ôâµ}S¥î..WIN-HUFD93AR622\john..Default..1.2.2.0
System Guid ComputerName\Username RAT Group Version

The bytes are stored in array2 and are encrypted with the following code and stored in the byte array named buffer.

```
byte[] buffer = Class13.icryptoTransform_0.TransformFinalBlock(array2, 0, array2.Length);
```

NanoCore can output messages to a console if the EnableDebugMode parameter is enabled in the RATs configuration.



Conclusion

Phishing is often how threat attackers gain access to targeted systems and user awareness is the first line of defense. Phishing isn't new but the increased distribution of the full-featured NanoCoreRAT implants is. Users should be made aware of the dangers that enabling macros poses. We have observed macro-based attacks on the rise in October of 2014

Palo Alto Networks customers with WildFire turned on would have been alerted to the presence of this threat on their networks. AutoFocus customers are able to further research both tax-themed phishing and NanoCoreRAT samples and trends.

Indicators

Email Subject Lines

[Attention] Your 2014 Tax Report

[Urgent Attention] Your 2015 Secure IP PIN

[ATO: URGENT] Your 2014 Tax Return Report!

[URGENT ATTENTION] Your 2014 Tax Return!

[ATO: ATTENTION] Your 2015 Tax Return PIN!

[IRS ATTENTION] Your 2015 Secure IP PIN!!!

[HMRC ATTENTION] Your 2015 Tax Report PIN!

[ATTENTION] Your 2015 Tax Return PIN!!!

Email Attachment Filenames

IRSReport.doc
CATAXREPORT.doc
2015TaxPIN.pdf.exe
[CRA]Report.pdf.exe
SGTAXREPORT.doc
[CRA]TaxReport.doc
[IRS]TaxReport.doc
[HMRC]TaxReport.doc
TaxReport!!.doc
SGTAXREPORT.pdf.exe
[CRA]ReadReport.doc
UKTaxReturnReport.pdf.exe
CATaxReturnReport.pdf.exe
[CA]Report.pdf.exe
[BE]TaxReport.pdf.exe
US2015TaxPIN.doc
AUTaxReport.pdf.exe
AU2015TaxPIN.doc
2015TaxPIN.doc
CRA-Report.doc.exe

TaxReport.doc
UKTAXREPORT.doc
AUTAXREPORT.doc
CATaxreturn.doc
[CRA]Report!.pdf.exe
FRTaxReport.pdf.exe

Email Attachment SHA256s

b633e5b9d6961f63dbf07ccd864903948a3c0772f2f66f86ad42c5b1faa0c539
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b11ac7fcb5d0427b922a8f6ba0bf6078647cb8bf3bed11ca43dc30f0f30157f2
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cdc350df224011bd95f8fc04cfe355b44f1a3732ea7683339227baaa89a7935e
161a7c71330f0088b5bc06cc2a80fb1217e1a834d8ca87e749cdafa64f521bc5

Email Attachment Resolved Domains

agor0020.gotdns.ch
btint.net16.net
dawood00.no-ip.org
dawood01.ddns.net

dawood02.no-ip.org
www.cnw-inc.com
www.iphonetechie.com
www.pantech224.firstcom.com.sg
www.secretchamber.sg

NanoCore Deobfuscated Plugin SHA256s

ClientPlugin.dll	277f74d0ce633645c1a3a91b45f800f16385496d50c511084ccbd19c33a39b23
CoreClientPlugin.dll	8c18712257e04e0554a4fa8414906489bc4300ee71405719d43ce949decddf18
FileBrowserClient.dll	98b70d6b88b8fdf05d8da676fa7a48622c2d415cd5cf8e8a1f193dc6c65dc101
Lzma#.dll	ee05e8bd662e8e59c851b4053d2b34e8524cbe5356ee6c385b07d028a9dfb28d
ManagementClientPlugin.dll	3ad61e99f7a09c524121981f536b625fadcb27481d99ffe75938bb550be8883e
MyClientPlugin.dll	1e6cc9c0ee28a352611fd1a6b41f4a5e66019729b529d9177b14b25624533cad
MyClientPluginNew.dll	c986b9e146cb4f88dc68bea7927c76e0056e181b7b0de45fe4a221ce5e900d08
NanoCoreBase.dll	ea8ddf633460353ab0e641b97a370873b16ac4aef3e6ef6bffc2c4618256ab64
NanoCoreStressTester.dll	edd0e15cdf75f8158c5aae90db3e8c7d7705a247c5d807bc74c027c36ef6dc3d
NetworkClientPlugin.dll	6995887a9827808ca41ffbfddbeb93b8de9468387ec8958207a3eb9951d286f6
SecurityClientPlugin.dll	ee5cb353a3e4bdce3ac3b514e2e17e0dd0b04d787b4705c7cf1a681c0b422d85
SurveillanceClientPlugin.dll	beaf550d664abe4653fd0ddbdd1783894141b51272d8ac565556aa28e2ac847d
SurveillanceExClientPlugin.dll	5db139678bcfda1b46ddab1e2956b599da89a364230d16703a4ac0b02325a13a
ToolsClientPlugin.dll	a4f7a7dddbef1930d11609e4cd7604d1c3a75646db051499b1247b3b03b48692
MyClientPlugin.dll_2	7c1d77c3b41af227c5f6ae49000134420ce9fdd8d3050eceb5aa2358a31a4724

Additional Resources

- NanoCore and Unpacking the AutoIT Cryptor
- NanoCore: Another RAT tries to make it out of the gutter
