

Royal Road! Re:Dive

 nao-sec.org/2021/01/royal-road-redive.html



nao_sec

[Home](#)[Archive](#)[About](#)

2021-01-04



Abstract

We introduced the “Royal Road RTF Weaponizer” in our previous blog [1] (and the presented at Japan Security Analyst Conference 2020 and CPX 360 CPRCon 2020). Royal Road is a tool shared by many targeted attack groups believed to belong to China. It’s been a year since our previous blog, and Royal Road is still in use. Here, we will introduce the Royal Road-related attacks observed during 2020.

Previous Blog

Let’s briefly review the previous blog. Royal Road is a tool that generates RTF files that exploit the Microsoft Office Equation Editor vulnerabilities (CVE-2017-11882, CVE-2018-0798, CVE-2018-0802). The details of the tool are unknown, but the RTF file generated by it has various characteristics. The definition of “RTF file generated by Royal Road” may vary from researcher to researcher. Therefore, we define a file that meets the following conditions as an “RTF file generated by Royal Road”.

1. Exploiting a vulnerability in Microsoft Office Equation Editor
2. Containing an object named “8.t”

However, some RTF files are likely to be related to Royal Road, even though they don’t meet the second condition. For classification purposes, we refer to this as “Related Samples”. In reality, this may also be an RTF file generated by Royal Road, but the truth is only known to the attacker. Due to the our research, we have divided these into “Royal Road Samples” and “Related Samples”. However, they are treated the same in the specific case studies below.

And Royal Road is shared among various attack groups believed to belong to China. Specifically, it is believed to be used by the following attack groups. The attack group alias is written for reference. Strictly speaking, these can be different. For example, TA428 and Pirate Panda are not exactly equivalent.

1. Temp.Tick (BRONZE BUTLER, RedBaldKnight)
2. Temp.Conimes (Goblin Panda, Hellsing)
3. Temp.Periscope (Leviathan, APT 40)
4. Temp.Trident (Dagger Panda, IceFog)
5. Tonto (Karma Panda, CactusPete, LoneRanger)
6. TA428 (Pirate Panda)
7. Rancor

Also, we categorized the various characteristics of the RTF files used by these groups and showed what they have in common.

Group-A	Group-B	
Temp.Conimes	Temp.Trident	TA428
Temp.Periscope		Tonto
Rancor	Tick	

Updates

It's been a year since we introduced Royal Road. In the meantime, the RTF file, believed to have been generated by Royal Road, has been used many times in targeted attacks, and several updates have been observed. First of all, we will introduce the updates.

The RTF file generated by Royal Road contains encoded malware. It is decoded by Shellcode after exploit. In our previous blog, we introduced the following 5 encodings.

1. 4D 5A 90 00 (not encoded)
2. F2 A3 20 72
3. B2 A6 6D FF
4. B0 74 77 46
5. B2 5A 6F 00

Many of the RTF files we observed in 2020 used the 3rd and 4th encodings. However, a few samples used the new encodings. The following 2 encodings.

1. A9 A4 6E FE



ADDRESS	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	0123456789ABCDEF
00000000	A9	A4	6E	FE	F3	FE	FE	F2	FE	FE	FF	FF	FE	FE	FE	FE	黒.n.....
00000010	46	FE	FE	FE	FE	FE	FE	BE	FE	F.....t.....							
00000020	FE															
00000030	FE	1E	FE	FE													
00000040	E8	DF	44	E8	FE	42	F5	29	DD	46	FD	AA	29	DD	A2	96	鍔D..B.)SF.エ)」「抹
00000050	95	83	DE	8E	8C	8F	97	8C	9D	89	DE	93	9D	88	88	8F	・詞女拳迦統・盾
00000060	82	DE	9C	91	DE	8C	81	88	DE	95	88	DE	B2	AF	A3	DE	・恆『載萎譜』イ」
00000070	89	8F	92	91	C8	E9	E9	F4	D2	FE	縁酌禱・.....						
00000080	A9	17	C6	7E	F5	70	A0	23	F5	70	A0	23	F5	70	A0	23	ウ.ニ~・.#・.#・.#
00000090	1D	65	AC	23	EB	70	A0	23	1D	65	9A	23	E9	70	A0	23	.eア#・.#.e.#駱.#[
000000A0	C8	BE	C9	23	E8	70	A0	23	F5	70	A7	23	DC	70	A0	23	社ノ#罐.#[・ア#7p.#[
000000B0	FE	F8	1A	23	EB	70	A0	23	FE	F8	32	23	F6	70	A0	23	...#.#[.2#・.#
000000C0	FE	F8	37	23	F6	70	A0	23	AC	95	93	96	F5	70	A0	23	..7#・.#.無靖p.#[
000000D0	FE															
000000E0	AE	B1	FE	FE	AA	FD	F3	FE	74	EA	A0	98	FE	FE	FE	FE	ヨア..エ...t権.....
000000F0	FE	FE	FE	FE	1E	FE	FC	DD	EB	FD	F5	FE	FE	CE	FE	FE木.....

ADDRESS	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	0123456789ABCDEF
00000000	4D	5A	90	00	03	00	00	00	04	00	00	00	FF	FF	00	00	MZ..
00000010	B8	00	00	00	00	00	00	00	40	00	00	00	00	00	00	00	ク.....@.....
00000020	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00000030	00	00	00	00	00	00	00	00	00	00	00	00	E0	00	00	00
00000040	0E	1F	BA	0E	00	B4	09	CD	21	B8	01	4C	CD	21	54	68	..コ..エ.^!ク.^.!Th
00000050	69	73	20	70	72	6F	67	72	61	6D	20	63	61	6E	6E	6F	is program canno
00000060	74	20	62	65	20	72	75	6E	20	69	6E	20	44	4F	53	20	t be run in DOS
00000070	6D	6F	64	65	2E	0D	0D	0A	24	00	00	00	00	00	00	00	mode....\$.....
00000080	4D	E7	38	80	09	86	56	D3	09	86	56	D3	09	86	56	D3	M.8..・モ..・モ..・モ
00000090	E1	99	52	D3	0B	86	56	D3	E1	99	5C	D3	0D	86	56	D3	瘤Rモ..・モ瘤¥モ..・モ
000000A0	2E	40	2D	D3	0E	86	56	D3	09	86	57	D3	22	86	56	D3	.@-モ..・モ..・モ”・モ
000000B0	00	FE	DC	D3	0B	86	56	D3	00	FE	C4	D3	08	86	56	D3	..ワモ..・モ..トモ..・モ
000000C0	00	FE	C7	D3	08	86	56	D3	52	69	63	68	09	86	56	D3	..モ..・モRich..・モ
000000D0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
000000E0	50	45	00	00	4C	01	03	00	8A	0C	56	5E	00	00	00	00	PE..L.....V^.....
000000F0	00	00	00	00	E0	00	02	21	0B	01	09	00	00	30	00	00!.....0..

This encoding can be decoded with code like the following:

```
dec_data = []

for i in range(len(enc_data)):
    dec_data.append(((int.from_bytes(enc_data[i], "little") ^ 0x7b) + 0x7b) % 256)
```

1. 94 5F DA D8



ADDRESS	00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F	0123456789ABCDEF
00000000	94 5F DA D8 F9 B8 BA 9E D2 C8 E9 74 3F 04 17 1C	農レリ・コ樽禮髪?...
00000010	7C B1 48 D8 FD 3E 97 73 02 C7 2C F5 6D 50 AA E7	「アリ.」耀.又,・Pi.
00000020	18 BE CD 5E FA F4 C6 E3 1E AE DC B5 74 CF 74 AE	.セハ^志ニ...ヨウオテヲ
00000030	91 68 CA F1 12 D0 88 84 E5 2D 33 51 92 CE 83 76	蘇ハ..ミ・.-3Q観ブ
00000040	E3 50 D4 E9 39 E7 75 7E 45 40 C6 2A 59 93 C3 2B	契ヤ.9転~E@ニ*Y禿+
00000050	6A 29 AD 70 D4 F1 DE 3E B0 62 44 9F DE 3D 13 4F	j)ユヤ・>-bD満=..0
00000060	FD 0E 88 D3 9A C6 B8 2E C9 11 92 A9 4C FD DC 09	..意堡ク.ノ.朝L.7.
00000070	20 51 DA 97 F3 74 74 6F 0F 7A AC 80 CF 1E B4 A5	Qレ烈!tto.zア.7.イ.
00000080	A0 CE 02 02 3C FF 65 D5 57 69 4B CC D6 B9 3E 60	.ホ..<.eコWiKワヨケ`
00000090	B3 83 60 8E 6F 09 32 3B 08 3B 13 4C C5 48 F0 41	ウチ姉.2;.;.LTH.
000000A0	1A 3B 43 CA 01 5A CB B5 F6 00 3B 76 52 29 50 4C	.;CH.7ヒオ..;vR)PL
000000B0	6F 8B A7 F2 3F CF 32 2D BD A9 EA FC D9 3A BE 01	o匡.?Z2-スウ・ル:セ.
000000C0	09 8B 51 43 83 80 BD AC 88 8E 98 C1 6F EF 3B CB	.飢Cムスヤ・价o.;ヒ
000000D0	97 18 F7 62 07 30 99 E6 77 3A CF E7 84 32 E6 6D	...・.0呪w:ズ辟2詢
000000E0	FF 3E 33 A4 78 8D 50 39 BE DF 36 83 58 7F 0B 51	.>3.恒9セ6ス..Q
000000F0	06 F2 4F 12 95 7B DE BF 65 30 B6 D4 22 B1 50 97	.・.府^ソe0かヤ?P.

ADDRESS	00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F	0123456789ABCDEF
00000000	4D 5A 90 00 03 00 00 00 04 00 00 00 FF FF 00 00	MZ.....
00000010	B8 00 00 00 00 00 00 00 40 00 00 00 00 00 00 00	ク.....@.....
00000020	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00000030	00 00 00 00 00 00 00 00 00 00 00 00 00 00 F0 00
00000040	0E 1F BA 0E 00 B4 09 CD 21 B8 01 4C CD 21 54 68	..コ..エ.ヘ!ク.Lヘ!Th
00000050	69 73 20 70 72 6F 67 72 61 6D 20 63 61 6E 6E 6F	is program canno
00000060	74 20 62 65 20 72 75 6E 20 69 6E 20 44 4F 53 20	t be run in DOS
00000070	6D 6F 64 65 2E 0D 0D 0A 24 00 00 00 00 00 00 00 00	mode....\$.....
00000080	F3 A4 81 5E B7 C5 EF 0D B7 C5 EF 0D B7 C5 EF 0D	・/ヰ..ヰ..ヰ..ヰ..
00000090	D2 A3 EC 0C BD C5 EF 0D D2 A3 EA 0C 3F C5 EF 0D	メ」..メ」..メ」..?
000000A0	D2 A3 EB 0C A5 C5 EF 0D 62 A8 EA 0C AA C5 EF 0D	メ」..ナ..ビイ..ヰ..
000000B0	62 A8 EB 0C B8 C5 EF 0D 62 A8 EC 0C A6 C5 EF 0D	ビイ..ヰ..ビイ..ヰ..
000000C0	D2 A3 EE 0C B2 C5 EF 0D B7 C5 EE 0D E6 C5 EF 0D	メ」..ヰ..ヰ..貨..
000000D0	2D AB E6 0C B5 C5 EF 0D 2D AB ED 0C B6 C5 EF 0D	-オ..ヰ..-オ..ヰ..
000000E0	52 69 63 68 B7 C5 EF 0D 00 00 00 00 00 00 00 00 00	Richヰ.....
000000F0	50 45 00 00 4C 01 04 00 16 0B FE 5D 00 00 00 00 00	PE..L.....]

This encoding can be decoded with code like the following:

```

dec_data = []
xor_key = 1387678300

for i in range(len(enc_data)):
    for _ in range(7):
        x0 = (xor_key & 0x20000000) == 0x20000000
        x1 = (xor_key & 8) == 8
        x2 = xor_key & 1
        x3 = 1 + (x0 ^ x1 ^ x2)
        xor_key = (xor_key + xor_key) + x3
    dec_data.append(int.from_bytes(enc_data[i], "little") ^ (xor_key % 256))

```

Our tool for decrypting Royal Road encoded object is already available on GitHub. It also supports the above new encodings.

https://github.com/nao-sec/rr_decoder

New Attack Groups

As we mentioned earlier, several attack groups use Royal Road. The following eight attack groups have been observed to use Royal Road (including both Royal Road Samples and Related Samples) during 2020.

1. Temp.Conies
2. Tonto
3. TA428
4. Naikon
5. Higaisa
6. Vicious Panda
7. FunnyDream
8. TA410

Of these, we have already reported on 1-3 attack groups in our previous blog. Temp.Conies used NewCore RAT to attack Vietnamese organizations. Tonto used Bisonal to attack organizations in East Asia such as Russia.

And the TA428 was also particularly active, using PoisonIvy, Cotx RAT, Tmanger, and nccTrojan to attack East Asian organizations such as Mongolia. We will not cover these individual cases here, but if you are interested, see the IOC chapter. For TA428, the paper [2] and blogs [3][4][5] are available from NSJ (NTT Security Japan). Please refer to that.

For Naikon, CheckPoint Research reported [6], but unfortunately, we could not observe this. Therefore, in the following, we will introduce attack cases related to Royal Road for four groups (5-8).

Higaisa

Higaisa is an attack group that seems to have been active since at least around 2016. It is primarily targeted at North Korean-related organizations and is believed to be aimed at stealing information using AttackBot, PIZ Stealer, and Ghost RAT.

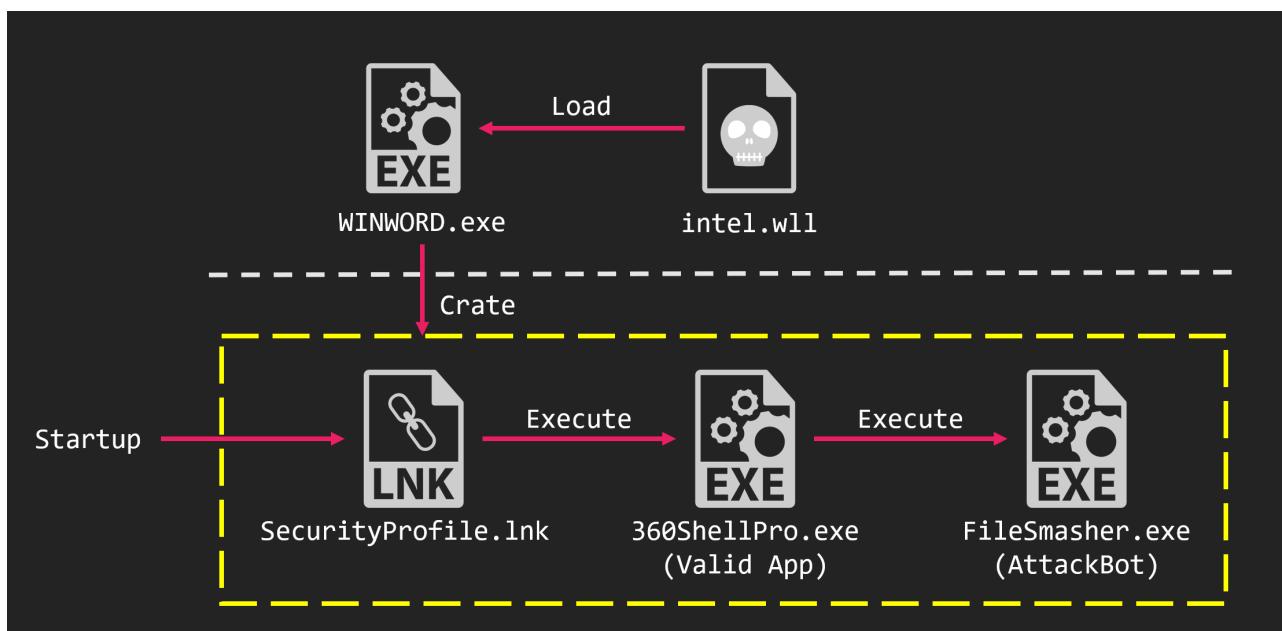
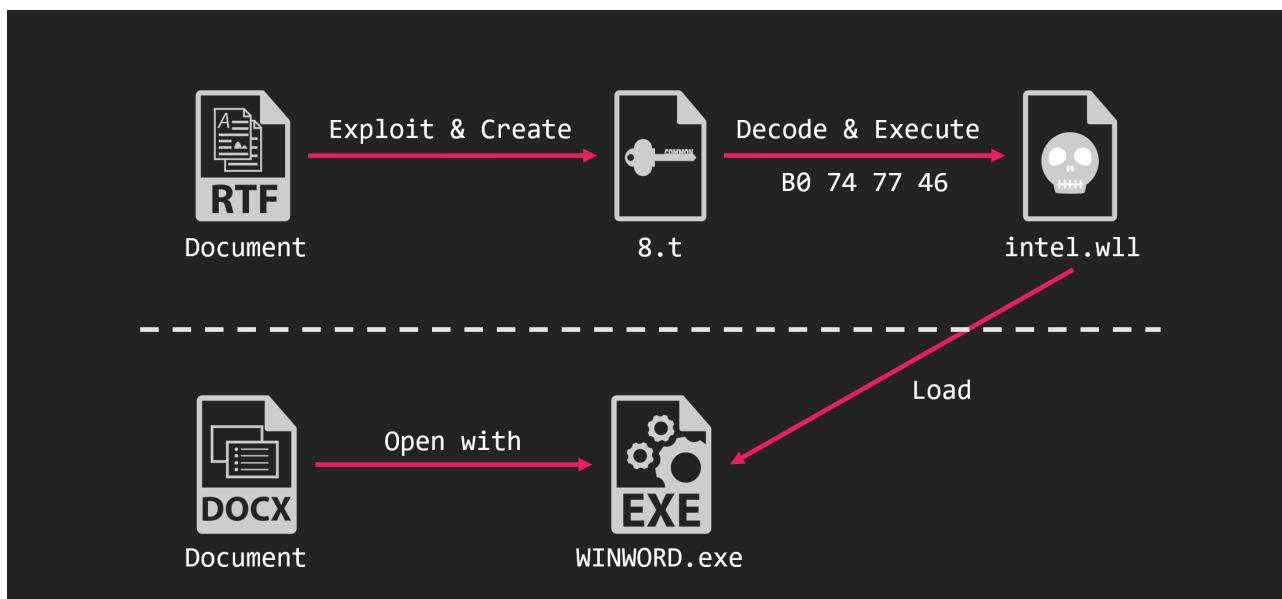
The blogs have been written by Tencent and Positive Technologies so far [7][8][9], and are attributed to (South) Korea. However, NSJ's paper [10] showed a connection with Ghost Dragon [11] and PKPLUG [12], and it was reported that it might belong to China.

We observed an attack by Higaisa on Royal Road in March 2020.

Merry Christmas And Happy New Year!

Hope all your Christmas dreams come true!

I wish you a merry Christmas. All affection and best wishes to you and yours.



The malware executed by the Royal Road RTF was AttackBot. AttackBot is a downloader that has been used by Higaisa since at least April 2018.

0x00401063	mov	ecx, 5
0x00401068	mov	eax, 8
0x0040106d	xor	esi, esi
0x0040106f	nop	
0x00401070	add	eax, ecx
0x00401072	cdq	
0x00401073	mov	edi, 0xff ; 255
0x00401078	idiv	edi
0x0040107a	inc	esi
0x0040107b	mov	eax, ecx
0x0040107d	mov	byte [ebp + esi - 0x45], dl
0x00401081	movzx	ecx, dl
0x00401084	cmp	esi, 0x40 ; 64
0x00401087	jb	0x401070

Vicious Panda

Vicious Panda is an attack group reported by CheckPoint Research in March 2020 [13]. It is said to belong to China and targets East Asia such as Russia, Mongolia, and Ukraine.

We observed an attack on the Royal Road by Vicious Panda in March 2020.

БНХАУ-ын Төрийн зөвлөлийн гишүүн, Гадаад хэргийн сайд Ван И “2020 он бол Хятад Үндэстний агуу их сэргэн мандалтын явц дахь түүхэн ач холбогдол бүхий жил бөгөөд гадаад харилцаанд 6 чухал үүргийг анхаарах ёстой”-г илэрхийлсэн.

Энэ хүрээнд 2020 онд гадаад харилцааны чиглэлээр дараах зорилтуудыг хэрэгжүүлэхээр төлөвлөөд байна.

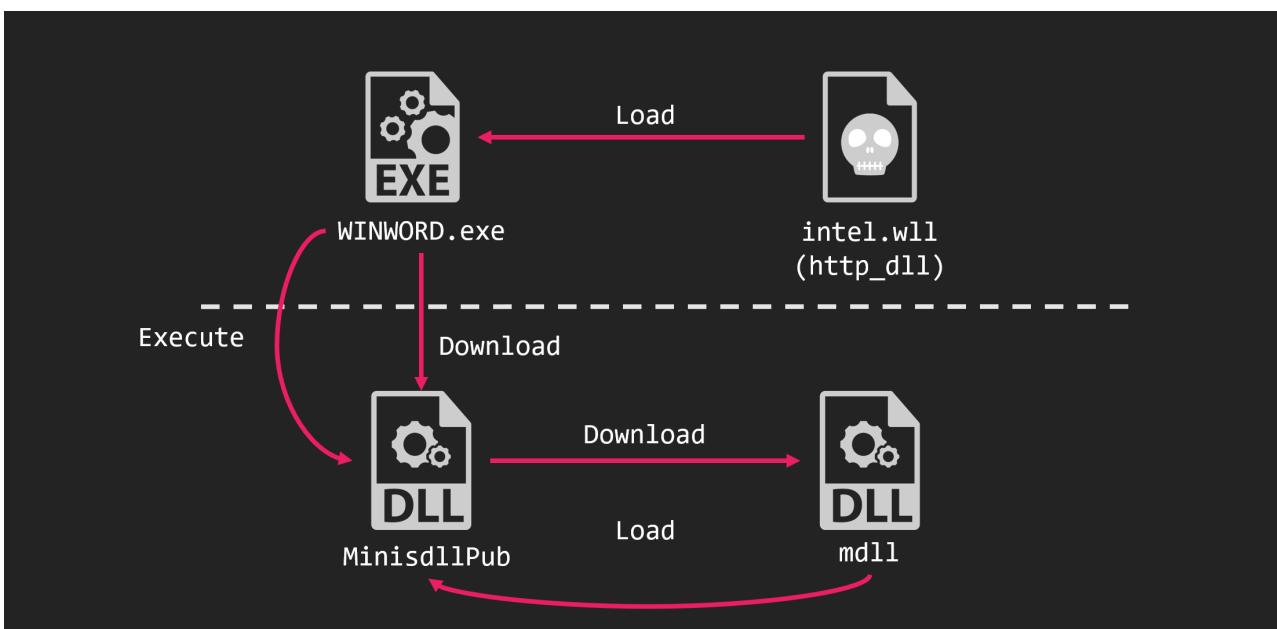
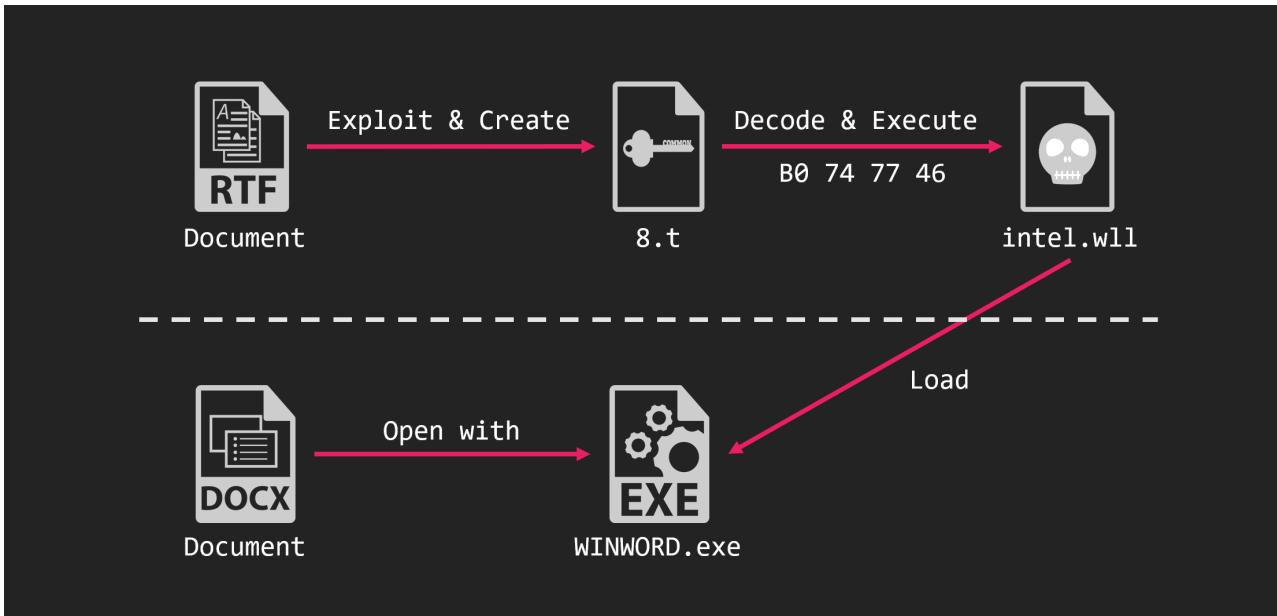
Нэгдүгээрт. Дотоодын хөгжилд бүх чадлаараа үйлчлэх.

Чинээлэг нийгмийг бүх талаар бий болгох нь Хятад улсын “хос зуун” жилийн чухал зорилт бөгөөд үүний тулд олон улс бус нутгийн таатай гадаад орчинг бүрдүүлэхийн төлөө чармайлт гаргаж ирсэн. Ван И хэлэхдээ, 2020 онд дотоод, гадаад нөхцөл байдлыг харгалзан, гадаад харилцааны нөөц боломжийг бүрэн дүүрэн ашиглаж, улсын хөгжлийн томоохон стратегийг хэрэгжүүлэхийн зэрэгцээ гадаад сурталчилгаа, танилцуулах арга хэмжээг улам идэвхтэй зохион байгуулж, орон нутаг дэлхий нийттэй харилцан ашигтай хамтын ажиллах өргөн индэрийг бий болгохыг зорьж буйгаа илэрхийлсэн.

Хоёрдугаарт. Улсын эрх ашигийг эрс шийдэмгий хамгаална.

Хятал vpsc галаал харилцааны нээлттэй боллогыг төпөөнүүн пэхийн зэрэгцээ vpsc-ын

It has been reported to execute malware similar to Enfal and BYEBY.



FunnyDream

FunnyDream is an attack group that is said to have been active since around 2018. It is said to belong to China and targets Southeast Asia such as Vietnam and Malaysia. FunnyDream uses Chinoxy and FunnyDream Backdoor. BitDefender has published a detailed report [14] on FunnyDream.

We observed an attack by FunnyDream from March to May 2020.

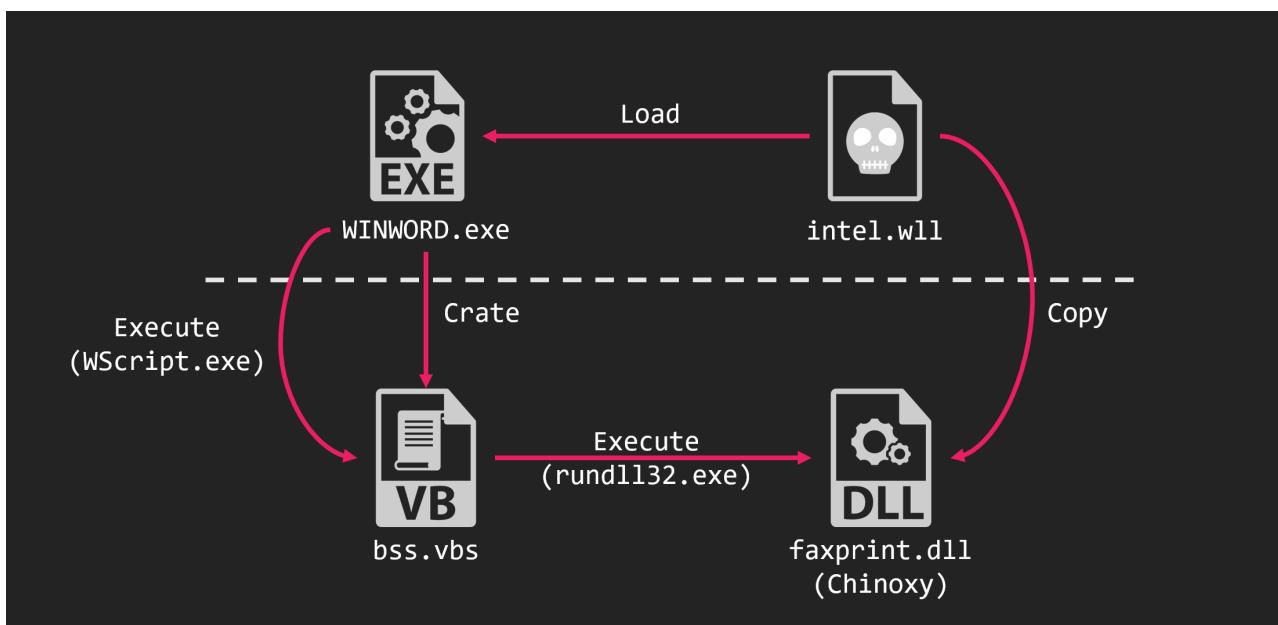
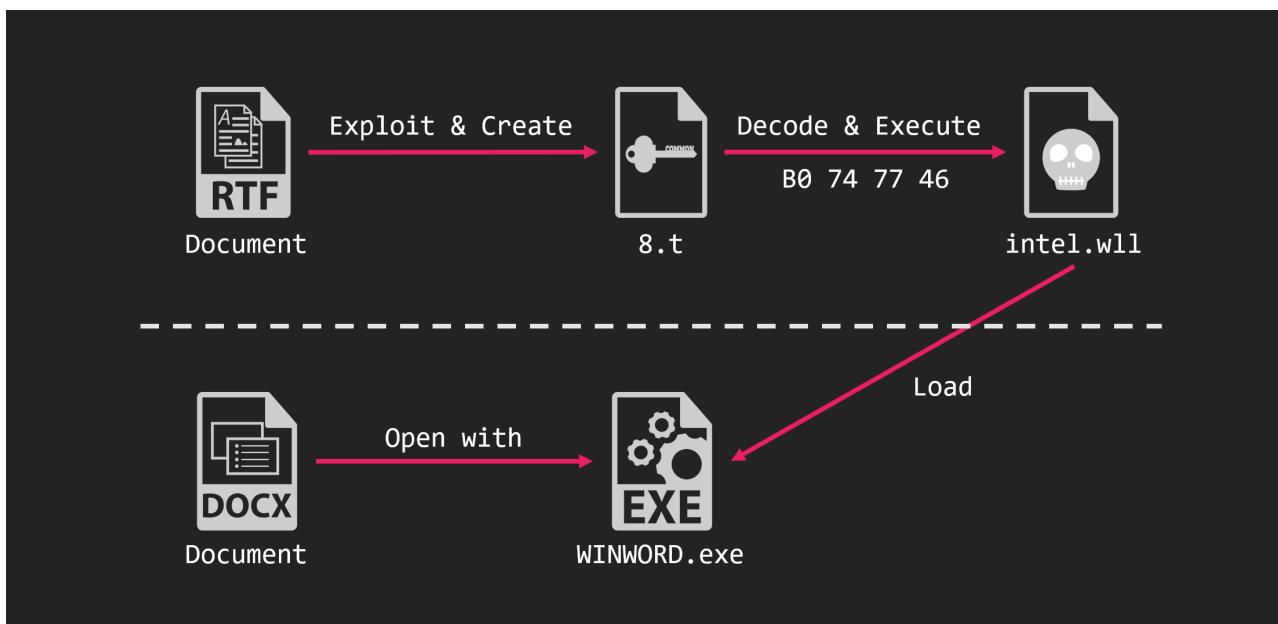
Thủ trưởng Vịnh giao cho Cỗng tiếp thu nội dung của CĐN, chỉnh sửa, hoàn chỉnh bài viết của TT, hoàn thành trước 15.00, ngày 20/5/2020.

Bài viết để đăng tải trên Đặc san “VN-HK: Dấu ấn 25 năm” của Báo TG&VN/Bộ Ngoại giao. Y/c bài viết khoảng 1.000 chữ.

Đề nghị các đồng chí nghiên cứu bài viết này, đầu sáng mai (19/5) cho ý kiến/hướng xử lý hoàn chỉnh.

QUÂN SỰ-QUỐC PHÒNG – NHÂN TÓ THÚC ĐẨY QUAN HỆ VIỆT NAM – HOA KỲ SAU CHIẾN TRANH.

(Bài viết của đồng chí Thượng tướng Nguyễn Chí Vịnh,
Thứ trưởng Bộ Quốc phòng đăng trên Báo Thế giới & Việt Nam)



Chinoxy is a RAT that has been used by FunnyDream since around 2018. It decoded the config using two numeric data and communicates with the C&C server using its original protocol using Blowfish.

TA410

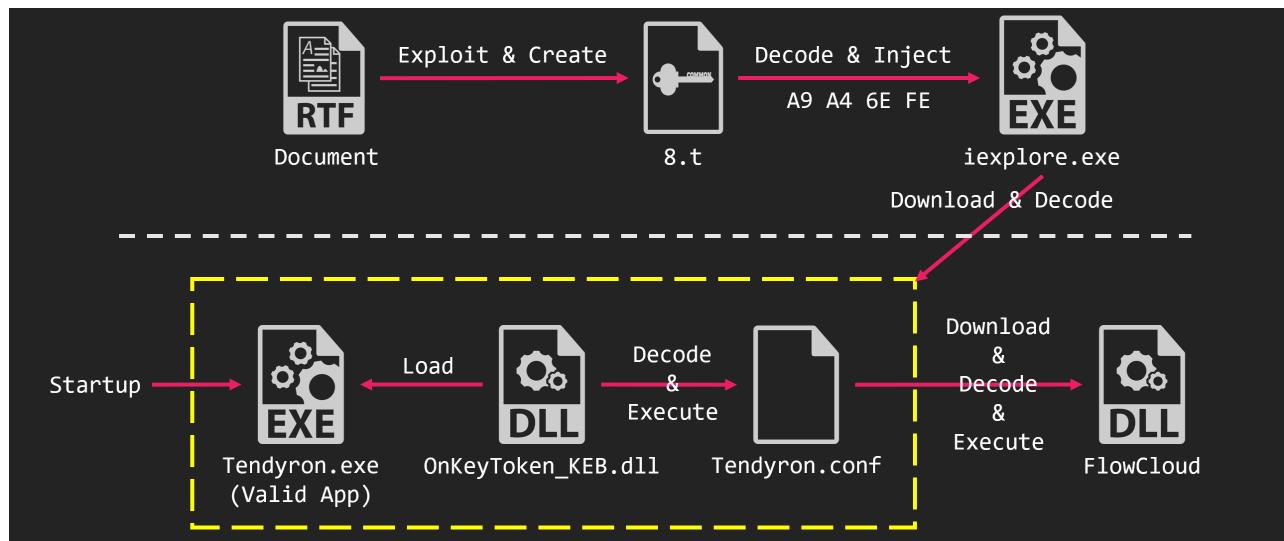
TA410 is an attack group that is said to have been active since around 2016. It is said to belong to China and is suspected to be related to APT10. The report has been published by Proofpoint [15][16][17] and is mainly targeted at public sector in the US. It uses malware called LockBack and FlowCloud.

We observed an attack by TA410 in October 2020.

怎样看待蔡双十讲话的内容和风格。

总的评价，她的讲话是在放烟雾弹，是暗度陈仓，掩人耳目。

第一，蔡讲话通篇不同于以往，几乎完全不触及涉及两岸政治定位和台湾政治前途的敏感语汇，没有回应“九二共识”、没有出现“中国”或“中华民国”，也没有提“维持现状”或“独立”与否，连随时挂在嘴边的“自主”“尊严”或“主权”等都较少浮现。显然是要有意回避，在双十这样的重要“节日”，不提“国家”，只讲社会，显得毫不切题、不伦不类。这与她惯有的风格和一段时间以来“台独”



FlowCloud is a RAT reported by Proofpoint in June 2020. FlowCloud has been reported to be v4 and v5, but the FlowCloud we observed at this time was similar to v4.

Attack case against Japan

In addition to the four attack groups shown so far (Higaisa, Vicious Panda, FunnyDream, TA410), attacks that appear to be related to Royal Road have been observed. Among them, we will introduce an example of attacks on Japan. We are not able to identify which attack group made this attack. If you have any knowledge about it, please share it with us...

The attack on Japan took place in November 2020. The attack began with 2 RTF files attached to the email.

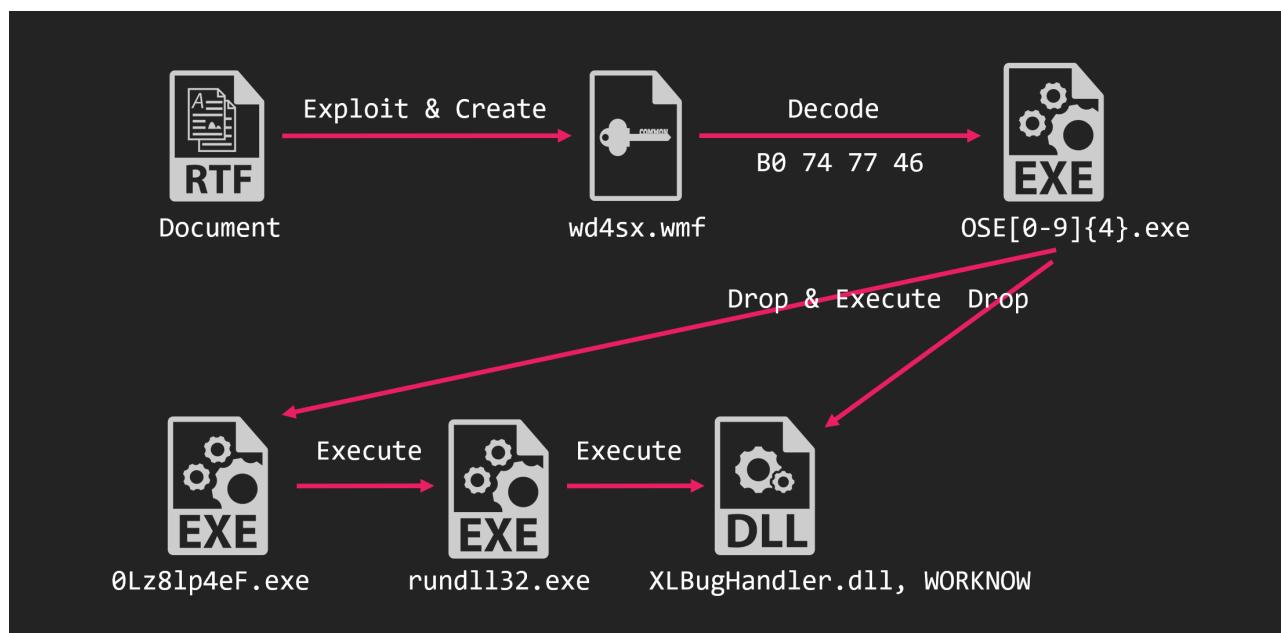
経費支出明細表						
<経費明細総括表>						
(単位: 円)						
申請者名	予算額(交付決定額または変更申請額)			実績額		
	A	B	B×2/3以内	A	B	B×2/3以内
補助事業に要する経費	補助対象 経費	補助金 交付決定額	補助事業に要した経費	補助対象 経費	補助金の額	
(税込み)	(税抜き)	(税抜き)	(税込み)	(税抜き)	(税抜き)	
<代表者> 補助事業者名						
合 計	0	0	0	0	0	0
<経費明細表>						
(事業者名:) (単位: 円)						
事業者名	予算額(交付決定額または変更申請額)			実績額		
	A	B	B×2/3以内	A	B	B×2/3以内

精算請求書						
事業者名:						
管 理	支払	支払先	内容および仕様等詳細	数 量	单 価	補助事業に要した経費 <支払額>
No.	年	月	日			補助対象 経費
1						
2						
3						
4						
5						
6						
7						
合 計						0 0 0

These RTF files did not contain an 8.t object, however did contain an associated object. This is the malware encoded by the 4th (Bo 74 77 46) encoding shown above.

id	index	OLE Object
0	00036596h	format_id: 2 (Embedded) class name: 'Package' data size: 553136 OLE Package object: Filename: u'wd4sx.wmf' Source path: u'C:¥¥Windows¥¥wd4sx.wmf' Temp path = u'C:¥¥Windows¥¥wd4sx.wmf' MD5 = '9a67a7ccace7d8f788663077d57d6811'
1	00144786h	format_id: 2 (Embedded) class name: 'Equation.2¥x00¥x124Vx¥x90¥x124VxvT2' data size: 6436 MD5 = '00b38c4c02dcda01f8abea580c95a919'
2	0014476Ch	Not a well-formed OLE object

The overall picture of the attack is as follows.



The malware executed was an unknown RAT. We call this XLBug RAT because of the characteristics left in this RAT. The RAT held information such as C&C server encoded by Base64 and XOR.

1002588c	4d 59 41 ...	ds	"MYAAAAArq+wvbK1vbKwva6xtamnr58="
100258ab	4d 59 42 ...	ds	"MYBBBB5PH88u+unw=="
100258be	4d 59 43 ...	ds	"MYCCCC0Lz8lp4eF"
100258ce	4d 59 44 ...	ds	"MYDDDD/f76Aq6f"

```

size = base64_decode(param_1,&buf);
i = 0;
if (0 < (int)size) {
    do {
        *(char *) (i + (int)buf) = *(char *) (i + (int)buf) + 'z';
        *(byte *) (i + (int)buf) = *(byte *) (i + (int)buf) ^ 0x19;
        i = i + 1;
    } while (i < (int)size);
}
return buf;
}

```



103.56.53.126:80
Group1
name1

The following commands are implemented in XLBug RAT.

- Get directory information
- Get file information
- Get computer information
- Execute file
- Upload file
- Download file
- Rename file
- Delete file
- Delete itself

The naming convention and encoding of the encoded object contained in the RTF are similar to those of the TA428. However, we could not say that this was a TA428 attack.

Relationship

In the previous blog, we summarized the characteristics of attack groups that use Royal Road. We used it to divide the attack groups into two groups. However, by 2020, those characteristics are almost meaningless. It has been standardized or deleted. It's not as easy to group as it used to be. In the first place, the groups sharing Royal Road should be close. We do not classify further, but if you have any comments please let us know.

Yara Rule

The GitHub repository we shared in the previous blog is still being updated.

https://github.com/nao-sec/yara_rules

IOC

The IOC sheet shared in the previous blog is still being updated.

https://nao-sec.org/jsac2020_ioc.html

Tool

The tool used by Royal Road to decrypt encoded object is still being updated.

https://github.com/nao-sec/rr_decoder

Wrap-Up

The attacks using Royal Road have decreased compared to 2019, but are still ongoing. There are many cases of attacks by TA428 and Tonto, but other attacks by different attack groups (Higaisa, Vicious Panda, FunnyDream, TA410) have also been observed.

The attacks on Japan have also been observed and we were unable to identify this with a known attack group. The use of Royal Road by these unknown attack groups is expected to continue.

In addition to Royal Road, there are other cases, such as the Tmanger family, that appear to share tools among multiple targeted attack groups. We should continue to pay close attention to these tool sharing cases.

Acknowledgments

“nao_sec” is an independent research team that does not belong to any company. Individuals belong to each company and engage in research, but the activities of nao_sec still maintain their independence from each company. We are grateful to all of you who cooperated with our research activities every day.

References

- [1] nao_sec, “An Overhead View of the Royal Road”, <https://nao-sec.org/2020/01/an-overhead-view-of-the-royal-road.html>
- [2] NTT Security Japan, “Operation LagTime IT: colourful Panda footprint”, <https://vblocalhost.com/uploads/VB2020-Ozawa-etal.pdf>
- [3] NTT Security Japan, “Panda’s New Arsenal: Part 1 Tmanger”, <https://insight-jp.nttsecurity.com/post/102gi9b/pandas-new-arsenal-part-1-tmanger>
- [4] NTT Security Japan, “Panda’s New Arsenal: Part 2 Albaniutas”, <https://insight-jp.nttsecurity.com/post/102gkfp/pandas-new-arsenal-part-2-albaniutas>
- [5] NTT Security Japan, “Panda’s New Arsenal: Part 3 Smanager”, <https://insight-jp.nttsecurity.com/post/102glv5/pandas-new-arsenal-part-3-smanager>
- [6] CheckPoint Research, “Naikon APT: Cyber Espionage Reloaded”, <https://research.checkpoint.com/2020/naikon-apt-cyber-espionage-reloaded/>
- [7] Tencent, “APT攻击组织”黑格莎 (Higaisa) ”攻击活动披露”, <https://s.tencent.com/research/report/836.html>
- [8] Tencent, ““Higaisa (黑格莎) ”组织近期攻击活动报告”, <https://s.tencent.com/research/report/895.html>
- [9] Positive Technologies, “COVID-19 и новогодние поздравления: исследуем инструменты группировки Higaisa”, <https://www.ptsecurity.com/ru-ru/research/pt-esc-threat-intelligence/covid-19-i-novogodnie-pozdravleniya-issleduem-instrumenty-gruppirovki-higaisa/>
- [10] NTT Security Japan, “Crafty Panda 標的型攻撃解析レポート”, <https://www.nttsecurity.com/docs/librariesprovider3/default-document-library/craftypanda-analysis-report>
- [11] Cylance (BlackBerry), “The Ghost Dragon”, <https://blogs.blackberry.com/en/2016/04/the-ghost-dragon>
- [12] Palo Alto Networks, “PKPLUG: Chinese Cyber Espionage Group Attacking Southeast Asia”, https://unit42.paloaltonetworks.com/pkplug_chinese_cyber_espionage_group_attacking_asia/
- [13] CheckPoint Research, “Vicious Panda: The COVID Campaign”, <https://research.checkpoint.com/2020/vicious-panda-the-covid-campaign/>
- [14] BitDefender, “A Detailed Timeline of a Chinese APT Espionage Attack Targeting South Eastern Asian Government Institutions”, <https://labs.bitdefender.com/2020/11/a-detailed-timeline-of-a-chinese-apt-espionage-attack-targeting-south-eastern-asian-government-institutions/>
- [15] Proofpoint, “LookBack Malware Targets the United States Utilities Sector with Phishing Attacks Impersonating Engineering Licensing Boards”, <https://www.proofpoint.com/us/threat-insight/post/lookback-malware-targets-united-states-utilities-sector-phishing-attacks>
- [16] Proofpoint, “LookBack Forges Ahead: Continued Targeting of the United States’ Utilities Sector Reveals Additional Adversary TTPs”, <https://www.proofpoint.com/us/threat-insight/post/lookback-forges-ahead-continued-targeting-united-states-utilities-sector-reveals>
- [17] Proofpoint, “TA410: The Group Behind LookBack Attacks Against U.S. Utilities Sector Returns with New Malware”, <https://www.proofpoint.com/us/blog/threat-insight/ta410-group-behind-lookback-attacks-against-us-utilities-sector-returns-new>