Interesting FormBook Crypter - unconventional way to store encrypted data

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This FORMBOOK CRYPTER loader contain a lot of interesting feature to bypassed sandbox, obfuscate its code and many more. It also show a unique way to store and parse its encrypted data to execute.

so let's start :).

FORMBOOK CRYPTER LOADER (ANTI-VM):

After decrypting some shellcode in the memory it will use several technique to check if its code is running in a virtual machine or not. The screenshot below show 3 techniques it use.

- ANTI-VM I : it use the cpuid with EAX=0x40000000 as input to determined the hypervisor brandname to check if it is running in a virtualize environment
- ANTI-VM II: use cpuid with EAX=1 as an input to check the 31st bit of its return value in ECX if set or not. if it is set then it is in VM.
- ANTI-VM III: check the existence of some known driver component of the virtual machine. for this example it checks the existence of the vmmouse driver in the machine.

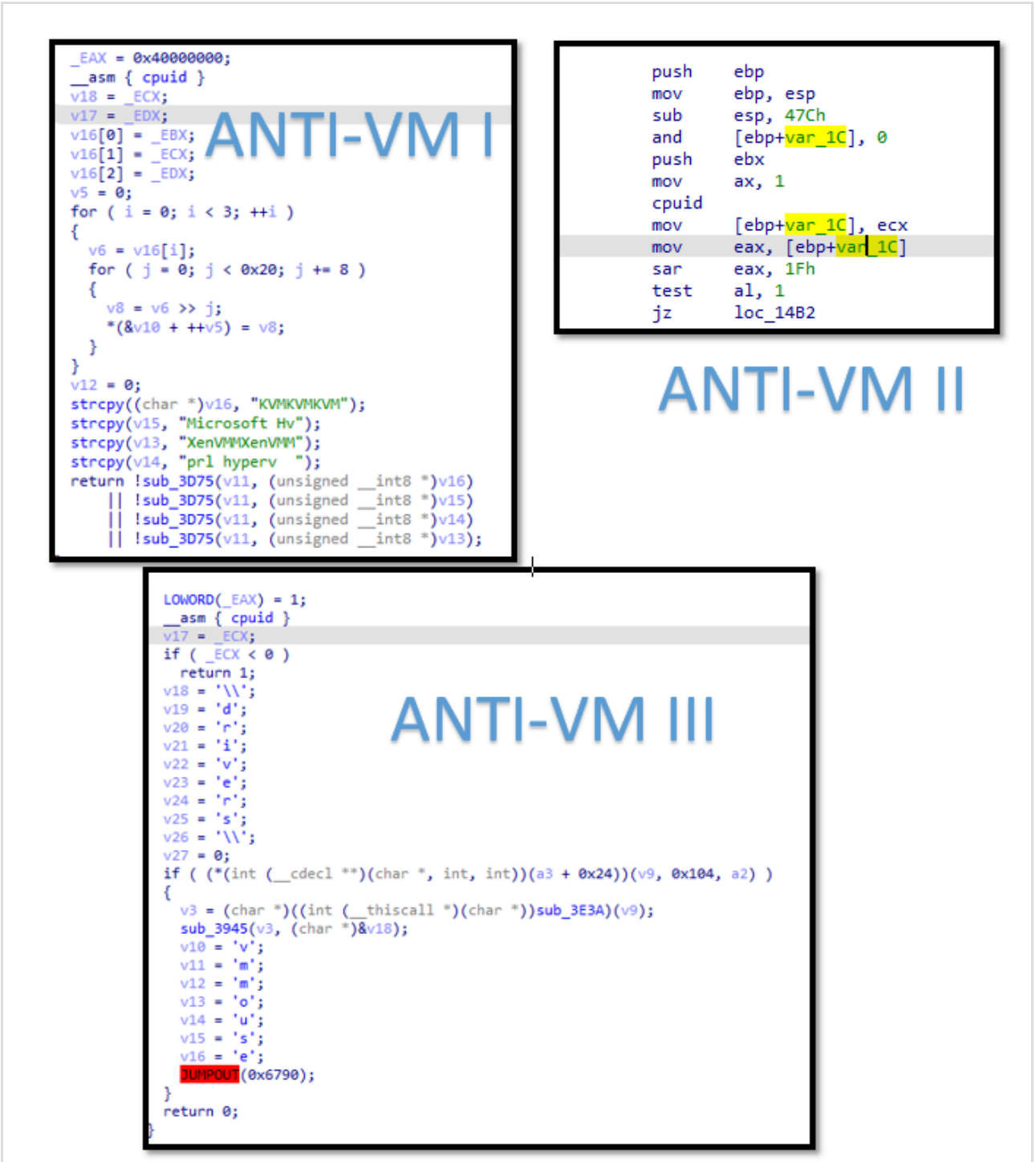


figure 1: Different ANTI-VM technique checks

FORMBOOK CRYPTER LOADER (ANTI-SANDBOX):

It also has some feature to check if its code is running in a sandbox by using the 2 technique shown below.

- ANTI-SANDBOX 1 : check the file path of its running code using GetModuleFileName API if it contains "sample", "sandox" or "malware". if yes exit the process
- ANTI-SANDBOX 2: checks the existence of the sbiedll.dll that are component of known sandbox.

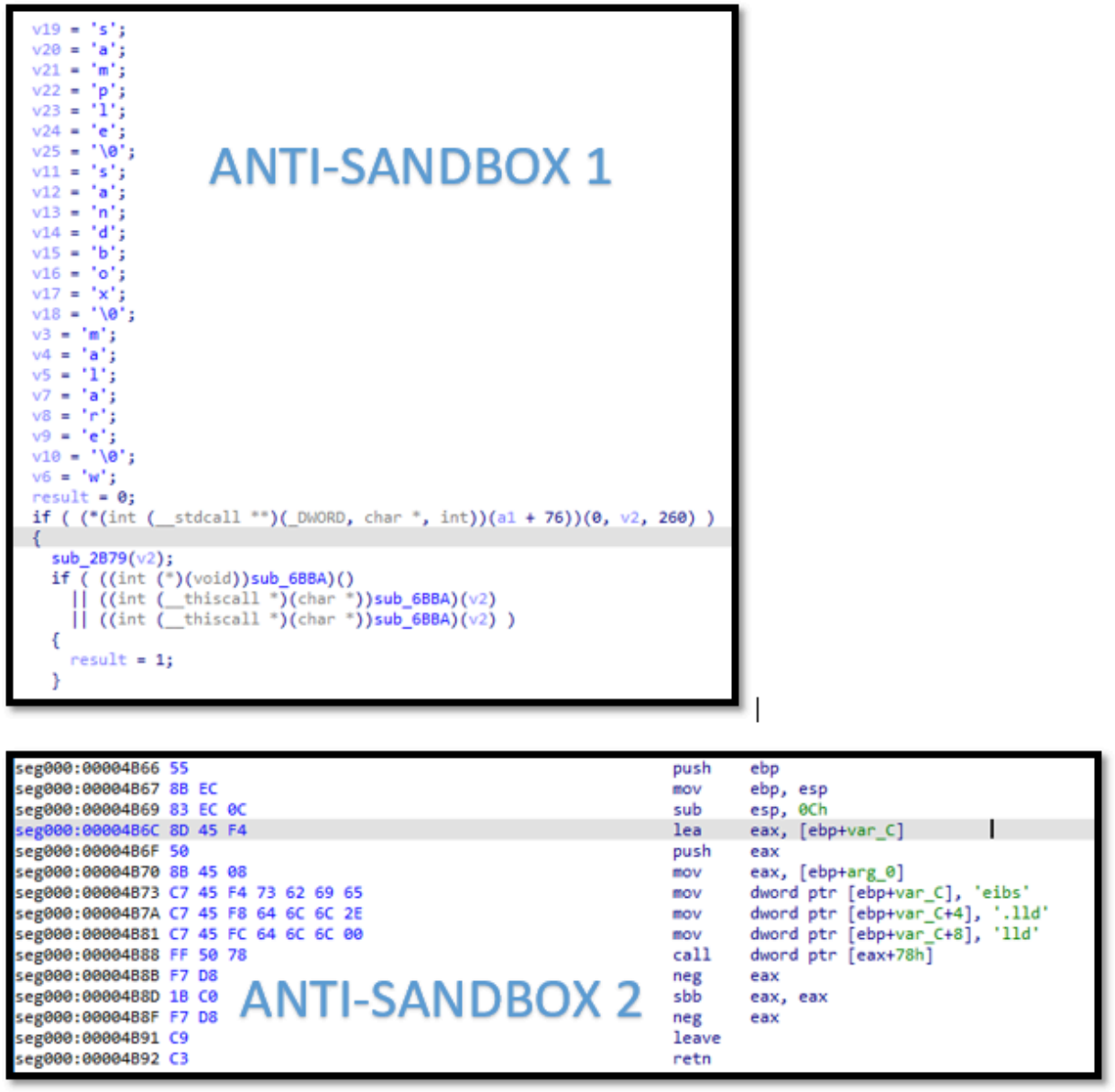


figure 2: Anti-Sandbox technique

FORMBOOK CRYPTER LOADER (PROCESS CHECK):

It also enumerate all the process running to the machine and try to check the existence of known debugging tools process if it is exist, if yes exit the process. For AV related process and services, it tries to create a counter how many AV product it saw in the machine max of 2 (it seems like it checks for a testing machine that contain several AV product on it).

below is the list of the process it checks related to malware analysis tools and AV product:

figure 3: Process checking to evade malware lab environment

DECRYPTING THE FORMBOOK IN RSRC:

The next thing it will do is to decrypt the encrypted Formbook malware in its resource section. It is done by looking to 2 entry in rsrc section. The first entry is with rsrc ID "14d" with rsrc type of 17 "RT_DLGINCLUDE" that contain the 16 bytes rc4 key to decryp the rc4 key to decrypt the FORMBOOK.

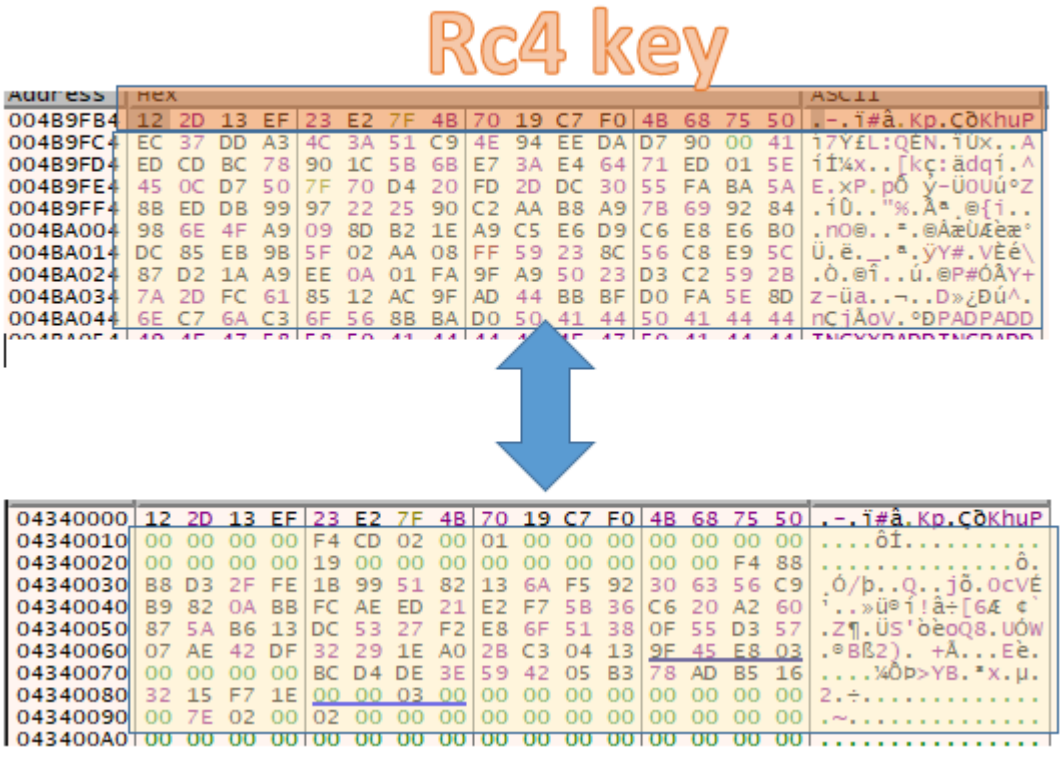


figure 4: decrypting the rc4 key for FORMBOOK

Once the Rc4 key was parse, it will decrypt the encrypted formbook malware, it will load another resource entry with rsrc id "3e8" type "2". Then it will remove 3 dummy bytes to the data blob before decrypting it using rc4 algorithm.

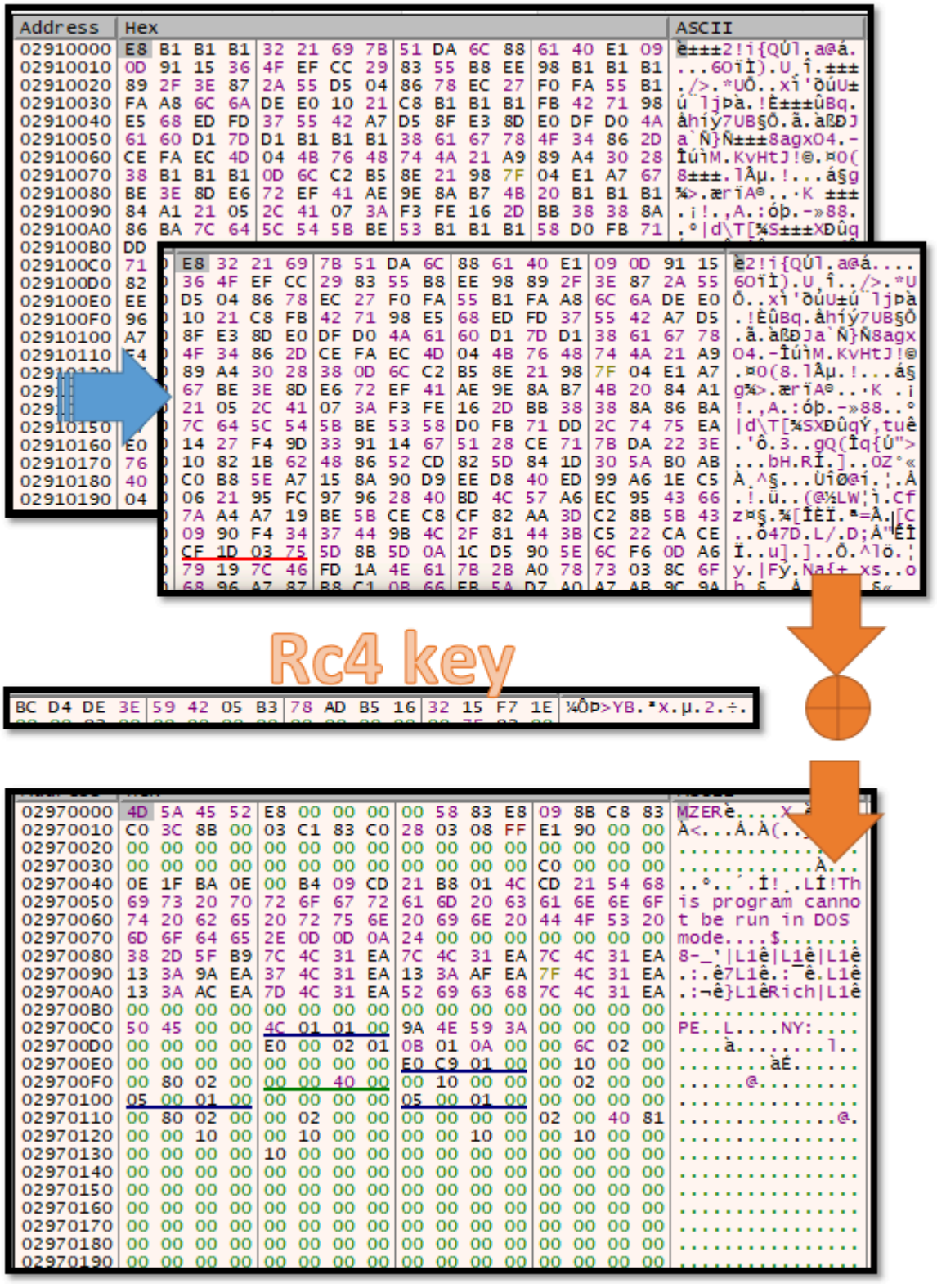


figure 5: decrypting FORMBOOK

FORMBOOK MZ HEADER:

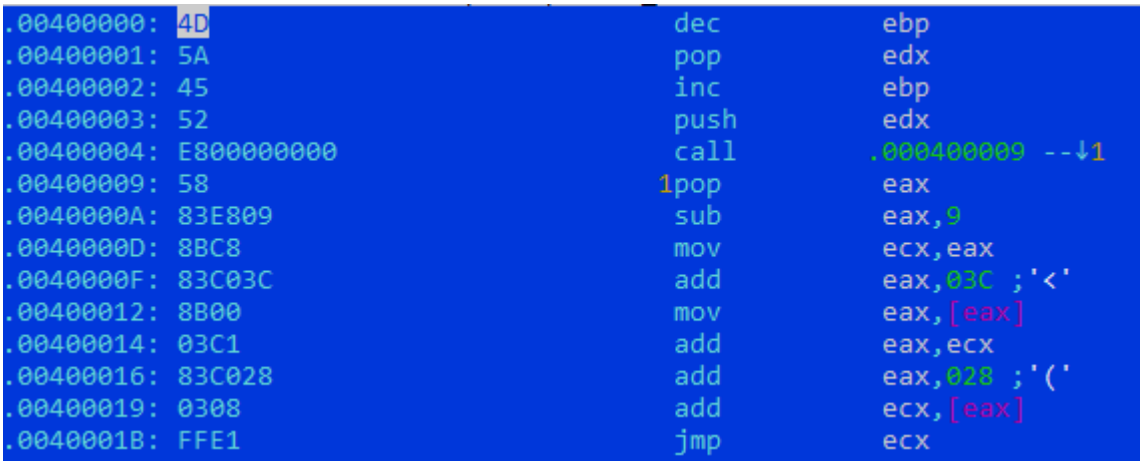


figure 6: MZ header shellcode

INTERESTING STORING AND PARSING ENCRYPTED DATA:

The Formbook obfuscate its code. One interesting feature of this is how it store and parse its needed bytes to decrypt or to hash to perform its task. Malware commonly used "stack string technique" to initialized its string or data in stack or in an allocated memory space like the screenshot we saw in anti-vm and anti-sandbox headings of this post.

But for this variant it used another technique where it save its needed bytes in a code like structure, then it will parse each instruction to check its opcode if it will passed its requirements, if yes it will parse the operand or opcode that is part of its needed bytes to decrypt or to hash.

requirement:

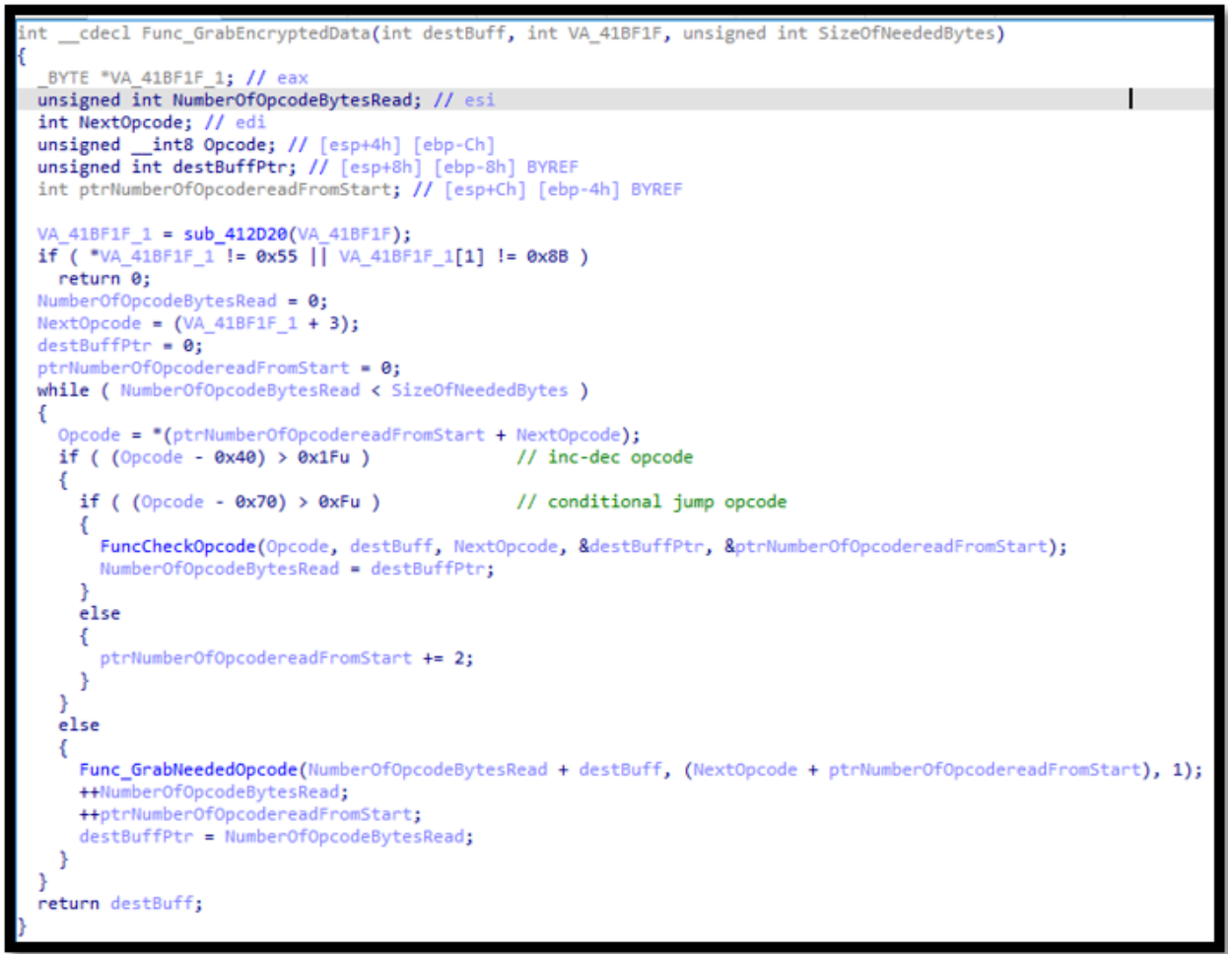
I. if opcode is 0x40-0x5f just grab the opcode itself.

II. if opcode is 0x70-0x7f which is mostly a conditional jump mnemonics then skip that instruction.

III. (if opcode - 0x40 > 0x1f) and (opcode - 0x70 > 0x0f) then it will check what opcode is that (opcode range from 0x00 to 0xFF) to know what other opcode or how big is the operand it will parsed.

40	inc	AX	50	push	AX	70	jo	rel8
		EAX			EAX	71	jno	rel8
41	inc	CX	51	push	CX	72	jb	rel8
		ECX			ECX		jnae	
42	inc	DX	52	push	DX	72	jc	rel8
		EDX			EDX	73	jae	rel8
43	inc	BX	53	push	BX		jnb	
		EBX			EBX	73	jnc	rel8
44	inc	SP	54	push	SP	74	je	rel8
		ESP			ESP		jz	
45	inc	BP	55	push	BP	75	jne	rel8
		EBP			EBP		jnz	
47	inc	SI	56	push	SI	76	jbe	rel8
		ESI			ESI		jna	
48	dec	AX	57	push	DI	77	ja	rel8
		EAX			EDI		jnbe	
48	inc	DI	58	pop	AX	78	js	rel8
		EDI			EAX	79	jns	rel8
49	dec	CX	59	pop	CX	7A	jp	rel8
		ECX			ECX		jpe	
4A	dec	DX	5A	pop	DX	7B	jnp	rel8
		EDX			EDX		jpo	
4B	dec	BX	5B	pop	BX	7C	jl	rel8
		EBX			EBX		jnge	
4C	dec	SP	5C	pop	SP	7D	jge	rel8
		ESP			ESP		jnl	
4D	dec	BP	5D	pop	BP	7E	jle	rel8
		EBP			EBP		jng	
4E	dec	SI	5E	pop	SI	7F	jg	rel8
		ESI			ESI		jnle	
4F	dec	DI	5F	pop	DI			
		EDI						

figure 7.A: initial opcode it tries to grab and opcode it skip



```
int __cdecl Func_GrabEncryptedData(int destBuff, int VA_41BF1F, unsigned int SizeOfNeededBytes)
{
  _BYTE *VA_41BF1F_1; // eax
  unsigned int NumberOfOpcodeBytesRead; // esi
  int NextOpcode; // edi
  unsigned __int8 Opcode; // [esp+4h] [ebp-Ch]
  unsigned int destBuffPtr; // [esp+8h] [ebp-8h] BYREF
  int ptrNumberOfOpcodereadFromStart; // [esp+Ch] [ebp-4h] BYREF

  VA_41BF1F_1 = sub_412D20(VA_41BF1F);
  if ( *VA_41BF1F_1 != 0x55 || VA_41BF1F_1[1] != 0x8B )
    return 0;
  NumberOfOpcodeBytesRead = 0;
  NextOpcode = (VA_41BF1F_1 + 3);
  destBuffPtr = 0;
  ptrNumberOfOpcodereadFromStart = 0;
  while ( NumberOfOpcodeBytesRead < SizeOfNeededBytes )
  {
    Opcode = *(ptrNumberOfOpcodereadFromStart + NextOpcode);
    if ( (Opcode - 0x40) > 0x1Fu )              // inc-dec opcode
    {
      if ( (Opcode - 0x70) > 0xFu )             // conditional jump opcode
      {
        FuncCheckOpcode(Opcode, destBuff, NextOpcode, &destBuffPtr, &ptrNumberOfOpcodereadFromStart);
        NumberOfOpcodeBytesRead = destBuffPtr;
      }
      else
      {
        ptrNumberOfOpcodereadFromStart += 2;
      }
    }
    else
    {
      Func_GrabNeededOpcode(NumberOfOpcodeBytesRead + destBuff, (NextOpcode + ptrNumberOfOpcodereadFromStart), 1);
      ++NumberOfOpcodeBytesRead;
      ++ptrNumberOfOpcodereadFromStart;
      destBuffPtr = NumberOfOpcodeBytesRead;
    }
  }
  return destBuff;
}
```

figure 7.B: FormBook opcode condition for parsing its data

figure 8: the parse stored data that either to be decrypt or hash it.

And also not all stored data that it will parse to its code will be decrypted, some of those stored data is designed to compute sha1 hash that will serve as the decryption key (rc4 algortihm) to decrypt another blob of code.

```
 _BYTE *__cdecl Func_DecryptBytesGrabbed(int DestBuff)
{
  int VA_41C3A6; // eax
  int VA_41C50B; // eax
  int VA_41BEF1; // eax
  char dest_buff; // [esp+Ch] [ebp-140h] BYREF
  char v6[215]; // [esp+Dh] [ebp-13Fh] BYREF
  _DWORD sha1_ctx[26]; // [esp+E4h] [ebp-68h] BYREF

  dest_buff = 0;
  Func_MemSet(v6, 0, 0xD4u);
  VA_41C3A6 = sub_41C3A1();
  Func_GrabEncryptedData(&dest_buff, VA_41C3A6 + 2, 0xD3u);
  VA_41C50B = sub_41C506();
  Func_GrabEncryptedData(DestBuff + 0x444, VA_41C50B + 2, 0x2F0u);
```

```
  VA_41BEF1 = sub_41BEEC();
  Func_GrabEncryptedData(DestBuff + 0x7B8, VA_41BEF1 + 2, 0x14u);
  Func_SHA1_Init(sha1_ctx);
  Func_Sha1_Update(sha1_ctx, &dest_buff, 0xD3);
  Func_Sha1_Final(sha1_ctx);
  Func_GrabNeededOpcode(DestBuff + 0x7A4, sha1_ctx, 20);
  Func_DecryptWithRc4((DestBuff + 0x444), 0x2F0u, DestBuff + 0x7A4);
  Func_SHA1_Init(sha1_ctx);
  Func_Sha1_Update(sha1_ctx, (DestBuff + 0x7B8), 0x14);
  Func_Sha1_Final(sha1_ctx);
  Func_DecryptWithRc4((DestBuff + 0x444), 0x2F0u, sha1_ctx);
  Func_SHA1_Init(sha1_ctx);
  Func_Sha1_Update(sha1_ctx, (DestBuff + 0x444), 752);
  Func_Sha1_Final(sha1_ctx);
  return Func_DecryptWithRc4((DestBuff + 0x7B8), 0x14u, sha1_ctx);
}    tag
```

SAMPLES:

filename: Formbook_loader.bin
md5: 65880d23eb6051a1604707371ebb6d2c
sha1: 3f5d0833adbd39715f1d45f1a3c8982c52519bc1
sha256: ac2e9615b368e00fb4bf4d5180bbfc0d6fb7bbce3fa1af603d346d7a8f2450e5

filename: formbook.bin
md5: df93eecd1799f9c9c674b8cdb2f1dad1
sha1: e66c893f39c7553f59a5381d23a5c65e5c2e84f7
sha256: 5d7eba73b4d29ee17529511bb8b0745e658bf2adfcae57bdfa8d0870f4732a18

YARA RULES:

```
 import "pe"

rule formbook_loader_crypter {
    meta:
        author =  "tcontre"
        description = "detecting formbook-loader-crypter malware"
        date =  "2020-11-05"
        sha256 = "ac2e9615b368e00fb4bf4d5180bbfc0d6fb7bbce3fa1af603d346d7a8f2450e5"

    strings:
        $mz = { 4d 5a }
```

```
        $dec = { 03 CE 8A 03 88 45 F9 8B C6 51 B9 03 00 00 00 33 D2 F7 F1 59 85 D2 75 14 8A 45 F9 32 45 FA 88 0
        $rc4_key = {12 2D 13 EF 23 E2 7F 4B 70 19 C7 F0 4B 68 75 50}

    condition:
        ($mz at 0) and ($dec ) or ($rc4_key)

    }

rule formbook_crypter {
    meta:
        author =  "tcontre"
        description = "detecting formbook-crypter malware"
        date =  "2020-11-05"
        sha256 = "5d7eba73b4d29ee17529511bb8b0745e658bf2adfcae57bdfa8d0870f4732a18"

    strings:
        $mz = { 4d 5a }

        $shell = { 4D 5A 45 52 E8 00 00 00 00 58 83 E8 09 8B C8 83 C0 3C 8B 00 03 C1 83 C0 28 03 08 FF E1 90 00
                $opcode_check = {8B 4D FC 8A 04 39 03 CF 88 45 F4 8D 50 C0 80 FA 1F 77 18 6A 01 51 8D 04 1E 50 E

    condition:
        ($mz at 0) and ($shell at 0) or ($opcode_check)

    }    tag
```

Source: https://tccontre.blogspot.com/2020/11/interesting-formbook-crypter.html